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**Volume No. 5**

**Aug. - 77 - Dec. - 78**

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**U.S. DEPARTMENT OF TRANSPORTATION  
Urban Mass Transportation Administration  
Office of Transportation Management  
and Demonstrations  
Washington , D.C. 20590**



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16. Abstract  This volume is a reference document prepared by the Urban Mass Transportation Administration (UMTA) and serves as a guide to 168 reports generated under contract to UMTA. This document reflects UMTA's continuing commitment to the dissemination of technical report information to government, state, and local transportation planning bodies; private industry; and the general public.  The documents abstracted in this volume are arranged by grant number into sections which are: Part I) Research, Development, and Demonstration Project Reports; Part II) Technical Studies; and Part III) University Research and Training Reports. Part IV contains indexes to the reports contained herein by report title, personal author, corporate author, geographic location, and keywords.  All reports abstracted in this volume are available for sale at the National Technical Information Service (NTIS). Each abstract contains an order number and a price code for paper copy. Most of the reports are also available in microfiche. Volumes I, II, III, and IV of the URBAN MASS TRANSPORTATION ABSTRACTS are available at NTIS. The order number for Volume I (October 1972) is PB 213-212, and the price code is A23; for Volume II (September 1973) PB 225-368, price code A11; for Volume III (July 1976) PB 264-904, price code A16; and for Volume IV (December 1977) PB 277-290, price code A16					
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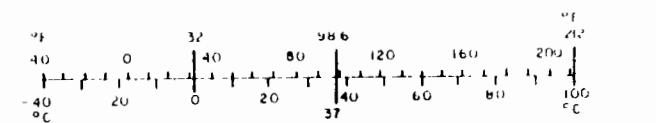
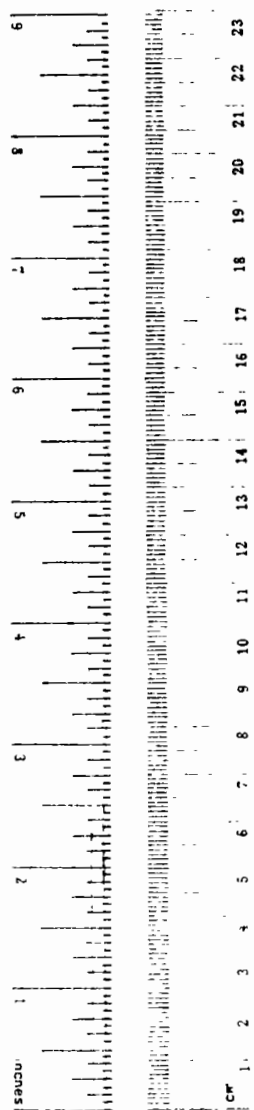
## METRIC CONVERSION FACTORS

### Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
<b>LENGTH</b>				
in	inches	2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
<b>AREA</b>				
in <sup>2</sup>	square inches	6.5	square centimeters	cm <sup>2</sup>
ft <sup>2</sup>	square feet	0.09	square meters	m <sup>2</sup>
yd <sup>2</sup>	square yards	0.8	square meters	m <sup>2</sup>
mi <sup>2</sup>	square miles	2.6	square kilometers	km <sup>2</sup>
	acres	0.4	hectares	ha
<b>MASS (weight)</b>				
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
<b>VOLUME</b>				
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft <sup>3</sup>	cubic feet	0.03	cubic meters	m <sup>3</sup>
yd <sup>3</sup>	cubic yards	0.76	cubic meters	m <sup>3</sup>
<b>TEMPERATURE (exact)</b>				
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

### Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To find	Symbol
<b>LENGTH</b>				
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
<b>AREA</b>				
cm <sup>2</sup>	square centimeters	0.16	square inches	in <sup>2</sup>
m <sup>2</sup>	square meters	1.2	square yards	yd <sup>2</sup>
km <sup>2</sup>	square kilometers	0.4	square miles	mi <sup>2</sup>
ha	hectares (10,000 m <sup>2</sup> )	2.5	acres	
<b>MASS (weight)</b>				
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
<b>VOLUME</b>				
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liter	0.26	gallons	gal
m <sup>3</sup>	cubic meters	35	cubic feet	ft <sup>3</sup>
m <sup>3</sup>	cubic meters	1.3	cubic yards	yd <sup>3</sup>
<b>TEMPERATURE (exact)</b>				
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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## FOREWORD

This reference document was prepared by the Urban Mass Transportation Administration (UMTA) of the U.S. Department of Transportation as a guide to 168 reports generated under contract to UMTA. It is a reflection of UMTA's continuing commitment to the dissemination of technical report information to government, state, and local transportation planning bodies; private industry; and the general public.

All reports in this document are available for sale at the:

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Each abstract in this volume contains an NTIS order number and a price code for paper copy. Most documents are also available in microfiche for \$3.00 each. A current NTIS price code schedule is included in this report. NTIS PRICES ARE SUBJECT TO CHANGE WITHOUT NOTICE. Therefore, it is advisable that prices are verified before ordering. All orders to NTIS must be prepaid and must contain the report order number.

Volumes I, II, III, and IV of the URBAN MASS TRANSPORTATION ABSTRACTS are also available at NTIS. The order number for Volume I (October 1972) is PB 213-212, and the price code is A23; for Volume II (September 1973) PB 225-368, price code A11; for Volume III (July 1976) PB 264-904, price code A16; and for Volume IV (December 1977) PB 277-290, price code A16.

The documents abstracted in this volume are arranged by grant number in sections, which are: Part I) Research, Development and Demonstration Project Reports; Part II) Technical Studies; and Part III) University Research and Training Reports. Part IV contains indexes to the reports contained herein by report title, personal author, corporate author, geographic location, and keywords.

For additional information concerning the reports in this volume, contact:

Transit Research Information Center (TRIC)  
Urban Mass Transportation Administration  
2100 Second Street, S.W., Room 6412, UPM-44  
Washington, DC 20590  
Telephone Number: (202) 426-9157

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**TITLE:** COMMUNITY BROKERAGE OF TRANSPORTATION SERVICES  
FOR THE ELDERLY IN MOUNTAIN VIEW, CALIFORNIA  
Final Report

**AUTHOR:** Crain & Associates/under contract to Transportation  
Systems Center  
(Tom Cooper)

**DATE:** February 1978

**PROJECT NO.:** CA-06-0002

---

**KEYWORDS:**

- |                      |                              |
|----------------------|------------------------------|
| 1. Community Broker  | 5. Passenger, Transportation |
| 2. Elderly           | 6. Trip Generation           |
| 3. Handicapped       |                              |
| 4. Transit Dependent |                              |

---

The Mountain View Community Broker Demonstration Project has been sponsored by UMTA's Office of Service and Methods Demonstration of the U.S. Department of Transportation. This document is a final evaluation of the demonstration, and it reports on a unique way of providing transportation and transportation-related service to elderly and handicapped individuals in a small geographic area. The main objective of this study is directly addressed in that the project proposes to make a new transportation service that combines informational and referral help with a very personalized transportation service to the target group. The report covers the operation of the project from February 1976 to February 1977, when the UMTA funding lapsed. The project is continuing operation under Caltrans and the Department of Health, Education and Welfare funding.

In this Community Broker project, a community broker furnished his clients with individualized primary service information and scheduling assistance. He also drove these clients to their destination in a 12-passenger van. The project was intended to demonstrate the economic and operational feasibility of combining these functions in one role. This report describes the community broker concept and project operations; assesses the economic feasibility of the idea; discusses the project's impact on the target group; and provides some commentary on ways a community-broker type of project could be integrated into the existing network of social services for the handicapped and elderly. The author concludes that: the most popular trips were for shopping (34%), a nutrition program trip (23%), and commercial meals (11%); the total ridership never reached expected levels (only 112 users); and the estimated operating costs for the project were high (\$29,285 for 8776 passenger trips; cost per trip was \$3.34; revenues totaled only \$3,432, about 12 percent of operating cost; and subsidy cost per passenger trip was \$2.95). This demonstration has not proved the economic feasibility of the community broker concept in the Mountain View area.

NTIS NO.: PB 285-234/AS

PRICE: A06

TITLE: THE LOS ANGELES DOUBLE DECK BUS DEMONSTRATION  
PROJECT: AN EVALUATION

AUTHOR: CACI, Inc.- Federal  
(C.H. McCall, Jr. and H.J. Simkowitz)

DATE: May 1978

PROJECT NO.: CA-06-0069

---

KEYWORDS:

1. Double Deck Bus
  2. Demonstrations
  3. Evaluation
  4. High-Occupancy Vehicle
  5. Site Selection
- 

This report is the third of three documents that constitute an evaluation of the Double Deck Bus (DDB) project sponsored by the Urban Mass Transportation Administration. The DDB project involved the purchase and operation of contemporary DDBs in New York City and Los Angeles (July 1974-June 1977). The intent was to assess whether the DDB was able to make its greater passenger capacity available at a cost per capacity-mile less than or equivalent to its conventional counterpart.

DDBs carry from 68-84 passengers; conventional buses carry from 45-47 passengers. Both buses require a single transit employee, the driver. This report provides a comparative evaluation between the two German Neoplan DDBs and the two conventional Flexible buses, and it explores vehicle-related, transit operator-related, and user-related issues. In Los Angeles, the two Neoplan buses operated between the suburbs and the central business district, providing a combination of express and collection/distribution/park-and-ride services. Only eleven months of revenue service are analyzed, due to project delays to correct original manufacturing deficiencies. This evaluation considers passenger acceptance/perception of the DDB vis-a-vis the conventional bus. Statistics are presented on schedule adherence, dwell times, passenger throughput, vehicle reliability, on-board safety, repair and maintenance costs, and fuel/oil consumption.

The report concludes that: passengers (52%) preferred the DDB; operating costs were nearly identical for the two bus types; major delays were associated with debugging and retro-fitting the DDBs; facility modifications must be accomplished before initial receipt of vehicles; the features generating the greatest percentage of "major deficiency" rankings were legroom (12.3%) and seat arrangement (5.0%); and results argued for the incorporation of the DDB into the American bus fleets from both an economic and level-of-service viewpoint.

NTIS NO.: PB 287-837/AS

PRICE: A07

**TITLE:** AUTOMATED MIXED TRAFFIC VEHICLE (AMTV) TECHNOLOGY  
AND SAFETY STUDY  
Final Report

**AUTHOR:** Jet Propulsion Laboratory  
(Alan R. Johnston, Ted K. C. Peng, Howard C. Vivian,  
and Peter K. Wang)

**DATE:** February 1978

**PROJECT NO.:** CA-06-0088

---

**KEYWORDS:**

1. Automated Vehicles
2. Community-Based Transit Systems
3. Malls, Pedestrian, Automated Vehicles
4. Malls, Shopping, Automated Vehicles
5. Safety, Automated Vehicles
6. Shuttle Transit
7. Vehicle Design

---

This report discusses technology and safety related to the implementation of an Automated Mixed Traffic Vehicle (AMTV) System. An AMTV system is one which follows a buried cable, and is used in areas that require low-speed vehicles, such as in shopping and pedestrian malls. The purpose of this study is to review the technology used in an AMTV system, to identify areas where further development is either required or desirable, and to conduct a safety analysis on an AMTV system. The results are intended as a guide for further efforts in AMTV system design and technology for both near-term and long-term applications.

The systems discussed include a low-speed system and a hybrid system which can operate at the low speed and at a higher speed within a protected right-of-way. The low-speed system is a candidate for a near-term demonstration and can be used in pedestrian malls, large campuses, and recreational parks. The hybrid system may have application, after further development, on urban streets, in airports, or in situations where longer distances may be involved. Examples are given of an AMTV application and of an AMTV demonstration. The report describes a comprehensive safety analysis which was conducted to examine potential hazards caused by hardware failure and by events unrelated to hardware failure. Hazards which are common to other transportation modes such as earthquake or falling objects; and social hazards, such as vandalism and criminal attack were not treated. Corrective and preventive actions in terms of modification or operational procedures are suggested. Also, a list of References and Appendices A, B, and C: "Safety Analysis Data - Hazard Catalog"; "Safety Analysis Data - Failure Induced Hazard Catalog"; and "Analytical Models of AMTV", respectively, are contained herein.

The major findings of this study are that straightforward development using current technology will make it possible to demonstrate a low-speed AMTV system in three to five years. With a prudent, fail-safe design, and appropriate right-of-way protection, the system can operate safely in an environment containing pedestrians. An initial demonstration should restrict the mixed-traffic environment in order to ensure safety during the learning period.

NTIS ORDER NO.: N78-25257

PRICE: A07

**TITLE:** COSTS AND ENERGY EFFICIENCY OF A DUAL-MODE SYSTEM  
Automated Guideway Transit Technology Program

**AUTHOR:** California Institute of Technology  
Jet Propulsion Laboratory  
(R.C. Heft and C.S. Borden)

**DATE:** April 1977

**PROJECT NO.:** CA-06-0088

---

**KEYWORDS:**

1. Automated Guideway Transit
2. Economic Analysis
3. Energy, Efficiency
4. Life-Cycle Cost
5. Propulsion Systems
6. Dual-Mode

---

This project was sponsored by the Urban Mass Transportation Administration of the U.S. Department of Transportation, and the work was performed at the Jet Propulsion Laboratory (JPL), California Institute of Technology, by agreement with the National Aeronautics and Space Administration, to which Caltech/JPL is a prime contractor.

This report represents a more detailed examination of two areas of a previous analysis on a Dual-Mode System as documented in "Technical and Cost Considerations for Urban Applications of Dual-Mode Transportation" (JPL, May 1972). It uses the technical and cost data of the previous report and employs the life-cycle cost approach (Appendix B). This report is divided into two parts plus the Appendices: 1) An Economic Analysis and 2) An Energy Consumption Analysis.

The Economic Analysis is a preliminary analysis of a dual-mode transportation system (PATH). It examines the present value Life-Cycle Costs of the system for both public and semi-private system ownership and presents the costs in terms of levelized required revenue per passenger mile. Two transit modes associated with a high-speed guideway system are included, namely, pallets and command actuated passenger service (CAPS) vehicles. The system evaluated is a 280-mi single lane (140-mi double-lane) high speed guideway. Two outputs have been generated by this report: 1) a life-cycle methodology which can be used as a standard to evaluate and compare various transportation system designs, and 2) this methodology was used to compute costs for PATH dual-mode systems.

The Energy Consumption Analysis considers the energy use of the various Dual-Mode Vehicles by means of a detailed vehicle simulation program for the control policy and guideway system as described in the previous study. The five vehicles included in the energy analysis are: Car/Pallet; Bus (CAPS); Bus (CAPS)/Pallet; and Bus (Transit). The three candidate propulsion systems considered are: Electric traction (DC series); Diesel (4 stroke); and Otto (4 cycle). It is concluded that the electric traction is more energy efficient than Otto or Diesel for the dual-mode pallets.

NTIS ORDER NO.: PB 272-714/AS

PRICE: A05

**TITLE:** INDEPENDENT STUDY OF PERSONAL RAPID TRANSIT

**AUTHOR:** The Aerospace Corporation  
(C. L. Olson)

**DATE:** December 1977

**PROJECT NO.:** CA-06-0090

---

**KEYWORDS:**

1. Automated Guideway Transit
  2. Environment and Environmental Control, PRT
  3. Guideways, PRT
  4. Personal Rapid Transit
- 

The objectives of the Urban Mass Transportation Administration's Automated Guideway Transit (AGT) Technology Program are to: 1) develop estimates of the cost, service, reliability, safety and performance of AGT systems in representative urban deployments; 2) generate performance specifications for future AGT engineering development programs; 3) synthesize guideline standards for AGT systems to include safety and reliability; and 4) identify critical technology shortcomings that currently impede the implementation of viable AGT systems and develop the required technology. A portion of the AGT Technology Program consists of independent studies in specific areas by organizations that have special expertise in those areas. This report summarizes the findings of an independent study in the area of Personal Rapid Transit (PRT) which was conducted by the Aerospace Corporation.

This study consists of four Tasks which are presented separately. In Task 1, "Review of Available Technology", existing hardware and software technology is reviewed for applicability to implementation of future U.S. PRT systems. The PRT system characteristics reviewed include Aerospace, Aramis, Cabtrack, Cabintaxi, and those of the Computer-Controlled Vehicle System. In Task 2, "Environmental and Energy Impacts of PRT", environmental and energy impacts of PRT are estimated and compared with alternate forms of AGT and conventional urban transportation modes. Energy consumption by fuel type, land use needs, visual intrusion, air pollution emissions, and noise burden data are included in this estimation. In Task 3, "PRT Deployment: General Methodology for Feasibility Assessment of PRT Deployment in an Urban Area", a general methodology for establishing the feasibility of PRT in an urban area is defined, and applied to the Los Angeles Basin for demonstration purposes. This deployment requirements study includes service, cost, dependability, and growth potential characteristics of PRT systems. In Task 4, "Research and Development Activities for PRT", areas where research and development are required to make a future PRT system deployment feasible are described, and an approach to fulfill the noted technology shortcomings is provided.

The study concludes that further developments are required of the PRT full-scale systems and in most of the critical subsystem areas as well.

NTIS ORDER NO.: PB 287-869/AS

PRICE: A16

**TITLE:** SAFETY DURING SPECIAL TRANSPORTATION SERVICE TRIPS  
Volume Two: Movement In and Out of Special Transportation  
Service Vehicles

**AUTHOR:** California Department of Transportation  
(Bertil Aldman, Sven-Olof Brattgard, and Soren Hansson)

**DATE:** October 1974

**PROJECT NO.:** CA-06-0098

---

**KEYWORDS:**

- |                                    |                           |
|------------------------------------|---------------------------|
| 1. Emergency Vehicles and Services | 4. Hydraulics, Lifts      |
| 2. Handicapped, Transportation     | 5. Ramps                  |
| 3. Human Factors, Safety           | 6. Safety, Transportation |

---

Special Transportation Services (STS) is a form of transportation in Sweden which provides for persons who cannot, or have difficulty using existing public transportation. Special Service Vehicles (SSV) are designed or modified to accommodate wheelchairs, and are driven by personnel who pick up the handicapped person at home or work. This report deals with the safety factors during movement into and out of the SSV. Its intent is to lay a foundation for increased safety from personal injury. Attention is placed upon the risks involved for wheelchair users who use a ramp as compared to those who use a hydraulic lift. The ramp has proven to be relatively easy to handle in moving these passengers into and out of the SSV. In most cases, the hydraulic lift is the most comfortable way to enter and exit the vehicle. However, most lifts do not have security rails, which increases the risk of falling off the platform. Manual lifting of the passenger and of the wheelchair creates additional risks of personal injury to both the passenger and the assistance personnel; therefore, this method is not analyzed in this study. In order to evaluate the risks involved in modern transportation service systems and to gain an understanding of how to increase the security for handicapped persons moving in and out of an SSV, a study was conducted at the University of Goteborg investigating actual events in a transportation service situation. Problems were discussed with passengers and service personnel and experiments were performed with ramps and hydraulic lifts. The major results of the study are that both ramps and lifts can be designed so as to provide adequate safety. Ramps more than 78'7" are difficult to use and can therefore only be used for vehicles with low floor heights of approximately 23'6" or lower. Ramps with a width of less than 39'4" should be provided with drive-off barriers having a minimum height of 5'9". The lift platform should have an area of 35'4" X 63" in order to allow for both the wheelchair user and an assistant.

This report contains Appendices 1 and 2: Specifications of Eight Different Wheelchairs and Tables Describing Components from the Primary Experiment, respectively, and a Bibliography. An earlier study: Safety During Special Transportation Service Trips, Vol. I: Trips With the Special Service Vehicle, reported on the technical prerequisites that increase personal safety during trips in the SSV. Volume I is not available from NTIS at this time.

NTIS ORDER NO.: PB 289-132T/AS

PRICE: A05

**TITLE:** DEVELOPMENT OF A SAFETY PROGRAM PLAN FOR THE OFFICE OF  
SAFETY AND PRODUCT QUALIFICATION - VOLUME I  
VOLUME II - APPENDIX D

**AUTHOR:** University of Southern California/  
Institute of Safety and Systems Management  
(G.P. Jones, et al)

**DATE:** September 1977

**PROJECT NO.:** CA-06-0105

---

**KEYWORDS:**

- |                        |                        |
|------------------------|------------------------|
| 1. Abstracts, Safety   | 5. Information Aids    |
| 2. Safety              | 6. Guides and Guidance |
| 3. Research Activities |                        |
| 4. Accidents           |                        |
- 

The Institute of Safety and System Management of the University of Southern California under a grant from the Urban Mass Transportation Administration of the U.S. Department of Transportation undertook a four month development of information to be used in the development of a Safety Program Plan for the Office of Safety and Product Qualification (OSPQ). This report contains the results of the research project to develop information for the development of a Safety Plan for OSPQ. The purpose of the project was to identify and describe the critical safety issues which should be included in the Plan.

Six Key Objectives were developed from a review of legislative acts, administrative directives, past and present programs, goals of UMTA, and recommendations of associated agencies. The Six interrelated Key Objectives are the following: Decrease Accident Rates; Eliminate Catastrophic Accident Conditions; Prevent "Unsafe" Conditions; Assure Use of "Best" Technology; Accomplish Objectives in a Cost-Effective Manner; and Determine and Correct "Unsafe" Conditions. In addition, twenty-nine Critical Objectives and over ninety Specific Objectives were developed. This report recommends sixteen specific programs for top priority consideration.

The Appendixes in this report contain data from five sources: Federal Railroad Administration, Bureau of Motor Carrier Safety, National Highway Traffic Safety Administration, American Public Transit Association, and UMTA. The Appendixes are as follows: Accident Data Base Forms; Data and Statistics; References; and On-Going Research by Mitigation Type (This latter is Appendix D, a separate report and Volume II of this study). Volume II - Appendix D contains 202 abstracts of reports cross-referenced to the major hazard areas in urban mass safety.

**NTIS ORDER NO.:** PB 279-331/AS Vol.I  
PB 279-332/AS Vol.II

**PRICE:** All  
All

TITLE: STUDY OF FLYWHEEL ENERGY STORAGE  
VOLUME 1: EXECUTIVE SUMMARY  
Final Report

AUTHOR: AiResearch Manufacturing Company  
(L.J. Lawson, A.K. Smith, and G.D. Davis)

DATE: September 1977

PROJECT NO.: CA-06-0106

---

KEYWORDS: 1. Brakes and Braking, 5. Propulsion Systems, Diesel  
Regenerative 6. Propulsion Systems, Electric  
2. Bus 7. Propulsion Systems, Flywheel  
3. Energy Storage 8. Flywheels  
4. Life-Cycle Costing 9. Trolleys

---

In 1976, the Urban Mass Transportation Administration of the U.S. Department of Transportation established the present program-- Study of Flywheel Energy Storage--to determine the practicality and viability of flywheel propulsion systems for urban mass transit vehicles. This study is based on the use of present state-of-the-art technology that could be demonstrated within 24 months in full-scale urban transit vehicles.

The overall objectives addressed in this Phase I study are:

- 1) Develop new transit vehicle propulsion system alternatives;
- 2) Establish the economic viability of new propulsion systems in comparison with present vehicles using life-cycle cost analyses;
- and 3) Plan a comprehensive program leading to full implementation of new propulsion concepts in production vehicles. This study has shown the viability of flywheel-propelled buses and recommends that the Phase II program leading to the development of prototype flywheel-propelled vehicles be promptly initiated.

This report, Volume 1 of Phase I, presents the summary of the results of the Study of Flywheel Energy Storage. Plans that have been formulated for Phase II system design, fabrication, test, and evaluation program are included. Charts and tables herein illustrate transit user requirements, concept development, design studies, life-cycle costs, and Phase II plans. Conclusions, recommendations, and references are also furnished.

Phase I of this flywheel study is presented in five separate volumes, respectively: "Executive Summary" (PB 282-652); "Systems Analysis" (PB 282-653); "System Mechanization" (PB 282-654); "Life-Cycle Costs" (PB 282-655); and "Vehicle Tests" (PB 282-656).

NTIS ORDER NO.: PB 282-652/AS  
PB 282-651-SET OF 5

PRICE: A06  
E14



TITLE: STUDY OF FLYWHEEL ENERGY STORAGE  
VOLUME 2: SYSTEMS ANALYSIS  
Final Report

AUTHOR: AiResearch Manufacturing Company  
(L.J. Lawson, A.K. Smith, and G.D. Davis)

DATE: September 197.

PROJECT NO.: CA-06-0106

---

KEYWORDS: 1. Brakes and Braking, Regenerative  
2. Bus  
3. Energy Storage  
4. Flywheels  
5. Life-Cycle Costing  
6. Propulsion Systems, Diesel  
7. Propulsion Systems, Electric  
8. Propulsion Systems, Flywheel  
9. Trolleys

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and 3) Plan a comprehensive program leading to full implementation of new propulsion concepts in production vehicles. This study has shown the viability of flywheel-propelled buses and recommends that the Phase II program leading to the development of prototype flywheel-propelled vehicles be promptly initiated.

This requirements study report, Volume 2 of Phase I, reviews, identifies, and definitizes the requirements for improved rubber-tired urban transit vehicles. It includes the quantification of three baseline vehicles: a 40-foot diesel bus, a trolley coach, and a battery bus. Eleven transit properties were visited to determine their requirements for rubber-tired transit vehicles over the next two decades; this transit property survey is contained herein.

Phase I of this flywheel study is presented in five separate volumes, respectively: "Executive Summary" (PB 282-652); "Systems Analysis" (PB 282-653); "System Mechanization" (PB 282-654); "Life-Cycle Costs" (PB 282-655); and "Vehicle Tests" (PB 282-656).

NTIS ORDER NO.: PB 282-653/AS  
PB 282-651-SET OF 5

PRICE: A11  
E14

TITLE: STUDY OF FLYWHEEL ENERGY STORAGE  
VOLUME 3: SYSTEM MECHANIZATION  
Final Report

AUTHOR: AiResearch Manufacturing Company  
(L.J. Lawson, A.K. Smith, and G.D. Davis)

DATE: September 1977

PROJECT NO.: CA-06-0106

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KEYWORDS: 1. Brakes and Braking  
          Regenerative  
          2. Bus  
          3. Energy Storage  
          4. Flywheels  
          5. Life-Cycle Costing  
          6. Propulsion Systems, Diesel  
          7. Propulsion Systems, Electric  
          8. Propulsion Systems, Flywheel  
          9. Trolleys

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In 1976, the Urban Mass Transportation Administration of the U.S. Department of Transportation established the present program-- Study of Flywheel Energy Storage--to determine the practicality and viability of flywheel propulsion systems for urban mass transit vehicles. This study is based on the use of present state-of-the-art technology that could be demonstrated within 24 months in full-scale urban transit vehicles.

The overall objectives addressed in this Phase I study are:  
1) Develop new transit vehicle propulsion system alternatives;  
2) Establish the economic viability of new propulsion systems in comparison with present vehicles using life-cycle cost analyses; and 3) Plan a comprehensive program leading to full implementation of new propulsion concepts in production vehicles. This study has shown the viability of flywheel-propelled buses and recommends that the Phase II program leading to the development of prototype flywheel-propelled vehicles be promptly initiated.

Volume 3 of this Phase I study describes the results of the system mechanization for the four flywheel propulsion configurations that scored highest in the screening (Volume 2): Pure flywheel drive; Flywheel/battery hybrid drive; Flywheel/diesel engine hybrid drive; and Flywheel-augmented trolley coach drive. This report states that a family of transit buses configured with these four propulsion systems could provide the types and quality of service required for at least 95 percent of the urban transit routes in the United States. Charts, figures, and tables are furnished in this report. The Appendixes are: Flat Disc Stress Calculations; Containment Ring Detail Calculations; Tie Bolt Sizing and Stress Calculations; and Bearing Analysis: Tapered Roller Bearing.

Phase I of this flywheel study is presented in five separate volumes, respectively: "Executive Summary" (PB 282-652); "Systems Analysis" (PB 282-653); "System Mechanization" (PB 282-654); "Life-Cycle Costs" (PB 282-655); and "Vehicle Tests" (PB 282-656).

NTIS ORDER NO.: PB 282-654/AS  
PB 282-651-SET OF 5

PRICE: A08  
E14

TITLE: STUDY OF FLYWHEEL ENERGY STORAGE  
VOLUME 4: LIFE-CYCLE COSTS  
Final Report

AUTHOR: AiResearch Manufacturing Company  
(L.J. Lawson, A.K. Smith, and G.D. Davis)

DATE: September 1977

PROJECT NO.: CA-06-0106

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KEYWORDS: 1. Brakes and Braking  
          Regenerative  
          2. Bus  
          3. Energy Storage  
          4. Flywheels  
          5. Life-Cycle Costing  
          6. Propulsion Systems, Diesel  
          7. Propulsion Systems, Electric  
          8. Propulsion Systems, Flywheel  
          9. Trolleys

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1) Develop new transit vehicle propulsion system alternatives;  
2) Establish the economic viability of new propulsion systems in comparison with present vehicles using life-cycle cost analyses;  
and 3) Plan a comprehensive program leading to full implementation of new propulsion concepts in production vehicles. This study has shown the viability of flywheel-propelled buses and recommends that the Phase II program leading to the development of prototype flywheel-propelled vehicles be promptly initiated.

This report, Volume 4 of Phase I, describes life-cycle cost analyses for the baseline vehicles and flywheel-equipped vehicles. The methodology and basis for the analyses are described, costs elements are developed, vehicle life-cycle costs are compared, and sensitivity studies are presented. Based on these cost analyses, conclusions and recommendations are made. Charts, figures, tables, and references are furnished. The Appendix is: UMTA SDC 103-0 STANDARD BUS LIFE-CYCLE COSTING METHODOLOGY AND COST OF THREE BASELINE VEHICLES.

Phase I of this flywheel study is presented in five separate volumes, respectively: "Executive Summary" (PB 282-652); "Systems Analysis" (PB 282-653); "System Mechanization" (PB 282-654); "Life-Cycle Costs" (PB 282-655); and "Vehicle Tests" (PB 282-656).

NTIS ORDER NO.: PB 282-655/AS  
PB 282-651-SET OF 5

PRICE: A06  
E14

TITLE: STUDY OF FLYWHEEL ENERGY STORAGE  
VOLUME 5: VEHICLE TESTS  
Final Report

AUTHOR: AiResearch Manufacturing Company  
(L.J. Lawson, A.K. Smith, and G.D. Davis)

DATE: September 1977

PROJECT NO.: CA-06-0106

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KEYWORDS: 1. Brakes and Braking  
                  Regenerative  
          2. Bus  
          3. Energy Storage  
          4. Flywheels  
          5. Life-Cycle Costing  
          6. Propulsion Systems, Diesel  
          7. Propulsion Systems, Electric  
          8. Propulsion Systems, Flywheel  
          9. Trolleys

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In 1976, the Urban Mass Transportation Administration of the U.S. Department of Transportation established the present program-- Study of Flywheel Energy Storage--to determine the practicality and viability of flywheel propulsion systems for urban mass transit vehicles. This study is based on the use of present state-of-the-art technology that could be demonstrated within 24 months in full-scale urban transit vehicles.

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This report, Volume 5 of Phase I, presents the test results regarding fuel and energy consumption of baseline vehicles operating over typical transit routes. Tests were performed on a new 40-foot diesel bus under controlled conditions and on a San Francisco Municipal Railway trolley coach; test data from the 20-vehicle M.A.N. Electrobus demonstration program in Germany are provided for use in the substantiation of the battery bus performance model. Details of the tests, test data, and other test results are included in Appendixes A, B, and C.

Phase I of this flywheel study is presented in five separate volumes, respectively: "Executive Summary" (PB 282-652); "Systems Analysis" (PB 282-653); "System Mechanization" (PB 282-654); "Life-Cycle Costs" (PB 282-655); and "Vehicle Tests" (PB 282-656).

NTIS ORDER NO.: PB 282-656/AS  
PB 282-651-SET OF 5

PRICE: A05  
E14

**TITLE:** SYMPOSIUM PROCEEDINGS ON COMMUNITY DEVELOPMENT  
AND PASSENGER TRANSPORTATION  
November 8-9, 1977

**AUTHOR:** Institute of Public Administration

**DATE:** June 1978

**PROJECT NO.:** DC-06-0106

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**KEYWORDS:**

- |                      |               |
|----------------------|---------------|
| 1. Community         | 5. Planning   |
| 2. Joint Development | 6. Housing    |
| 3. New Towns         | 7. Recreation |
| 4. Passengers        | 8. Workshop   |
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In November 1977, the Service and Methods Demonstration Office of the Urban Mass Transportation Administration sponsored a "Symposium on Community Development and Passenger Transportation" in Washington, D.C. The objective of the symposium was to exchange information among local multi-purpose project operators and federal program managers interested in improving passenger transportation and community development.

This report is a compilation of material that was presented at the symposium and contains summaries of remarks presented at one plenary session and four workshops. Discussion topics include the joint economic development of land uses and transportation facilities; non-work trip purposes and multi-use community development; community development planning and site selection for transportation benefits; and uses of passenger transportation for community resource management. Viewpoints on the relationship between community development and passenger transportation are presented by major Federal programs dealing with community development, and illustrated with significant Federal demonstrations. Major agency presentations include the following: New Communities Administration, and Office of Policy, Development and Research, Department of Housing and Urban Development; National Park Service, Department of Interior, and the Urban Mass Transportation Administration, U.S. Department of Transportation; among others.

This report also contains a symposium program and a list of participants.

**NTIS NO:** PB 284-798/AS

**PRICE:** A07

**TITLE:** A STUDY OF MINORITY BUSINESS PARTICIPATION IN THE URBAN  
MASS TRANSPORTATION INDUSTRY  
Volume I - Analysis of Minority Business Participation

**AUTHOR:** One America, Inc.

**DATE:** July 1977

**PROJECT NO.:** DC-06-0146

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**KEYWORDS:**

1. Minorities
  2. Contracting
  3. Urban Mass Transit
  4. Survey
- 

Since it was officially established in 1970, UMTA's Office of Civil Rights (UCR) has mounted a concerted effort to develop, implement, and monitor a viable Minority Business Enterprises (MBE) Affirmative Action Program that directly relates to UMTA (internal programs) and grantees (external programs). This study focuses primarily on UMTA's external programs.

The UCR commissioned this 3-volumed study to establish a data base on the current level of MBE participation in the planning, development, and implementation of transit systems and to recommend changes in enforcement strategies in order to substantially increase MBE participation.

The purpose of this report, Volume I, was to examine the participation by and opportunities for MBE in the urban mass transportation industry. A national survey was conducted and the UMTA Minority Business Enterprise Information Sheet (Appendix A) was developed and distributed to twenty-one transit properties selected by UCR (Table 1). The survey revealed that participation by minority businesses in the urban mass transit industry is minimal. In 1976, 18 properties awarded minority firms less than one percent of contracts valued at \$275 million. This study examined transit properties' procurement activities from 1974-76, affirmative action plans, and UMTA documents. The study recommends that UCR which monitors transit property minority business programs establish more stringent requirements of grantees, require proposed annual and quarterly transit property reports, institute a priority monitoring system, and take measures to more closely link the minority business program with the UMTA grant funding system.

Other volumes available at NTIS include: Volume II-Developing Successful Minority Business Enterprise Programs for Public Transit Properties: A Manual (PB 274-774), and Volume III-Public Transit Contracting Opportunities: A Manual (PB 274-775). Volume IV-Minority Business Capabilities - Data Bank is computerized and is available from UCR upon written request.

**NTIS ORDER NO.:** PB 274-773/AS  
PB 274-772-SET OF 3

**PRICE:** A06  
A21

**TITLE:** A STUDY OF MINORITY BUSINESS PARTICIPATION IN THE URBAN  
MASS TRANSPORTATION INDUSTRY  
Volume II - Developing Successful Minority Business Enterprise  
Programs for Public Transit Properties: A Manual

**AUTHOR:** One America, Inc.

**DATE:** July 1977

**PROJECT NO.:** DC-06-0146

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**KEYWORDS:**

1. Affirmative Action Program
  2. Minorities
  3. Guides and Guidance
  4. Handbook
  5. Urban Mass Transit
- 

Since it was officially established in 1970, UMTA's Office of Civil Rights (UCR) has mounted a concerted effort to develop, implement, and monitor a viable Minority Business Enterprises (MBE) Affirmative Action Program that directly relates to UMTA (internal programs) and grantees (external programs). This study focuses primarily on UMTA's external programs.

The UCR commissioned this 3-volumed study to establish a data base on the current level of MBE participation in the planning, development, and implementation of transit systems and to recommend changes in enforcement strategies in order to substantially increase MBE participation.

This Manual, Volume II, provides guidelines for mass transit properties on developing an effective minority business enterprise (MBE) program. Information and recommendations are provided on the use of transit planning and programming tools in planning the MBE program, goal setting mechanisms, MBE subcontract requirements of prime contractors, communications procedures, staffing needs, and recordkeeping and monitoring methods. The Appendices are the following: Annual Report Form, Quarterly Report Form, Sample Bid Work Sheet, List of MBE Liaison Officers, National Trade and Professional Associations, and Minority Contractors and Technical Assistance Organizations.

A study of a sample of minority business programs conducted by 21 transit properties and a review of many existing affirmative action plans indicated the need for improved programs. This Manual reflects UCR's requirements for transit property grantees. These requirements were instituted to implement the Revised Title VI Order issued in 1977.

Other volumes available at NTIS include: Volume I-Analysis of Minority Business Participation (PB 274-773), and Volume III-Public Transit Contracting Opportunities for Minority Business Enterprises: A Manual (PB 274-775). Volume IV-Minority Business Capabilities - Data Bank is a computerized and is available from UCR upon written request.

NTIS ORDER NO.: PB 274-774/AS  
PB 274-772-SET OF 3

PRICE: A04  
A21

**TITLE:** A STUDY OF MINORITY BUSINESS PARTICIPATION IN THE  
URBAN MASS TRANSPORTATION INDUSTRY  
Volume III - Public Transit Contracting Opportunities For  
Minority Business Enterprises: A Manual  
**AUTHOR:** One America, Inc.

**DATE:** July 1977

**PROJECT NO.:** DC-06-0146

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**KEYWORDS:**

1. Minorities
  2. Contracting
  3. Affirmative Action Program
  4. Urban Mass Transportation
  5. Guides and Guidance
- 

Since it was officially established in 1970, UMTA's Office of Civil Rights (UCR) has mounted a concerted effort to develop, implement, and monitor a viable Minority Business Enterprises (MBE) Affirmative Action Program that directly relates to UMTA (internal programs) and grantees (external programs). This study focuses primarily on UMTA's external programs.

The UCR commissioned this 3-volumed study to establish a data base on the current level of MBE participation in the planning, development, and implementation of transit systems and to recommend changes in enforcement strategies in order to substantially increase MBE participation.

This Manual, Volume III, provides information on procurement programs, the Title VI Regulations, the contracting procedures utilized by various transit properties, and the names and addresses of MBE Liaison Officers by Region. This Manual also contains suggestions for doing business with transit properties relative to the transit/marketing contracting process. This Manual discusses such items as the Organization for Procurement, the Procurement Process, Technical Assistance Organizations, Marketing Techniques, Financial Planning and Management, Bonding, and Job Performance. The ADDENDA contains : Definition of Transit Terms; Selected Active UMTA Grants By Amount and Purpose; Selected MBE Contract Awards; List of MBE Liaison Officers; List of Commonly Procured Items; MBE Marketing Check List; National Trade and Professional Associations List; and Minority Contractors and Technical Assistance Organizations.

Other volumes available at NTIS include: Volume I-Analysis of Minority Business Participation (PB 274-773), and Volume II-Developing Successful Minority Business Enterprise Programs for Public Transit Properties: A Manual (PB 274-774). Volume IV-Minority Business Capabilities - Data Bank is computerized and is available from UCR upon written request.

**NTIS ORDER NO.:** PB 274-775/AS  
PB 274-772-SET OF 3

**PRICE:** A04  
A21



TITLE: EXPERIMENTAL DESIGN PLAN FOR THE DOWNTOWN PEOPLE MOVER  
DEMONSTRATION PROJECTS  
Final Report

AUTHOR: Peat, Marwick, Mitchell and Company  
(R. B. Rubin and R. H. Ellis)

DATE: April 1977

PROJECT NO.: DC-06-0162

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KEYWORDS:

1. Automated Guideway Transit
  2. Downtown People Mover
  3. Planning
  4. Evaluation Plan
- 

Shuttle Loop Transit (SLT) is a form of Automated Guideway Transit (AGT) which has demonstrated itself in a number of deployments throughout the country, namely, airports, recreational/amusement parks, and similar special purpose applications. The Urban Mass Transportation Administration (UMTA) of the U.S. Department of Transportation has approved federal financing of demonstration systems in four cities (Cleveland, Houston, Los Angeles, and St. Paul) to establish the viability and desirability of this technology in more demanding general downtown applications.

This document presents an experimental design (ExD) Plan for the Downtown People Mover (DPM) projects planned by UMTA. This ExD Plan is a structured evaluation approach, designed to permit the objective assessment of the individual demonstration projects and development of transferable evaluation conclusions. The ExD Plan aims to provide guidance to the selected cities in preparing their own detailed demonstration project evaluation work plans. It is designed to assure the most widely applicable results from the individual demonstration project experiences. This ExD Plan addresses data collection, data analysis and evaluation, and the presentation of results. This report is the ExD Plan to be used by UMTA and the selected cities in conducting the DPM evaluation.

NTIS ORDER NO.: PB 270-614/AS

PRICE: A09

TITLE: THE UNITED STATES AND THE INTERNATIONAL MARKET  
FOR RAIL EQUIPMENT

AUTHOR: Richard J. Barber Associates, Inc.

DATE: March 1978

PROJECT NO.: DC-06-0213

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KEYWORDS:

- |                         |                              |
|-------------------------|------------------------------|
| 1. Industrial Relations | 5. Rail, Rolling Stock       |
| 2. International        | 6. Government, International |
| 3. Marketing            |                              |
| 4. Policy Studies       |                              |
- 

This report intends to shed light on the international rail transit car market and the firms which manufacture the equipment for it, with emphasis on the position of the U.S. domestic segment of that market at the present time and in the foreseeable future. Long the preserve of domestic manufacturers, the U.S. transit car market has been penetrated successfully in recent years by Canadian, French, and Italian carbuilders. The author purposes to discuss the circumstances surrounding these events and to develop their implications.

This report discusses the following issues: 1) the commercial and economic outlook of carbuilders and component suppliers; 2) government funding of the rail passenger equipment market (worldwide); 3) the degree of interdependence that exists among the economies of the world, the corporations who manufacture and trade on a global scale, and the rail industry itself; 4) the U.S. Domestic transit car market; and 5) the implications for public policy. This report is based principally on a series of interviews and discussions with people drawn from the rail carbuilding industry, component supply companies, transit authorities, railroads, trade associations, and government agencies.

Some of the conclusions drawn from this study are: 1) the principal problems faced by U.S. carbuilders were strongly in evidence well before the appearance of foreign competitors; 2) transit authorities and UMTA have been faced with rising transit equipment costs and a bid pattern which shows an alarming tendency for only one or two (or none) U.S. firms to bid; and 3) none of the sources consulted expect all U.S. carbuilders to disappear, but most tend to regard a reduction in the number of carbuilders as inevitable.

NTIS ORDER NO.: PB 285-613/AS

PRICE: A06

TITLE: LOW FARE AND FARE-FREE TRANSIT: SOME RECENT APPLICATIONS  
BY U.S. TRANSIT SYSTEMS

AUTHOR: The Urban Institute  
(Keith M. Goodman and Melinda A. Green)

DATE: February 1977

PROJECT NO.: DC-52-0002

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KEYWORDS:

1. Economics
  2. Fare, Free
  3. Fare, Reductions
  4. Planning
  5. Urban Planning
- 

This work has been sponsored by the Office of Service and Methods Demonstration Programs of the Urban Mass Transportation Administration of the U.S. Department of Transportation. It is part of a continuing effort by this office to document the experiences of the transit industry in order to bring about improved transit operations through pricing and service policy changes.

The purpose of this report is to provide a reference document describing succinct case studies of the experience accrued by more than 40 U.S. transit systems which have introduced fare-free or reduced-fare services of one form or another in recent years. The report is a useful reference document for decision makers contemplating similar pricing policies as well as a preliminary planning guide to the Urban Mass Transportation Administration for the development of demonstration programs to evaluate various transit pricing and service strategies.

Many different types of fare reductions were identified. They are classified into five divisions: 1) systemwide fare reductions without any restrictions; 2) fare reductions applicable to specific geographical areas only--typically the Central Business District; 3) fare reductions which are operable only during limited hours--typically the off-peak hours; 4) fare reductions subject to both geographical and time-of-day restrictions; and 5) fare reductions of short duration. When viewed from the limited perspective of financial aspects of transit system operations, it does not appear that fare reductions alone have had a favorable impact on the overall economic conditions of transit systems.

NTIS ORDER NO.: PB 271-077/AS

PRICE: A08

TITLE: THE SAN DIEGO TRANSIT CORPORATION: The Impact of Fare and Service Changes on Ridership and Deficits, 1972-1975

AUTHOR: The Urban Institute  
(Keith M. Goodman, Melinda A. Green, and Michael E. Beesley)

DATE: May 1977

PROJECT NO.: DC-52-0002

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KEYWORDS:

- |  |                                      |
|--|--------------------------------------|
| 1. Fare                                  | 4. Management, Planning and Analysis |
| 2. Financing Mass Transportation         | 5. Pricing                           |
| 3. Management, Operations and Techniques | 6. Ridership, Attraction             |
- 

This research is supported by a grant from the Urban Mass Transportation Administration (UMTA) Office of Service and Methods Demonstration of the U.S. Department of Transportation.

This paper is one of a series from a study of forty months' operating experience of the San Diego Transit Corporation (SDTC) bus system between 1972 and 1975. It reflects a concern with the increasing deficits of transit operators as well as the diversity contained within a single bus system such as that in San Diego. The principal objectives of this report are: 1) to provide a brief overview description of the bus system and of the data available for analysis; and 2) to present initial estimates of fare and service level elasticities for comparison with the many other estimates in common use among transportation planners and to examine SDTC's financial performance over this period.

Over the system as a whole, the patronage response was similar to that which might have been expected from previous independent work. The responses were such as to increase deficits when fares were lowered and service levels were substantially improved. However, the greater numbers of passengers were carried at a cost per passenger which, over the period studied, did not increase in real terms. San Diego's experience of an expanding system at an approximately constant real cost per passenger were very unusual among transit operators in this period. Limited disaggregation of the systemwide data into major groupings of routes shows clearly that the systemwide analysis masks a great deal of heterogeneity within the system. The implications for transit planning and for further research are also discussed herein. The Appendix contains single-equation models of demand for the San Diego system.

Companion reports provide a detailed introduction to this study: AN ECONOMETRIC MODEL OF BUS TRANSIT DEMAND AND SUPPLY, Working paper 5032-1-4, and THE SAN DIEGO TRANSIT STUDY DATA BASE: REFERENCE MANUAL, (PB 275-010/AS).

NTIS ORDER NO.: PB 275-009/AS

PRICE: A03

TITLE: THE SAN DIEGO TRANSIT STUDY DATA BASE:  
Reference Manual

AUTHOR: The Urban Institute  
(Melinda A. Green)

DATE: June 1977

PROJECT NO.: DC-52-0002

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KEYWORDS:

- |                        |                             |
|------------------------|-----------------------------|
| 1. Guides and Guidance | 5. Pricing                  |
| 2. Codes and Coding    | 6. Management, Planning and |
| 3. Information Aids    | Analysis                    |
| 4. Fares               |                             |

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This research is supported by a grant from the Urban Mass Transportation Administration (UMTA) Office of Service and Methods Demonstration of the U.S. Department of Transportation.

This report, one of a series of reports, presents descriptions of the sources and procedures used in compiling a data set for analyzing the impacts of changes in the service and fare policies of the San Diego Transit Corporation (SDTC) bus system over a 40-month period between 1972-1975. The analysis aims to explore variations in the demand for and supply of transit service across routes and months as they relate to specific actions taken by the transit operators. This manual describes the data items, the sources of data, the coding procedures, and the creation of computer files. It provides a glossary of terms and concepts adopted in creating and using the data set. The intent of this document is twofold: 1) to serve as a supplementary reference document to other reports of the Urban Institute's San Diego transit study, and 2) to be a source for those who wish to familiarize themselves with the nature and structure of the computer files.

The major source of information is a series of monthly reports, produced by SDTC, which provide key operating statistics for the system by bus route: ridership (broken down by fare type and method of payment), passenger revenues, and bus miles and bus hours operated. In addition, various statistics characterizing the level of service provided on each route in each month have been derived from the published schedules for the system. A detailed breakdown of operating costs was obtained from SDTC's monthly financial reports.

The methods of coding data from these and other sources are described in detail. A total of 160 different time series are contained in the data set, of which about 90 are specified for a number of different bus routes, thereby producing a total of some 3,100 variables.

Companion reports are: 1) AN ECONOMETRIC MODEL OF BUS TRANSIT DEMAND AND SUPPLY, Working paper 5032-1-4, and 2) THE SAN DIEGO TRANSIT CORPORATION: THE IMPACTS OF FARE AND SERVICE CHANGES ON RIDERSHIP AND DEFICITS, 1972-1975, (PB 275-009/AS).

NTIS ORDER NO.: PB 275-010/AS

PRICE: A05

TITLE: GAS TURBINE ENGINE APPLICATION IN TRANSIT COACHES  
Final Report

AUTHOR: Booz, Allen & Hamilton, Inc.

DATE: March 1977

PROJECT NO.: IT-06-0025

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KEYWORDS:

1. Bus, Transbus
  2. Propulsion Systems, Diesel, Turbine
  3. Fuel, Types
  4. Life Cycle Costing
- 

The Bus Technology Program was initiated by the Urban Mass Transportation Administration (UMTA) in 1971 to develop a modern and efficient motor coach for use in urban mass transit systems. This report is the fourth of four reports submitted under Project 3 (Propulsion System Technology) of the overall Bus Technology Program. The purpose of Project 3 is to determine which propulsion systems are feasible for use in TRANSBUS (35 to 40-foot-long transit motor coach) and to select systems suitable for alternative use during the life span of this model bus. The Project 3 series of reports covers the following topics: 1) State-of-the-Art; 2) Propulsion Requirements; 3) Alternate Power Plant Installations; and 4) Advanced and Innovative Propulsion Concepts.

This report presents an investigation of gas turbine engine application in transit coaches that was conducted as part of the Transbus program to determine the viability of the gas turbine engine as a potential power source for transit coaches. The state of development of the gas turbine engine as a vehicular power source is described. An in-depth survey and evaluation was conducted of gas turbine engine manufacturers to determine the suitability of these engines for installation in transit coaches. Only one product is developed to a state where volume production can be seriously considered.

The gas turbine engine is described in detail and a comprehensive cost/benefit analysis was performed of this engine installed in a contemporary transit coach fleet. The results of the analysis and evaluation indicate that while current engines are not economically justifiable, the gas turbine engine is potentially superior to the diesel engine when fully developed with planned improvements scheduled for the near time frame. Recommendations are also presented in this report to demonstrate early production turbine engines in a small fleet of transit coaches in revenue service.

NTIS ORDER NO.: PB 272-608/AS

PRICE: A05

TITLE: TRANSBUS ENGINEERING TEST PROGRAM  
Final Report

AUTHOR: Booz, Allen & Hamilton Inc.

DATE: December 1977

PROJECT NO.: IT-06-0025

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KEYWORDS:

1. Bus, Transbus
  2. Bus, Design
  3. Bus, Cost
  4. Vehicle, Design
- 

This report summarizes the engineering tests that were performed in support of the Transbus Program implemented in 1971. The primary objective of the Transbus Program was to design and develop prototypes of a new generation of coaches. This program was sponsored by the Urban Mass Transportation Administration (UMTA); Booz, Allen and Hamilton Inc. was the prime contractor, responsible for the design, development, test, demonstration, and evaluation of the new prototype. Subcontractors assisted with the engineering tests and the American Public Transit Association assisted in the evaluations. Design documentation is available through the Transportation Systems Center in Cambridge, Massachusetts.

Transbus prototypes built by three manufacturers (AM General, General Motors, and Rohr Industries) were subjected to a series of tests. The objectives of the engineering tests were to obtain evaluation data to determine the degree of compliance with the Transbus specification, to assess the design improvements over current production buses, to identify product improvements required for production designs, and to provide overall technical assessments of the designs for a government decision regarding a production phase for Transbus. This report presents an overview of the entire test program--the test articles, procedures and facilities used for the development tests, acceptance tests, and independent engineering tests. It also presents a summary of the data obtained in each individual portion of the testing program. This report contains numerous charts/figures illustrating such tests as development tests, components supplier tests, acceptance tests, brake tests, durability tests and others.

The engineering tests described in this report began in November 1972 and were completed in March 1976. The basis for the tests were the requirements and rationale delineated in the "Transbus Engineering Test Plan," Booz, Allen Report TR-73-003, February 1973 (report is available from Booz, Allen & Hamilton Inc.).

NTIS ORDER NO.: PB 276-196/AS

PRICE: A13

TITLE: TRANSBUS OPERATIONAL, PASSENGER, AND COST IMPACTS  
Transbus Program

AUTHOR: Booz-Allen Applied Research and Simpson and Curtin

DATE: July 1976

PROJECT NO.: IT-06-0025

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KEYWORDS:

1. Bus, Cost
  2. Bus, Design
  3. Bus, Transbus
  4. Vehicle, Design
- 

Transbus is a new urban transit bus design which was developed during a 5-year, 28-million dollar R&D program sponsored by the Urban Mass Transportation Administration. This report assesses the impact that the introduction of Transbus would have on motor coach operations in the United States. Information from the Transbus demonstration and engineering test programs which involved the use of nine prototype Transbus coaches is analyzed in this report, along with substantial background information on U.S. transit operations.

The assessment of the operational impact of replacing the current bus fleet with Transbuses indicates that a significant opportunity exists for improving schedule dependability, increasing route coverage or improving driver productivity. Because of the reduced capacity of Transbus, total fleet size requirements will increase by two percent. Passenger and public impacts of Transbus introduction are shown to be very positive, especially in the areas of safety, comfort, aesthetics/image, and the accomodation of the elderly and handicapped. Ridership increases of up to ten percent are projected. Total operating costs are projected to increase by one percent on a life-cycle basis. Production costs for Transbus are projected to be about 12.5 percent greater than the current production bus.

Appendices include a discussion of the history of transit bus design innovation and detailed supporting materials related to operating cost projections.

NTIS ORDER NO.: PB 269-911/AS

PRICE: A06



TITLE: TRANSIT BUS PROPULSION SYSTEMS  
ALTERNATE POWER PLANT INSTALLATIONS  
TRANSBUS Program

AUTHOR: Booz, Allen & Hamilton Inc.  
Transportation Consulting Division

DATE: September 1977

PROJECT NO.: IT-06-0025

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KEYWORDS:

1. Bus, TRANSBUS
  2. Propulsion Systems, Diesel
  3. Propulsion Systems, Turbine
  4. Surveys
  5. Vehicle, Design
- 

The Urban Mass Transportation Administration of the U.S. Department of Transportation initiated the Bus Technology Program in 1971 to develop a modern and efficient motor coach for use in urban mass transit systems. This document is the third of four reports submitted under Project 3--Propulsion System Technology-- of the overall Bus Technology Program. The purpose of Project 3 is to determine which propulsion systems are feasible for use in TRANSBUS and to select systems suitable for alternative use during the life span of this model bus. Another Project 3 report available at NTIS is GAS TURBINE ENGINE APPLICATION IN TRANSIT COACHES (PB 272-608).

This report describes the survey and evaluation that was made of U.S. heavy-duty automotive engine manufacturers who could offer engines to power TRANSBUS during its production life which is expected to run to the 1990's. TRANSBUS is the heavy-duty, 35- to 40-foot long transit coach developed under this contract, and it incorporates the best available technology for improvement of mass transit transportation in urban U.S.A. Installation characteristics of the most suitable engines for each of the three TRANSBUS prototype coaches (constructed by AM General, General Motors, and Rohr Industries) are presented herein. Listed and illustrated in this report are: 1) the engine compartments of the three prototype TRANSBUS designs; 2) the candidate engines; and 3) the candidate engines fitted into the three prototypes.

The results presented herein show that two engine types, the 4-cycle diesel engine and the gas turbine engine, may challenge the Detroit Diesel 2-cycle diesel engine for the transit coach market. The report states that: 1) power plants in transit coaches, namely TRANSBUS, will not differ appreciably in the next decade; 2) the diesel engine will not be replaced but modified; 3) only the Detroit Diesel 92-series and the Cummins V-903 engines are likely to challenge the Detroit Diesel 71-series engine for the large transit coach market; 4) only one gas turbine engine was identified as a possible alternative to the diesel-- the Allison GT-404; and 5) the future of the gas turbine engine in transit coaches has not been determined.

NTIS ORDER NO.: PB 276-612/AS

PRICE: A03

TITLE: TRANSIT BUS PROPULSION SYSTEMS  
PROPULSION REQUIREMENTS

AUTHOR: Booz, Allen & Hamilton Inc.

DATE: January 1978

PROJECT NO: IT-06-0025

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KEYWORDS:

- |                       |                                   |
|-----------------------|-----------------------------------|
| 1. Bus, TRANSBUS      | 5. Propulsion Systems, Diesel     |
| 2. Bus, Design        | 6. Propulsion Systems, Turbine    |
| 3. Bus, Rapid Transit | 7. Propulsion Systems, Horsepower |
| 4. Vehicle, Design    |                                   |
- 

The Bus Technology Program was initiated by the Urban Mass Transportation Administration of the U.S. Department of Transportation in 1971 to develop a modern and efficient motor coach for use in urban mass transit systems.

This is the second of four reports prepared under Project 3--- Propulsion System Technology---of the overall Bus Technology Program. The purpose of Project 3 is to determine which propulsion systems are feasible for use in TRANSBUS and to select systems suitable for alternative use during the life span of this model bus.

The objective of this report is to furnish a rational basis and numerical procedure for assessing the power plant requirements of TRANSBUS, an advanced technology 40-foot urban transit motor coach. In this report, power requirements for propulsion and accessory service of TRANSBUS are evaluated. Performance goals and specifications for TRANSBUS are reviewed, and those that influence the power requirements are identified. A range of vehicular and operational factors appropriate to the transit coach is considered. Using these factors, a likely model is assumed and its power requirements computed. The assumed parameters are varied within a reasonable range of values. These charts may be used to refine the power estimate as more complete data become available for selected vehicle components. Sensitivity of power requirements to each of the significant factors is analyzed in a series of charts. Typical power requirements on representative operating profile segments are also presented. The charts provide a frame of reference for the evaluation of the TRANSBUS prototype vehicle performance and for the consideration of alternative and advanced power plants. This report concludes that the estimated minimum power requirements for the standard specification TRANSBUS is 264 horsepower. This is compatible with the industry standard V-8 engine.

Other Project 3 reports are: "Transit Bus Propulsion Systems: State of the Art" (PB 226-871); "Alternate Power Plant Installations" (PB 276-612); and "Gas Turbine Engine Application in Transit Installations" (PB 272-608).

NTIS NO.: PB 284-835/AS

PRICE: A04

**TITLE:** DEVELOPMENT OF A TIME-CALIBRATED, SELF-CANCELLING TICKET  
INITIAL FEASIBILITY DETERMINATION  
Final Report

**AUTHOR:** Arthur D. Little, Inc.  
(J. P. Tratnyek, J. D. Birkett, and M. R. Schlemm)

**DATE:** July 1977

**PROJECT NO.:** IT-06-0125

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**KEYWORDS:**

- |                        |                                 |
|------------------------|---------------------------------|
| 1. Instrumentation     | 5. Timing Devices               |
| 2. Meters and Metering | 6. Traffic Analysis, Congestion |
| 3. Pricing, Congestion | 7. Traffic Analysis, Control    |
| 4. Timers              |                                 |

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The Department of Transportation, through its congestion-pricing projects, is seeking means of reducing vehicular traffic congestion in urban areas. A time-calibrated, self-cancelling ticket is proposed as one means of control. In concept, it would be a disposable self-contained, or card-like package, with a built-in clock system, which, at a predetermined time after activation by the user, would measure a predetermined time period and indicate expiration by a color change. This ticket, purchased by the driver and affixed to a vehicle, would provide a time-limit identification system to control road and highway use, as well as on-street and off-street parking. In effect, it would provide a means of implementing road-pricing strategies designed to improve transit efficiency by reducing urban travel congestion. The objective of this study was to develop a practical, reliable, safe, easily produced ticket for the intended purpose, taking into account previous knowledge, as well as author inputs. The ticket would be required to operate over a temperature range of 0 to 150°F. for periods of 2, 4, or 10 hours. Several chemical mechanisms for timekeeping are investigated briefly; however, emphasis is on development of a preferred electrochemical approach.

Although different timekeeping mechanisms are possible and the physical appearance of a ticket may vary, a time-calibrated, self-cancelling ticket can be considered as having four parts: the signal which indicates activation; the chemical time-clock which determines the specified time period for the ticket; the signal or display which communicates the expiration; and the substrate which supports the clock and gives the ticket its form. The parts may be dependent upon each other for the effect, or they may be partially dependent or independent, but all must be ultimately considered together in order to develop a ticket having the desired characteristics of time reproducibility, reliability, safety, low cost, and stability. This study addresses functional parts of the ticket, criteria, proposed routes of development, chemical and electrochemical development, and suggestions for future development. Although the ticket is still in the experimental stage, it meets most of the objectives set forth in this program. However, advancement in design is needed. Relaxed criteria for ticket operation would simplify and accelerate this development. Appendices A and B in the report are: A Listing of References and A Summary of U.S. Patents, respectively.

NTIS ORDER NO.: PB 289-133/AS

PRICE: A05

**TITLE:** ACCELERATING MOVING WALKWAY SYSTEMS - TECHNOLOGY ASSESSMENT  
Report B

**AUTHOR:** Port Authority of New York and New Jersey  
(J. Fruin, R. Marshall, and M. Zeigen)

**DATE:** March 1978

**PROJECT NO.:** IT-06-0126

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**KEYWORDS:**

1. Conveyors, Passenger
2. Demonstrations, Accelerating Moving Walkway Systems
3. Pedestrians
4. Walkways, Accelerating

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This report is part of a series that assesses the technology and development of Accelerating Moving Walkway Systems (AMWS). The system resembles conventional constant speed escalators and moving walks, but has the capacity to accelerate pedestrians to 4 to 5 times the conventional system speed through changing treadway configuration. The purpose of this assessment is to determine the current status of development of AMWS technology, to establish potential candidates for a public demonstration, to fix definitive cost and operational data, and to establish user acceptability and safety. The objective is to produce a system which will operate with a line speed of twice the speed of walking and which will provide a time and human saving advantage to extend the effective moving way system range. This report includes a brief history of moving way system development and summarizes the available information necessary to describe and assess the systems of five AMWS developers which are currently at, or near, the hardware prototype stage of development and testing. They are the Speedway System by Dunlop; the Trax System by the Regie Autonome de Transports Parisiens; the Applied Physics Laboratory System by Johns Hopkins University; the Boeing System by the Boeing Corporation; and the Dean System by the Dean Research Corporation.

The systems considered in this study vary in their dimensional environs, thus affecting their adaptability to site applications. Two of the systems are bi-directional loops using a treadway of intermeshing pallets, and the remaining three systems are uni-directional, using treadways composed of either laterally moving pallets, intermeshing leaves, or abutting rollers. Handrails are developed for only two systems. One employs multiple conventional handrails in series, and the other utilizes moving variable speed handgrips. Furnishing and installation costs of the systems are relatively high, but their mechanical simplicity results in comparatively low operating expenses and energy use. Initial user tests show generally favorable acceptance, but some performance modifications may be necessary to meet the requirements of an unlimited public use demonstration. A review of AMWS safety and human factors indicate that the systems can operate at levels of safety acceptable to the public, providing that a specific safety program is followed. Contained in this report is the Appendix: Reference Bibliography and Chronological Highlights.

NTIS ORDER NO.: PB 287-082/AS

PRICE: A05

**TITLE:** ACCELERATING MOVING WALKWAY SYSTEMS - SAFETY AND HUMAN FACTORS  
Report C

**AUTHOR:** Port Authority of New York and New Jersey  
(J. Fruin, R. Marshall, and M. Zeigen)

**DATE:** March 1978

**PROJECT NO.:** IT-06-0126

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**KEYWORDS:**

- |                         |                           |
|-------------------------|---------------------------|
| 1. Conveyors, Passenger | 5. Safety                 |
| 2. Demonstrations       | 6. Site Selection         |
| 3. Human Factors        | 7. Walkways, Accelerating |
| 4. Pedestrians          | 8. Workshops              |

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This report is part of a series that assesses the technology and development of Accelerating Moving Walkway Systems (AMWS). The system is a pedestrian assist device having the capability through changing tread-way configuration to accelerate pedestrians to 4 to 5 times normal moving way system speeds after boarding and to decelerate prior to discharge. The purpose of this report is to identify the human factors and safety considerations associated with the technology, and to establish as accurately as possible the probable degrees of user risk. Several new operating characteristics will be introduced which may influence accident experience as compared to present systems. These characteristics are addressed within this study. A primary consideration will be the acceptability of these new characteristics to the elderly and handicapped. On the basis of limited passenger tests of existing prototype accelerating moving walkways, the probable safety experience with the new systems may be somewhere between that of existing moving walks and the escalator, which generally has a higher rate of accidents than the level walk. However, the final determination of the actual safety and acceptability of the new systems can only be made in the context of an operational demonstration and use by the general public. This study includes system comparisons of five AMWS developers that are currently sufficiently advanced in terms of hardware development to be considered as candidates in a general use public demonstration. The candidates are the Dunlop Speedway System; the Trax System by the Regie Autonome de Transport Parisiens; the Applied Physics Laboratory System by Johns Hopkins University; the Boeing System; and the Dean Research System. All of these systems have potential hazards in common, and others have characteristics which are unique to that specific design. As part of the AMWS project, independent opinions from recognized experts were obtained relating to user safety. In addition, these consultants participated in an AMWS Safety Seminar sponsored as part of the project. Their opinions and a general outline of the seminar are included herein. Based on studies which include an overview of transportation safety, identification and evaluation of possible AMWS hazards, an analysis of moving way accident experience on conventional escalators, the reports of safety consultants, and the proceedings of the Safety Seminar, there appears to be no a priori reason why an AMWS cannot be operated in a public demonstration mode, assuming that a basic safety program is followed. This report contains a Bibliography.

NTIS ORDER NO.: PB 286-831/AS

PRICE: A06

**TITLE:** ACCELERATING MOVING WALKWAY SYSTEMS - MARKET, ATTRIBUTES,  
APPLICATIONS AND BENEFITS  
Report D

**AUTHOR:** Port Authority of New York and New Jersey  
(J. Fruin, R. Marshall, and O. Perilla)

**DATE:** March 1978

**PROJECT NO.:** IT-06-0126

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**KEYWORDS:**

- |                         |                           |
|-------------------------|---------------------------|
| 1. Conveyors, Passenger | 4. Market Research        |
| 2. Demonstrations       | 5. Pedestrians            |
| 3. Human Factors        | 6. Walkways, Accelerating |

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This report is part of a series that assesses the technology and development of Accelerating Moving Walkway Systems (AMWS). The system is a pedestrian assist device with the capability through changing treadway configuration to accelerate pedestrians to 4 to 5 times the normal entrance speeds after boarding, and to decelerate prior to discharge. Time savings resulting from these systems make deployments over longer distances more feasible than with conventional moving walkways. Transportation technology development has concentrated largely on the longer distance transportation demand segments, with relatively little attention given to the pedestrian trip. This report attempts to show how AMWS offers the prospects of improving average pedestrian speeds and trip times and reduces human energy expenditure. This would effectively extend the pedestrian range and provide for increased urban development opportunities now constrained by the limits of acceptable walking distance. These systems come at a time when there is recognition that internal pedestrian movement within cities is not always convenient, that vehicular transportation does not function well on congested urban streets, that vehicles pollute and are energy intensive, and that the central city is in need of improvement in its quality of life. Effective human scale horizontal movement systems are seen as an important means of fulfilling many of these objectives. Potential applications include a wide spectrum of possible short range passenger movement situations, such as feeders to transit; as substitutes for automated guideway systems, bus, or rail transit under some circumstances; as airport movement systems; as urban land use integrators; and as vehicle free zone support systems. Benefits accruing from AMWS include improved transit connections and pedestrian convenience, security and safety, upgraded urban land use, reduced pollution and energy use, and improvements in urban life. The market potential for AMWS will determine the extent of their application and use.

This study addresses the attributes, benefit applications and costs of five systems: Dunlop Speedway; Trax; Applied Physics Laboratory; Boeing; and Dean Research. Also contained herein are Appendices A-1 through A-4: Electric Power Costs - Geographic Variations; Summary of Studies of the Value of Walking Time; Comparative Transit System Construction Costs; and Office Rent Differentials - Old and New Buildings, respectively, and a Bibliography.

NTIS ORDER NO.: PB 287-083/AS

PRICE: A05

**TITLE:** ACCELERATING MOVING WALKWAY SYSTEMS - SAFETY SEMINAR PROCEEDINGS  
Report G

**AUTHOR:** Port Authority of New York and New Jersey

**DATE:** March 1978

**PROJECT NO.:** IT-06-0126

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**KEYWORDS:**

- |                         |                           |
|-------------------------|---------------------------|
| 1. Conveyors, Passenger | 5. Safety                 |
| 2. Demonstrations       | 6. Seminars               |
| 3. Human Factors        | 7. Site Selection         |
| 4. Pedestrians          | 8. Walkways, Accelerating |

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This report is part of a series that assesses the technology and development of Accelerating Moving Walkway Systems (AMWS). The system is a pedestrian assist device with the capability through changing treadway configuration to accelerate pedestrians to 4 to 5 times the normal entrance speeds after boarding, and to decelerate prior to discharge. Time savings resulting from these systems make deployments over longer distances more feasible than with conventional moving walkways. AMWS will introduce several new operating characteristics which may affect the use and acceptance of these systems by the general public, including the elderly and handicapped.

On April 18, 1977, a seminar devoted to the discussion of the safety and human factors associated with the development and public use of AMWS was held at the New York World Trade Center. In attendance were more than 50 persons, including representatives of the escalator and moving walk industry, AMWS developers, human factors and safety consultants, physically handicapped persons, and representatives of government agencies participating in the AMWS program. The objective of the seminar was to provide a forum for discussion on the potential problems that might be associated with the use of this technology based on its current state-of-the-art. The proceedings included a presentation of films and photographic slides providing illustrative design details of several systems under development; presentations by four consultants dealing with various aspects of AMWS safety; and workshops in which all seminar attendees participated. According to Mr. John J. Fruin, the AMWS Project Director, there are four systems advanced sufficiently beyond the concept stage for consideration in a public demonstration program: Dunlop Speedway; Trax by the Paris Transport Authority; Applied Physics Laboratory by Johns Hopkins University; and the Boeing System. These systems are discussed in this report. The meetings closed with the understanding that most of the raised problems or questions can be solved, provided that sufficient efforts are devoted to their study. It was agreed that the proposed demonstration project would be a valuable asset to the development of an acceptable AMWS research program. Appendices 1 and 2 in this report are: The Conference Program and List of Conference Attendees, respectively.

NTIS ORDER NO.: PB 287-084/AS

PRICE: A05

**TITLE:** ASSESSMENT OF THE AUTOMATICALLY CONTROLLED TRANSPORTATION (ACT) SYSTEM AT FAIRLANE TOWN CENTER

**AUTHOR:** SRI International/Transportation and Industrial Systems Center (A. M. Yen, C. Henderson, M. Sakasita, M. Roddin, R. Cronin, and W. Siddiquee)

**DATE:** December 1977

**PROJECT NO.:** IT-06-0135

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**KEYWORDS:**

- |                               |                    |
|-------------------------------|--------------------|
| 1. Automated Guideway Transit | 4. Rail, Shuttle   |
| 2. Automated Vehicles         | 5. Shuttle Transit |
| 3. Guideways, Elevated        | 6. Vehicle, Design |

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This report contains the interim findings of an assessment of the Automatically Controlled Transportation (ACT) System for passenger transport in the Fairlane Town Center at Dearborn, Michigan. The Ford Motor Company is responsible for the design, fabrication, installation, testing, and operation of this Automated Guideway Transit (AGT) system. SRI International conducted the assessment as part of a program sponsored by the Urban Mass Transportation Administration, and is under contract to assess the systems at Sea-Tac International Airport, Fairlane Town Center, Tampa International Airport, Houston Intercontinental Airport, Walt Disney World, and King's Dominion Amusement Park. The purpose of the site reports is to provide a uniformly documented presentation of AGT installations for UMTA's AGT Socio-Economic Research Program, and to gain an in-depth understanding of the performance, capabilities, and limitations of existing domestic and foreign AGT systems. In assessing these sites, the overall objectives are to: 1) obtain factual engineering and operational data; 2) obtain descriptive economic, system performance, and user perception data; and 3) review the design, development, and implementation process. The findings are intended to establish the state of the art of AGT systems for ultimate use in planning, evaluating, producing, and deploying. This report addresses the method of approach used in the Fairlane assessment; the engineering systems description and assessment; operation, maintenance and reliability, and passenger-oriented system performance; systems economics; and the development history of the system.

The Fairlane system is a two-car bypass shuttle operating on an elevated guideway which connects a large shopping center with a hotel situated one-quarter mile across the center parking lot. The system has only recently passed the development stage, during which many design changes and related failures occurred. For this reason, some of the operating costs and related maintenance and reliability data will not be representative of a more mature deployment. Most of the system's design is excellent. A public attitude survey indicated that the passengers find it comfortable, safe, and enjoyable. However, because the owner, manufacturer, and operator are all part of the same company, comparisons with other AGT deployments are probably inappropriate. This report includes Appendices A through E: AGT Assessment Measures; Methods of Cost Estimating and Analysis; Chronology of Events; Major Participants; and Public Attitude Survey Questionnaire, respectively, and also a Listing of References.

NTIS ORDER NO.: PB 286-524/AS

PRICE: A06



TITLE: ASSESSMENT OF THE PASSENGER SHUTTLE SYSTEM (PSS)  
AT TAMPA INTERNATIONAL AIRPORT  
Final Report

AUTHOR: SRI International  
(A.M. Yen, et al)

DATE: December 1977

PROJECT NO.: IT-06-0135

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KEYWORDS:

1. AGT Systems
  2. Airport
  3. Evaluation
  4. Passenger Transportation
  5. Shuttle
- 

SRI International conducted this assessment as part of an assessment program sponsored by the Urban Mass Transportation Administration of the U.S. Department of Transportation. The purpose of the program is to establish the state-of-the-art of Automated Guideway Transit (AGT) systems for ultimate use in planning, evaluating, producing, and deploying future systems, as well as to provide a uniformly documented presentation of AGT installations for UMTA's AGT program.

This site report is the second in a series of six assessment reports. SRI is under contract to assess the systems at Seattle-Tacoma International Airport, Fairlane Town Center, Tampa International Airport, Houston Intercontinental Airport, Walt Disney World, and King's Dominion Amusement Park. In assessing systems at these sites, the overall objectives are: to obtain descriptive economic, system performance, and user perception data; to obtain factual engineering and operational data; and to review the design, development, and implementation process.

This report contains the findings of an assessment of the Tampa International Passenger Shuttle System (PSS), an elevated, automated AGT system that provides passenger transit service between a landside terminal and remotely located airside terminals at the airport. The information and data presented herein were collected by the authors through surveys of technical literature; formal site visits; interviews with operators, management, and engineering personnel; and a visit to the system manufacturer (Westinghouse). The PSS at Tampa has been in successful operation since 1971. The reliability of the system has reached a steady state, and the performance of the system meets the requirements and expectations of the airport operators. Another report is "Assessment of the Satellite Transit System at the Seattle-Tacoma International Airport" (PB 281-820).

NTIS NO.: PB 285-597/AS

PRICE: A06

TITLE: ASSESSMENT OF THE SATELLITE TRANSIT SYSTEM (STS)  
AT THE SEATTLE-TACOMA INTERNATIONAL AIRPORT  
Final Report

AUTHOR: SRI International  
(A.M. Yen, et al.)

DATE: December 1977

PROJECT NO.: IT-06-0135

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KEYWORDS:

- |                |                           |
|----------------|---------------------------|
| 1. AGT Systems | 4. Shuttle Loop Transit   |
| 2. Airport     | 5. Site Selection         |
| 3. Evaluation  | 6. Socioeconomic Analyses |
- 

SRI International conducted this assessment as part of an assessment program sponsored by the Urban Mass Transportation Administration of the U.S. Department of Transportation. The purpose of the program is to gain an in-depth understanding of the performance, capabilities, and limitations of the existing domestic and foreign Automated Guideway Transit (AGT) systems.

This site report is the first in a series of six assessment reports. SRI is under contract to assess the systems at Seattle-Tacoma International Airport (Sea-Tac), Fairlane Town Center, Tampa International Airport, Houston Intercontinental Airport, Walt Disney World, and King's Dominion Amusement Park. In assessing systems at these sites, the overall objectives are to: obtain factual engineering and operational data; obtain descriptive economic, system performance, and user perception data; and review the design, development, and implementation process. The findings are intended to establish the state-of-the-art of AGT systems for ultimate use in planning, evaluating, producing, and deploying future AGT systems.

This final report describes and assesses the Satellite Transit System (STS), an exclusively underground AGT system of the shuttle loop transit class used for passenger transport at Sea-Tac. The information and data presented herein were collected by the authors through surveys of technical literature; formal site visits; interviews with operators, management, and engineering personnel; and a visit to the system manufacturer (Westinghouse). This site report contains seven major sections and a comprehensive information checklist attached as an appendix: 1) Executive Summary; 2) Background Information; 3) Technical Description; 4) System Operational and Performance Assessment; 5) System Economics; 6) System Development Process; and 7) Concluding Remarks. This report concludes that the STS system has had no major problems in its four-year operating history, and it is in a position to further expand its final design capacity.

NTIS ORDER NO.: PB 281-820/AS

PRICE: A07

**TITLE:** ASSESSMENT OF THE UMI TYPE II TOURISTER AGT SYSTEM  
AT KING'S DOMINION

**AUTHOR:** SRI International/Transportation and Industrial Systems Center  
(A. M. Yen, C. Henderson, M. Sakasita, M. Roddin, and W. Siddiquee)

**DATE:** December 1977

**PROJECT NO.:** IT-06-0135

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**KEYWORDS:**

1. Automated Guideway Transit, Loop
  2. Automated Vehicles
  3. Recreation Facilities, Transit
  4. Vehicle Design
- 

This report describes the assessment of the Universal Mobility Inc. (UMI) Automated Guideway Transit (AGT) system used for passenger transport through the Lion Country Safari at King's Dominion Amusement Park near Richmond, Virginia. The information and data presented were collected by the authors through surveys of technical literature; formal site visits; interviews with operators, management, and engineering personnel; and a visit to the system manufacturer. SRI International conducted the assessment, and is under contract to assess the systems at Sea-Tac International Airport, Fairlane Town Center, Tampa International Airport, Houston Intercontinental Airport, Walt Disney World, and King's Dominion Amusement Park. The purpose of the site reports is to provide a uniformly documented presentation of AGT installations for the Urban Mass Transportation Administration's AGT Socio-Economic Program, and to gain an in-depth understanding of the performance, capabilities, and limitations of existing domestic and foreign systems. In assessing these sites, the overall objectives are to: 1) obtain factual engineering and operational data; 2) obtain descriptive economic, system performance, and user perception data; and 3) review the design, development, and implementation process. The findings are intended to establish the state of the art of AGT systems for ultimate use in planning, evaluating, producing, and deploying future systems. This report addresses the background of the project; the engineering system description and assessment; the subjects of operation, maintenance and reliability, and passenger-oriented system performance; systems economics; the development history of the system; and a comprehensive checklist with standard AGT assessment measurements and units attached as Appendix A.

The UMI Type II Tourister System at King's Dominion can be characterized as having a relatively low technological level, but an overall design that fulfills the site requirements in a reliable and economical manner. It is an unscheduled, loop-type system that transports passengers through an animal enclosure. Small wheelchairs, designed for children, can be accommodated on the vehicle. The system is in a mature state of development. However, it is less completely automated than some of the other AGT systems assessed by SRI. A UMI representative indicated that an improved door mechanism has been incorporated in their newer vehicles. This report includes Appendices A through C: AGT Assessment Measures; Methods of Cost Estimating and Analysis; and Chronology of Events, respectively, and a Listing of References.

NTIS ORDER NO.: PB 286-513/AS

PRICE: A04

TITLE: ASSESSMENT OF THE WEDWAY PEOPLEMOVER SYSTEM  
AT WALT DISNEY WORLD

AUTHOR: SRI International  
(A.M. Yen, et al.)

DATE: December 1977

PROJECT NO.: IT-06-0135

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KEYWORDS:

1. Automated Guideway  
Transit (AGT)
2. Passenger,  
Transportation

3. PeopleMover
  4. Planning
  5. Propulsion Systems,  
Linear Induction
- 

SRI International conducted this study as part of an assessment program sponsored by the Urban Mass Transportation Administration. The purpose of the program is to gain an in-depth understanding of the performance, capabilities, and limitations of the AGT systems at WALT DISNEY WORLD, Seattle-Tacoma International Airport, Fairlane Town Center, Tampa International Airport, Houston Intercontinental Airport, and King's Dominion Amusement Park, as well as to provide a uniformly documented presentation of automated guideway transit (AGT) installations for UMTA's AGT Socio-Economic Research Program and for use by other research groups and interested parties.

This final report, one of six site reports, describes and assesses the WEDway PeopleMover System, an automated guideway transit system used for passenger transport at WALT DISNEY WORLD in Lake Buena Vista, Florida. Information and data were collected by the authors through surveys of technical literature; formal site visits; interviews with operators, management, and engineering personnel; and a visit to the system manufacturer. The WEDway system represents the state-of-the-art in passive vehicles; it is completely passive except for its mechanical running gear. WEDway consists of a single 4,600-ft closed loop with only one station. Although it carries more than 4.5 million passengers/yr, there have been no serious accidents.

The system design of WEDway has resulted in a very reliable system. The use of a linear induction motor as the prime mover has shown efficiencies both in operation and maintenance. The authors state that although the WEDway exceeds its operational requirements, future work is necessary to explore the advantages and disadvantages of a passive system before durability of such a system is determined.

NTIS NO: PB 286-935/AS

PRICE: A05

**TITLE:** FEASIBILITY STUDY OF SHARED RIDE AUTO TRANSIT

**AUTHOR:** Cambridge Systematics, Inc. and Environmental Law Institute  
(G. Kocur, D. Zaelke, and L. Neumann)

**DATE:** September 1977

**PROJECT NO.:** IT-06-0144

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**KEYWORDS:** 1. Carpools  
2. Paratransit  
3. Private Transportation, Auto  
4. Private Transportation, Carpools  
5. Private Transportation, Drivers  
6. Ridership, Auto

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The objective of this report is to assess the feasibility of the implementation of shared-ride auto transit (SRAT), which is an innovative approach for increasing auto occupancy in rural and urban areas. The report focuses on operational concepts, potential usage, legal and regulatory issues, and institutional issues. Formulation of the SRAT concept was motivated by several concerns, such as: (1) energy conservation; (2) transit service extension to areas unable to economically justify conventional transit services, and to travel disadvantaged groups; (3) transit service replacement to achieve greater efficiency and to reduce transit deficits; (4) provision of inexpensive transit service to users; and (5) the increase of safety and reliability of hitchhiking.

Four case study sites (Boulder, Colorado; Boston, Massachusetts; Portland, Oregon; and Tidewater, Virginia), were used to identify the specific institutional issues likely to impact SRAT implementation for that site, and to identify the opportunities for designing, implementing and operating SRAT in a variety of institutional settings. The factors which might facilitate or impede SRAT implementation vary from site to site. However, a number of the same concerns may arise in each of the settings.

The report also includes Appendix A, which lists existing and proposed SRAT systems, and Appendix B, which shows the derivations of equations used in SRAT route and stop analysis.

The study recommends that SRAT can provide sufficiently high service levels. However, personal security, reliability, and social acceptance will have to be met. Also, a number of potentially serious institutional barriers to SRAT exist, but by designing the system to reflect a site's particular institutional setting, it appears that in many instances, these barriers can be overcome.

NTIS ORDER NO.: PB 276-539/AS

PRICE: A12

TITLE: AGT GUIDEWAY AND STATION TECHNOLOGY  
Volume 2: WEATHER PROTECTION REVIEW

AUTHOR: De Leuw, Cather & Company and ABAM Engineers Incorporated  
(R.D. Stevens, T.J. Nicarico, and T.J. McGean)

DATE: March 1978

PROJECT NO.: IT-06-0152

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KEYWORDS:

1. Automated Guideway Transit
  2. Guideways
  3. Power Distribution
  4. Switches and Switching
  5. Weather Effects
  6. Stations and Terminals
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This report is one of a series of reports associated with the AGT Guideway and Station Technology Project. The objective of the project is to develop guideway, station, and weather protection concepts which will reduce the cost and implementation time associated with AGT systems. This project includes a review of existing weather protection problems and techniques used in both AGT and non-AGT transportation mode applications, the development and analysis of weather protection concepts, and the testing of selected concepts. Only the review portion of the weather protection area is addressed in this report. The concept development, analysis, and testing portions are the subject of a separate volume.

This report presents a review of the experience of AGT systems under severe winter weather conditions as well as a review of the experience of non-AGT transportation modes (railroads, airports, and highways). The review material herein is a result of a literature search and interviews with personnel at operating AGT systems and manufacturers. This report focuses on bottom-supported, rubber-tired vehicle AGT systems (the only type of AGT system currently operating in a winter environment). Specifically, this means that the survey of existing AGT weather-related operating experiences focuses on the Ford Fairlane system, the Boeing Morgantown system, the Westinghouse test tracks, the Vought Airtrans system, and the Bendix Metropolitan Toronto Zoo system. Three areas were identified as having a high potential for winter weather problems: traction, power collection, and switching. None of the operating AGT systems employ power and signal rail heating. Only one of the reviewed AGT systems has experienced winter weather switching difficulties. These difficulties are primarily attributed to cold and/or ice accumulations on vehicle mounted steering components during sustained winter operation. This report contains a list of 130 winter weather related references. Conclusions and recommendations for further investigation are described herein.

NTIS ORDER NO.: PB 281-632/AS

PRICE: A07

**TITLE:** AGT GUIDEWAY AND STATION TECHNOLOGY  
VOLUME 3  
GUIDEWAY AND STATION REVIEW

**AUTHOR:** De Louw, Cather & Company and ABAM Engineers Incorporated  
(R.D. Stevens, et al.)

**DATE:** September 1978

**PROJECT NO.:** IT-06-0152

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**KEYWORDS:**

- |                 |   |
|-----------------|---|
| 1. AGT Systems  | 6. Power Distribution                       |
| 2. Contracts    | 7. Morgantown Personal Rapid Transit System |
| 3. Construction | 8. Site Selection                           |
| 4. Guideways    | 9. Stations                                 |
| 5. Planning     |   |
- 

This report is one of eight volumes associated with the AGT Guideway and Station Technology Project. The project objective is to develop guideway, station, and weather-protection concepts which will reduce the cost and implementation time associated with AGT systems and improve performance. The outputs are intended to aid planners, designers, administrators, and others interested in AGT systems and their application to specific transportation needs in urban areas.

Automated Guideway Transit (AGT) systems in the United States comprise more than 64 km (40 mi) of guideway, over 70 passenger stations, and nearly 700 vehicles. This report reviews the guideways and stations found at 30 AGT systems and purports to establish the existing state-of-the-art. Related conventional rail transit stations are briefly reviewed to supplement the AGT station material. Information presented was derived from a literature search, personal contact with system manufacturers, operators, and personal experience. This review summarizes the considerations in the design of AGT guideways and includes discussions of vehicle interface, power distribution, weather-related effects, structural alternatives, site-related effects, and ride comfort. For stations, the design considerations include station description, site relationships, and station elements. This coverage of design considerations for both guideways and stations gives an overview of the issues and illustrates them by examples from specific AGT installations. The review also includes a discussion of the codes used in the design of the structures, the construction techniques, and the contracting methods employed for the design and construction of existing AGT guideways and stations. Some conclusions presented herein are: guideways-- standardized shapes offer the most cost effective guideways; the double-tee and single-tee structures used at Morgantown and the Toronto Zoo are consistently less costly; stations--types and costs vary so greatly that no typical station can be defined. Other available report is "AGT Guideway and Station Technology, Volume 2: Weather-Protection Review," March 1978, PB 281-632.

NTIS NO.: PB 287-522/AS

PRICE: A14

**TITLE:** VEHICLE LATERAL CONTROL AND SWITCHING  
TECHNOLOGY EVALUATION MODELS STUDY PROGRESS REPORT  
COST AND WEIGHT MODEL

**AUTHOR:** Otis Elevator Company  
(C.A. Graver of General Research Corporation, and  
C.M. Fry)

**DATE:** April 1978

**PROJECT NO.:** IT-06-0156

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**KEYWORDS:**

- |  |                           |
|--|---------------------------|
| 1. Automated Guideway<br>Transit (AGT) | 5. Personal Rapid Transit |
| 2. Group Rapid Transit                 | 6. Shuttle Loop Transit   |
| 3. Life-Cycle Costing                  | 7. Switches and Switching |
| 4. Model                               | 8. Vehicle, Monitoring    |
- 

The Vehicle Lateral Control and Switching (VLACS) project has been established to investigate alternative steering and switching systems applicable to a wide variety of automated transit vehicles. The VLACS project tests include a review of existing lateral control and switching technology, detailed mathematical modeling analysis and simulation, detailed hardware studies, experimentation with alternative designs, and development of guideline specifications for VLACS systems.

A usable life-cycle cost and weight model is available for immediate application to AGT nominal designs and control alternatives from these designs. The model has incorporated the design goals delineated herein; a test case has been successfully run. This document contains a description of the cost and weight model for VLACS systems. The model is a life-cycle cost and weight model which focuses on system components which vary with lateral control option. This model is to be used to evaluate the cost and weight of VLACS design for four classes of AGT vehicles: Shuttle Loop Transit (SLT), Group Rapid Transit (GRT) large and small, and Personal Rapid Transit (PRT). Numerous illustrations and tables related to the model, its programs and subroutines, as well as a list of references are contained herein.

This report concludes that the model has been structured to allow for evolution to keep the model current and usable. Relative inflation rates will be added to this model in the immediate future, and a test case using data for the SLT nominal design will be run at General Research Corporation. The model will then be converted to Otis equipment and an updated version of this report will be prepared.

A related report is "Vehicle Lateral Control and Switching Technology, Review Study Progress Report," March 1978 (UMTA-IT-06-0156-78-1).

**NTIS NO:** PB 286-551/AS

**PRICE:** A07



**TITLE:** VEHICLE LATERAL CONTROL AND SWITCHING TECHNOLOGY REVIEW  
STUDY PROGRESS REPORT - FINAL

**AUTHOR:** Otis Elevator Company  
(G. A. Haines, C. M. Fry, T. McHugh, and J. O. Greeson)

**DATE:** March 1978

**PROJECT NO.:** IT-06-0156

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**KEYWORDS:**

1. Automated Guideway Transit, Switches and Switching
  2. Group Rapid Transit (GRT)
  3. Mathematical Modeling, VLACS
  4. Personal Rapid Transit (PRT)
  5. Shuttle-Loop Transit (SLT)
  6. Switches and Switching
- 

The Vehicle Lateral Control and Switching (VLACS) project has been established to investigate alternative steering and switching systems applicable to a wide variety of automated transit vehicle types. This project is part of the Automated Guideway Transit Technology (AGTT) development program derived from the Urban Mass Transportation Administration's experience with automated transportation systems. The objectives of the project are to: 1) reduce the cost, complexity and weight, and increase the life, reliability, maintainability, ride quality, and switching capability of VLACS systems; 2) develop specific performance requirements and guidelines for lateral control and switching systems for SLT, GRT, and PRT vehicles in trained and untrained configurations; 3) develop and evaluate baseline VLACS hardware designs reflecting project objectives; 4) provide experimental data to demonstrate capability of VLACS system and subsystem designs to meet performance requirements including line speed switching; 5) provide a comprehensive analytical evaluation of contact (mechanical) and non-contact (wire follower) lateral guidance approaches; and 6) perform an assessment of the positive retention capabilities of automatic switching systems.

The report contains descriptions of alternative VLACS technologies, a review of mathematical modeling techniques for VLACS systems, applicability of the technology to various transit vehicle classes, a summary of the characteristics of various operational transit systems, a review of ride quality criteria, and an annotated bibliography applicable to the VLACS technology review. The study provides an overview of lateral control and switching concepts which have been developed for operational and proposed systems, and the characteristics and advantages/disadvantages of those alternatives are discussed. From this review, promising VLACS designs will be selected for detailed analysis, simulation, and performance evaluation as part of the VLACS project design and analysis task. The study concludes that from a review of vehicle lateral control literature, there is still much to learn about the control of rubber-tired vehicles. The role of compensator design must be addressed and the trade-off between controller complexity, cost, reliability, and performance must be studied. Also, the work of researchers toward the application of optimal control theory must be evaluated. Optimal control theory is expected to play its most valuable role in providing a better understanding of the problem and in identifying limits of achievable performance.

NTIS ORDER NO.: PB 284-799/AS

PRICE: A08

TITLE: REVIEW OF DOWNTOWN PEOPLE MOVER PROPOSALS:  
PRELIMINARY MARKET IMPLICATIONS FOR DOWNTOWN  
APPLICATIONS OF AUTOMATED GUIDEWAY TRANSIT

AUTHOR: The MITRE Corporation, METREK Division  
(N.B. Mabee, and B.A. Zumwalt)

DATE: December 1977 PROJECT NO.: IT-06-0176

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KEYWORDS:

- |                                       |                  |
|---------------------------------------|------------------|
| 1. Automated Guideway Transit Project | 5. Guideways     |
| 2. Downtown People Movers, Proposals  | 6. Marketing     |
| 3. Information Aids                   | 7. Socioeconomic |
| 4. Center City                        | Analyses         |
- 

The Automated Guideway Transit (AGT) Socio-Economic Research Program, initiated by the Urban Mass Transportation Administration (UMTA) in 1975, is a comprehensive, multidisciplinary research effort addressing the social, economic, environmental, institutional, land use, and performance issues of AGT technology in the urban environment. A major objective of this program is to ascertain the potential market for AGT systems in the United States.

The information contained in this report has been extracted from the 38 proposals submitted by U.S. cities for consideration in UMTA's Downtown People Mover (DPM) Project in June 1976. These proposals address a range of socioeconomic considerations associated with the installation of DPM systems in central business district locations. The considerations include: application site characteristics, system ridership, system economics, past project planning, local funding sources, related transportation planning activities, related central city redevelopment activities, and environmental impacts.

This report presents a brief description of the status of AGT technology in the U.S., a summary of the project and site characteristics given in the DPM proposals, and individual summary sheets for each city. Summaries of the systems proposed by the 19 preliminary final candidate cities are also presented herein. The report concludes with a description of the remaining candidate DPM systems. No attempt was made to interpret the data provided by the cities or to evaluate the analysis techniques and results reported in the proposals.

NTIS ORDER NO.: PB 281-068/AS

PRICE: A07

**TITLE:** NATIONAL VALIDATION OF A SELECTION TEST BATTERY FOR MALE  
TRANSIT BUS OPERATORS  
Final Report

**AUTHOR:** The University of Chicago/Industrial Relations Center  
(Melany E. Baehr)

**DATE:** June 1976

**PROJECT NO.:** MA-06-0011

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**KEYWORDS:**

- |                      |                          |
|----------------------|--------------------------|
| 1. Bus Drivers       | 4. Industrial Relations  |
| 2. Employment        | 5. Public Relations      |
| 3. Human Engineering | 6. Quantitative Analysis |

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The major objectives of this research project were: 1) to establish valid procedures for the selection of applicants who would have the most potential for successful performance as bus operators in an urban transportation authority; 2) to investigate the validity and equitability of the selection procedure for applicants from all racial groups represented in the study; and 3) to investigate the applicability of the procedure for the five authorities which participated (the Metropolitan Atlanta Rapid Transit Authority, the Massachusetts Bay Transportation Authority, the Chicago Transit Authority, the Cleveland Transit System, and the Alameda-Contra Costa Transit District). Later, authorities who wished to use the procedure but who had not participated in the study were included. It was not feasible to investigate the validity of the procedure for female drivers because of the small number employed at the time the study was initiated in 1970. Therefore, the study was implemented for White, Black, and Spanish-surnamed male applicants in the participating authorities. However, a follow-up study is presently underway to validate the test battery for female operators.

Both concurrent and predictive performance-criterion validation models were employed, and within each model both primary and cross-validity coefficients were calculated. The concurrent model was implemented in the cooperating authorities with a total sample of 1,113 currently employed White, Black and Spanish operators. The predictive model was implemented in two of the five authorities with a sample of 356 White, Black and Spanish applicants who were subsequently hired. The results of the two validation models were essentially similar. Results of the implementation of the selection equation based on the total sample in the concurrent validation model indicate that the test battery rejects approximately the same percentage of applicants from each of the three racial groups.

An Appendix in the report shows a typical agenda for the two-day Workshop conducted by the Industrial Relations Center of the University of Chicago for representatives of any transit authority wishing to use the test battery. The report concludes that evidenced by survey, recruitment practices of most participating companies placed very little, if any, emphasis on minorities. At present, the companies are feeling the pressure of the past recession and now have an eligible list of people waiting to be hired. This surplus of applicants makes this validation study more imperative and urgent.

**TITLE:** DEVELOPMENT OF ECONOMIC FACTORS IN TUNNEL CONSTRUCTION  
Final Report

**AUTHOR:** Bechtel Incorporated/under contract to Transportation  
Systems Center  
(L.R. Damskey and G.T. Gin)

**DATE:** December 1977

**PROJECT NO.:** MA-06-0025

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**KEYWORDS:**

- |                          |                           |
|--------------------------|---------------------------|
| 1. BART                  | 5. Underground Structures |
| 2. Construction, Cost    | 6. Subways                |
| 3. Planning              |                           |
| 4. Tunnels and Tunneling |                           |

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The escalating cost of underground construction of urban transportation systems has made transit planning, especially construction cost estimating, difficult. This is a study of the cost of construction of underground, rapid transit tunnels in soft ground, and it is sponsored by the Urban Mass Transportation Administration's Office of Rail Technology of the U.S. Department of Transportation.

Twenty-two tunnels from the San Francisco Bay Area Rapid Transit District (BART), the Chicago Metropolitan Sanitary District, and the Washington DC, Metropolitan Area Transit Authority (WMATA) have been analyzed to determine what factors influence the Rate of Advance (ROA) through the ground. A statistical study of the factors that influence tunnel construction costs was made to determine the magnitude of the major factors involved in construction cost. Tunnel construction data on cost and resources expended was collected and used to develop relations between construction ROA and physical variables. The data is also used in an analysis of the cost impact of institutional factors such as: availability and analysis of geologic conditions; flexibility and quality of engineering specifications; conditions for obtaining right-of-way and construction and entry permits; potential contractor liability; and labor agreements. Utilization of the study results are expected to better the accuracy of cost estimating procedures for further tunnel construction.

The Appendixes contain numerous charts, tables, and figures illustrating such items as: Case History Data/format; Ring & Face Log Data/sheets; Average Weekly Progress Data/keypunch forms; Systems Calculations for estimating tunnel construction cost; Rate of Advance Calculations; Calculations for Downtime Hours; Mexico City Tunnel Data; and References.

**NTIS ORDER NO.:** PB 280-878/AS

**PRICE:** A09

TITLE: EXCITATION OF SURFACE ELECTROMAGNETIC  
WAVES ON RAILROAD RAIL

AUTHOR: University of Missouri-Rolla/under contract to  
Transportation Systems Center  
(C.A. Goben and M. Davarpanah)

DATE: March 1978

PROJECT NO.: MA-06-0025

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KEYWORDS:

1. Coupling
  2. Rail, Rapid Transit
  3. Rail, Safety
  4. Surface Electromagnetic Waves
- 

UMTA's Office of Rail Technology research programs are directed toward the improvement of urban rail transportation systems safety. This rail-transit research aims to develop an onboard, separate and independent obstacle-detection system--Surface Electromagnetic Wave (SEW)--so that rear-end train collisions can be avoided. The use of SEW for communication, control, and obstacle-detection on guided railroad systems is already underway in the United States, United Kingdom, Japan, and Canada.

SEW have been successfully used on the surface of standard railroad rail and other metallic surfaces. In this report, the preliminary investigation of the propagation properties of SEW on rail surfaces indicates that there exist applications in train-and-obstacle detection. The excitation efficiencies of two types of SEW couplers (prism and grating) are measured as functions of frequency, vertical displacement ( $h$ ) of the coupler above the rail, horizontal displacement ( $a$ ) of the coupler from rail center, pitch angle ( $\Phi$ ) of the coupler, roll angle ( $\Theta$ ) of the coupler, and yaw angle ( $\Psi$ ) of the coupler. The coupling efficiencies for both prism and grating couplers show a dependence on vertical displacement above the rail; horizontal displacement from rail center, pitch, roll, and yaw angles of the couplers. Measurements of radiation patterns are also made on the two types of SEW couplers in the area of the rail and in isolation at several microwave frequencies. The results of radiation pattern data show that to meet the FCC specification of 500  $\mu\text{V}/\text{m}$  at 100 ft from the coupler for 100 mW input, the couplers must be redesigned. Redesigning involves the use of absorbing material around the couplers to reduce the radiating power in the non-transmitting directions which exceeds the FCC limits. The data indicates that both the prism and grating couplers will operate successfully on a moving track-guided vehicle.

NTIS ORDER NO.: PB 279-853/AS

PRICE: A04

**TITLE:** GENERAL VEHICLE TEST INSTRUMENTATION MANUAL  
Operational Handbook

**AUTHOR:** U.S. Department of Transportation  
Transportation Systems Center  
(Lowell V. Babb)

**DATE:** September 1977

**PROJECT NO.:** MA-06-0025

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**KEYWORDS:**

1. Guides and Guidance
2. Instrumentation
3. Measuring and Measurements
4. Handbook
5. Vehicle, Design
6. Vehicle, Monitoring

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The Office of Rail Technology Division of the Urban Mass Transportation Administration (UMTA) Office of Technology Development and Deployment is conducting programs directed towards the improvement of urban rail transportation systems.

A General Vehicle Test System (GVTS) has been developed by the Transportation Systems Center (TSC) to facilitate rail transit vehicle testing at the Transportation Test Center, Pueblo, Colorado. This system was designed to be responsive to requirements specified in the report GENERAL VEHICLE TEST PLAN (GVTP) FOR URBAN RAIL TRANSIT CARS (PB 251-086). The GVTS system includes instrumentation, digital data acquisition and processing equipment and certain special purpose measurement system.

The purpose of this manual is to describe the instrumentation system (Part 1) of the GVTS and the standardized techniques to be employed to ensure the acquisition of valid test data using the system. The GVTS includes measurement systems for vehicle voltage, current, acceleration/vibration, pressure, temperature, displacement, strain and test reference data. Each individual measurement system is described in detail in the Appendix of this document. This document presents a system overview of the entire GVTS as well as a summary of the instrumentation systems referenced to the applicable Standard Outputs of the GVTP. It also describes signal monitor and calibration equipment and electrical shielding and grounding techniques. Descriptions of the supporting documentation file, the inventory control system, and miscellaneous system notes are also included. References are listed in this report.

A companion document, GENERAL VEHICLE TEST INSTRUMENTATION EVALUATION (PB 260-598) reports the results of evaluative tests performed on the instrumentation systems.

NTIS ORDER NO.: PB 274-543/AS

PRICE: A11

TITLE: GUIDELINES FOR IMPROVED RAPID TRANSIT TUNNELING SAFETY AND ENVIRONMENTAL IMPACT  
Volume I: Safety

AUTHOR: A. A. Mathews, Inc.  
(John D. Bledsoe and Arthur P. Chase)

DATE: January 1977

PROJECT NO.: MA-06-0025

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KEYWORDS:

1. Guidelines
  2. Safety
  3. Safety Statistics
  4. Tunneling Safety
  5. Underground Construction Safety
- 

Two of the major objectives of the Urban Mass Transportation Administration Tunneling Program are to lower subway construction costs and reduce construction hazards and damage to the environment. This study consists of a two-volume report and aims to develop guidelines for improved rapid transit tunneling safety and environmental impact, that is, this effort is directed toward underground construction applicable to modern transit subway systems in urban areas.

Volume I: Safety. Examination of construction safety regulations, tunnel construction accident data, and features of underground construction leading to unsafe work show that a systems approach to safety is required. Ten guidelines were drafted to supplement current construction safety regulations (OSHA 29CFR1926). Recommendations for further study and evaluation were made to complete the systems safety approach.

Volume II: Environmental Impact. Investigation of subway construction jobs show that at least two principles underlie treatment of environmental problems. First, planning and design should consider both short-term and permanent damage to environment, and second, a need for better communication of contractor's planned activities and public concerns so that disruptions can be minimized. Guidelines were developed along these principles and are grouped into the following categories: general; community relations; and specific environmental control techniques.

NTIS ORDER NO.: PB 271-047/AS

PRICE: A06

TITLE: GUIDELINES FOR IMPROVED RAPID TRANSIT TUNNELING SAFETY AND ENVIRONMENTAL IMPACT  
Volume II: Environmental Impact

AUTHOR: A. A. Mathews, Inc. and Alan M. Voorhees and Associates, Inc.  
(Andrew C. Lemer and C. Y. Cheng)

DATE: January 1977

PROJECT NO.: MA-06-0025

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KEYWORDS:

1. Community Relations
  2. Environment
  3. Guidelines
  4. Mitigating Techniques
- 

Two of the major objectives of the Urban Mass Transportation Administration Tunneling Program are to lower subway construction costs and reduce construction hazards and damage to the environment. This study consists of a two-volume report and aims to develop guidelines for improved rapid transit tunneling safety and environmental impact, that is, this effort is directed toward underground construction applicable to modern transit subway systems in urban areas.

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NTIS ORDER NO.: PB 271-048/AS

PRICE: A07



TITLE: IN-SERVICE PERFORMANCE AND COSTS OF METHODS TO CONTROL URBAN  
RAIL SYSTEM NOISE  
Test and Evaluation Plan - Interim Report

AUTHOR: DeLeuw, Cather and Company and Wilson, Ihrig and Associates, Inc.  
(Michael C. Holowaty and Hugh J. Saurenman)

DATE: April 1977

PROJECT NO.: MA-06-0025

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KEYWORDS:

1. Noise and Noise Control
  2. Rail, Rapid Transit
  3. Tracks and Trackage
  4. Wheels
- 

This interim report is the Test and Evaluation Plan, the second report of a study sponsored by the Rail Technology Division of the Urban Mass Transportation Administration under the technical management of the Transportation Systems Center, of a study to investigate the effectiveness of four techniques for reducing wheel/rail noise in rapid-transit systems (resilient wheels, damped wheels, wheel truing, and rail grinding) by implementing a testing program on the Market-Frankford Line of the Southeastern Pennsylvania Transportation Authority (SEPTA). The previous report covered the experimental design portion of this study (PB 257-200). The ultimate goal of this study is to provide sufficient information to allow a transit system with given track and car conditions and budgetary constraints to determine the mix of the available methods of control of wheel/rail noise which will result in the greatest overall benefit.

The purpose of this interim report is to present the test and evaluation plan of this study, that is, to detail the methods and equipment that will be used to collect, manage, and reduce the data on both acoustic performance and costs of the four noise control methods. Included are descriptions of the locations for the noise measurements, the schedule which has been set up for wheel and rail maintenance, and the survey of other transit systems which will be performed to collect information relevant to the application of the noise-control methods.

This study is designed to provide information on both the long-term and short-term costs and effectiveness of various noise abatement procedures if implemented on typical urban rail systems in the United States. This study is concerned with not only the acoustical evaluation of the four noise abatement methods, but also with the costs of the methods and the combination of the acoustical and cost data to determine the optimum combinations of abatement techniques for specific conditions. The methods to be used and the scheduling for collection of the data on wheel/rail noise are the primary topics covered in this report. This study consists of a general discussion of the program schedule, the specifics of the acoustic data collection, and a summary of the collection of the data for the cost parameters and the qualitative parameters.

NTIS ORDER NO.: PB 272-521/AS

PRICE: A04

TITLE: INSURANCE FOR URBAN TRANSPORTATION CONSTRUCTION  
Final Report

AUTHOR: Cresheim Company, Inc.  
(James E. Barrett)

DATE: June 1977

PROJECT NO.: MA-06-0025

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KEYWORDS:

1. Construction, Contracts
  2. Insurance
  3. Tunnels and Tunneling
- 

Coordinated Insurance Programs (Wrapups) are widely used in major construction projects, and their use in urban transportation projects has brought about considerable discussion and disagreement. This has led the U.S. Department of Transportation to commission a fact-finding study of the management of risks in urban transportation construction with particular reference to Coordinated Insurance Programs (CIP). CIP's came into being in the mid-1940's. It was a new idea in the way it grouped entities for rating, and this aspect of Wrapup has remained controversial. This report attempts to provide answers and descriptive information to remove the mystery and to dispel many of the myths surrounding the management of risk and the insurance programs involved in urban transportation. This report was prepared to be useful to transit authority executives and others interested in insurance and risk matters related to urban transportation construction.

This report investigates insurance programs for urban transportation construction, including subways, and establishes guidelines by which a transit authority owner can choose the insurance program which best serves the needs dictated by the conditions and factors of the specific job. An analysis of insurance programs is presented: coordinated and conventional; withholding policies; completed operations coverage; and other possible coverage combinations. Various forms of insurance are discussed, as are programs for general construction safety. Innovative variations of CIP's are explored. The results are decision-making guidelines for owners for managing risk in urban transportation construction. This report recommends that: 1) transit authority executives should involve themselves at the preliminary design state of the project in identification, measurement, and analysis of potential risk; 2) savings available through a CIP can be substantial if the project is of the correct size. Programs and projects of a size greater than \$60,000,000 should be CIP's, smaller projects should be conventional; and 3) CIP is a well-run, beneficial approach which serves well most of those interested in these projects.

The Appendices contain: 1) A Summary of Coordinated Insurance (Wrapup) Status in 50 states and the District of Columbia; 2) Glossary; and 3) Index.

NTIS ORDER NO.: PB 272-108/AS

PRICE: A06

TITLE: MARTA TUNNEL CONSTRUCTION IN DECATUR, GEORGIA--A CASE STUDY  
OF IMPACTS  
Final Report

AUTHOR: Abt Associates, Inc.

DATE: July 1977

PROJECT NO.: MA-06-0025

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KEYWORDS:

1. Forecasting
  2. Planning
  3. Qualitative Analysis
  4. Rail, Rapid Transit
  5. Tunnels and Tunneling
- 

This report is Phase II of the study: Assessment of Disruptive Effects Associated with Urban Transportation Tunnel Construction, Phase I (PB 256-848). Phase I is a theoretical study, and it developed a methodology that was intended to help forecast the impacts of urban tunnel construction. Phase II aims to test and refine the methodology developed in Phase I for the assessment of impacts. This report highlights the assessment-forecasting relationship, namely, to assess impacts and then to illustrate how those actual impacts could have been forecast.

Phase II presents a case study conducted in Decatur, Georgia, in order to assess the disruptive effects associated with the construction of rapid transit tunnels for the Metropolitan Atlanta Rapid Transit Authority (MARTA) East Line. This case study has three objectives: 1) to pilot test the assessment methodology developed in Phase I of this study; 2) to refine the methodology as a forecasting tool based on the case study findings; and 3) to develop mitigation procedures. A socio-economic profile of Decatur is presented. Impacts of the construction are considered, first in general terms and then in specific terms, by following the route of construction through Decatur for two miles from west to east. The major findings identified three causal agents as being more important than the others: the barrier effect, noise, and mud. Also identified are three groups of people that are more severely affected than the others: the retail merchants in downtown Decatur; middle class residents along a residential portion of the alignment; and the "special population" (Poor, Black, and Elderly) in a public housing project.

This report addresses "retrospective forecasting of impacts" in order to establish how the assessed impacts could have been predicted at the planning stage. The findings point out that many impacts could have been predicted through the use of a "predictive logic", and that, therefore, mitigation measures could have been taken.

NTIS ORDER NO.: PB 271-366/AS

PRICE: A07

TITLE: MUCK UTILIZATION IN URBAN TRANSPORTATION TUNNELING PROCESS  
Final Report

AUTHOR: Haley & Aldrich, Inc./under contract to Transportation  
Systems Center  
(T.K. Liu, et al.)

DATE: December 1977

PROJECT NO.: MA-06-0025

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KEYWORDS:

- |                               |                          |
|-------------------------------|--------------------------|
| 1. Construction, Materials    | 5. Subways               |
| 2. Construction, Equipment    | 6. Tunnels and Tunneling |
| 3. Guides and Guidance        |                          |
| 4. Handbook, Muck Utilization |                          |

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This study was sponsored by the Office of Rail Technology of the Urban Mass Transportation Administration of the U.S. Department of Transportation. The purpose of this study is to develop a workable approach to muck utilization for transit tunnels, including cut and cover construction. The report provides transportation system planners and engineers with the necessary information to use more efficiently the earth and rock materials produced during excavation for transportation tunnels and large excavations.

This report presents the results of a detailed investigation into the potential for muck utilization in the urban transportation tunneling process, and it documents the necessary technical and planning procedures that may be used to evaluate its utilization. Six guideline steps for muck utilization planning are presented as well as the selection of a Muck Utilization Coordinating Committee (MUCC) for implementing these guideline steps. The muck utilization planning concepts were investigated for three U.S. cities (case studies): Atlanta, Georgia; Chicago, Illinois; and Baltimore, Maryland. Additionally, a trial case study of the muck utilization guidelines was made for the Baltimore Rapid Transit System.

Other sections of this report are as follows: A summary of information obtained from a literature search of tunnel contractors, engineers, and owners; Interviews and correspondences with people in the tunneling and materials processing industries; Program of subsurface investigation; Muck utilization rationale; Handbook (developed during overall study) evaluation; and A summary of conclusions. The Appendices in this report are as follows: Respondents to Survey and Survey Form; Typical Gradation Curves for Rock Muck; Functional Steps for Program Implementation - City of Chicago Department of Development and Planning; and Report of Inventions.

NTIS ORDER NO.: PB 278-066/AS

PRICE: A17

TITLE: MUCK UTILIZATION PLANNING - URBAN TRANSPORTATION TUNNELING:  
A HANDBOOK OF RATIONAL PRACTICES FOR PLANNERS AND DESIGNERS

AUTHOR: Haley and Aldrich, Inc.  
(T. K. Liu, D. G. Gifford, and J. P. Dugan)

DATE: May 1977

PROJECT NO.: MA-06-0025

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KEYWORDS:

1. Construction Materials
  2. Excavation
  3. Muck Utilization
  4. Tunneling
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Traditionally, excavated material (muck) removed from tunnels has been considered to be waste materials of little or no value. In 1974 a study of the properties of muck generated from urban transit tunnel operations indicates that the material has great potential for re-use as an engineering material in transit and other civil works projects. This knowledge that tunnel muck is a useful by-product rather than a disposal problem generated interest and plans for utilization.

This handbook aims to alert transportation departments, transit agencies, city planners, engineers, and contractors to the potential uses of soil and rock materials encountered in transportation tunnel operations, and provides technical and administrative guidelines for using them to benefit both the transit agency and the public. This handbook documents the results of a study of alternative uses for tunnel muck including utilization of muck as backfill material within the transit project. The suggested utilization procedures are consistent with construction methods and project management.

This report discusses: 1) the benefits of muck utilization, advantages to owners, contractors, and public; 2) the potential uses of muck as a construction material, as compacted structural fill, as a sanitary landfill, and other specialized uses; 3) the estimation of type and quality of tunnel muck; 4) the planning steps (guidelines) for suitable muck utilization plans; 5) the contingencies which might develop during a tunneling project; and 6) the Muck Utilization Coordinating Committee that would be responsible for the implementation of the goals.

NTIS ORDER NO.: PB 272-139/AS

PRICE: A04

TITLE: PROCEEDINGS: SEMINAR ON UNDERGROUND CONSTRUCTION PROBLEMS,  
TECHNIQUES AND SOLUTIONS  
Chicago, Illinois, October 20-22, 1975

AUTHOR: Chicago Urban Transportation District  
(under contract to Transportation Systems Center)

DATE: December 1976

PROJECT NO.: MA-06-0025

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KEYWORDS:

1. Construction
  2. Tunnels and Tunneling
  3. Underground Structures
- 

The Urban Mass Transportation Administration (UMTA) is one of the participants in the Department of Transportation's Coordinated Tunneling Program. UMTA's assigned responsibilities in the tunneling program are carried out through the Urban Rail Supporting Technology Program Office at the Transportation Systems Center, Cambridge, Massachusetts.

The seminar on "Construction Problems, Techniques and Solutions" held at the First Chicago Center in Chicago, Illinois, on October 20-22, 1975, was organized to focus on anticipated construction problems of the Chicago Central Area Transit Project to include underground construction techniques, new technology, ground engineering techniques (underpinning, dewatering, grouting), and involved an exchange of experiences among owners, design teams, contractors, and other pertinent agencies.

This report consists of seminar presentations by representatives of the U.S., France, England, and Japan to an audience of more than 250 engineers, contractors, and administrators from the U.S. and Canada. The papers (19) prepared for this seminar follow in their entirety, and the authors are identified by their titles and associations as of October 1975. Additionally, a complete summary of the panel discussion held during the last afternoon of the seminar and moderated by Harold E. Nelson, CUTD Executive Director, is furnished because of the pertinent views that were expressed therein. This set of proceedings has been prepared because the seminar developed into a valuable summary of the state-of-the-art of urban underground construction technology, and because of the continuing requests for seminar presentation material.

The three-day seminar was funded by UMTA through the Transportation Systems Center as part of its tunneling program. These proceedings were compiled by the Chicago Urban Transportation District with funding assistance from UMTA.

NTIS ORDER NO.: PB 264-027/AS

PRICE: A19

TITLE: PROCEEDINGS - WORKSHOP ON MATERIALS HANDLING FOR  
TUNNEL CONSTRUCTION

AUTHOR: Colorado School of Mines  
(Robert R. Faddick and James W. Martin, Editors)

DATE: August 1977

PROJECT NO.: MA-06-0025

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KEYWORDS:

1. Materials Handling
  2. Tunnels and Tunneling
  3. Underground Structures
  4. Workshops
  5. Muck Transport/Haulage Systems
- 

With the anticipated increases in tunnel construction in the next decade, greater demands will be made on transportation systems to remove tunnel muck at rates consistent with tunnel excavation rates. This workshop discussed and noted that conventional materials-handling systems such as rail, rubber-tire vehicles, and conveyors will have to expand their capabilities. Simultaneously, it was noted that hybrid and lesser known systems such as pneumatic and slurry pipelines must be considered as potential systems for muck haulage, particularly since they show substantial promise of being capable of transporting the muck volumes projected for the next decade.

This workshop on "Materials Handling for Tunnel Construction" was sponsored by the Urban Mass Transportation Administration of the U.S. Department of Transportation, and it was held August 3, 4, 5, 1977, at Keystone, Colorado. The purpose of this workshop was to establish a true workshop where information and work assignments were submitted in advance to attendees with the goal of producing a definitive document at the close. Experts were invited from the construction, metal and non-metal mining industries. The participants evaluated the state of the art of materials-handling systems for underground construction, exchanged information on current systems applications and research, itemized research needs, and produced a written summary of their conclusions.

This document contains the 12 presentation papers, Questionnaire and Workshop Format, Workshop Summaries, Closing Remarks, and a List of Participants. The workshop reflects the view that major advancements in the field of materials-handling for rapid transit tunnel excavation would be implemented best by adapting ideas and techniques now used in general underground construction, metal mining, and coal mining.

NTIS ORDER NO.: PB 276-602/AS

PRICE: A13

TITLE: SYSTEMS ANALYSIS OF RAPID TRANSIT UNDERGROUND CONSTRUCTION

Volume I: Sections 1-5

Volume II: Sections 6-9 and Appendixes

AUTHOR: Bechtel, Incorporated in association with Arthur D. Little, Inc.  
(under contract to Transportation Systems Center)

DATE: December 1974

PROJECT NO.: MA-06-0025

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KEYWORDS:

- |   |                          |
|---|--------------------------|
| 1. Construction, Cost,<br>Equipment, Material | 4. Rail, Rapid Transit   |
| 2. Models                                     | 5. Tunnels and Tunneling |
| 3. Planning, Tools                            |                          |
- 

This study describes rapid transit system implementation, design and construction procedures. The relationships and responsibilities of governmental, private, and public groups involved in planning and implementing an urban rapid transit system are discussed.

In this report techniques and processes of cut-and-cover and tunnel construction are discussed in detail. Environmental impacts of this construction as well as safety and insurance aspects are presented. Physical and institutional controls (sensitivities) on construction are identified. Physical controls include such factors as utility density, traffic conditions, and weather. Institutional controls include among others, the project schedule, right-of-way acquisition, material and equipment supply, and labor agreements and productivity.

Three San Francisco Bay Area Rapid Transit (BART) projects and two Washington Metropolitan Area Transit Authority (WMATA) projects are analyzed herein with respect to time schedules, costs, and sensitivity to physical and institutional controls. These data are utilized in developing generalized models of four specific types of underground construction: cut-and-cover station, cut-and-cover line, free-air-driven tunnel, and compressed-air-driven tunnel. The models presented herein are a planning tool for evaluation of the alternative types of underground construction in a transit system with respect to local costs and physical and institutional controls. Possible future tunneling cost-reduction techniques and recommendations for further research are made.

Volume I includes sections 1 through 5; and Volume II, sections 6 through 9, and Appendixes A through F. The Appendixes are: Cost Information, Rapid Transit System Computation Program, Accident Report Summary and Report Forms, Estimated Escalation Values, English Bentonite Shield, and Report of Inventions.

NTIS ORDER NO.: Volume I: PB 275-567/AS  
Volume II: PB 275-568/AS

PRICE: A09  
A14



**TITLE:** TRACK GEOMETRY MEASUREMENT SYSTEM SOFTWARE MANUAL

**AUTHOR:** U.S. Department of Transportation/Transportation Systems Center  
(David Brownell)

**DATE:** April 1978

**PROJECT NO.:** MA-06-0025

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**KEYWORDS:**

1. Computer Applications
  2. Rail Transit, Tracks and Trackage
  3. Sensors
  4. Tracks and Trackage, Geometric Measurement
  5. Tracks and Trackage, Quality Control
  6. Transportation System Management
- 

The Urban Mass Transportation Administration, Technology Development and Deployment, Office of Rail Technology, sponsors programs directed toward improving urban rail transportation systems. The Transportation Systems Center supports UMTA by providing systems management and technical support for the Urban Rail Supporting Technology Program (URSTP) in the design, construction, and operating of UMTA test facilities; the analysis and testing of vehicles, components, and guideways; and the development of key technological data and systems. The Track Geometry Measurement System (TGMS) described herein was developed under the URSTP to provide rail properties with the capability of automatically measuring four track geometry parameters in real-time with equipment that can be installed on their own vehicle, and to aid transportation planners and maintenance personnel to better assess the quality of track for rapid, light, and commuter rail systems.

The purpose of this manual is to describe the TGMS real-time software and to provide operating instructions for its use. The system is adaptable to any resident vehicle on any rail transit system. Since the sensor equipment is designed to be installed on any vehicle, the "footprint" recorded is representative of the vehicle that actually travels the track being inspected. The TGMS dynamically measures those geometric parameters of track which affect ride quality, noise, and operational safety. All parameters are processed in real-time on board the vehicle using a UNIVAC 1616 digital computer. The system is designed to operate at revenue speeds ranging from 20 to 80 mph and the specific parameters measured by the TGMS include rail gage, alignment, profile and cross level. The parameters are defined herein and are discussed in detail and sections on track geometry techniques and on the sensor system are discussed as background for the program. The report gives a description of the three major TGMS subsystems and their interrelationships. Other discussion in the report includes the system software programs used in the TGMS and operating instructions for implementing the software programs. Appendices A through I are the details of engineering applications and software listings peculiar to the TGMS. Appendix H is a glossary of terminology.

NTIS ORDER NO.: PB 285-558/AS

PRICE: A06

TITLE: THE TRANSPORTATION OF TUNNEL MUCK BY PIPELINE

AUTHOR: Colorado School of Mines/under contract to the  
Transportation Systems Center  
(Robert R. Faddick and James W. Martin)

DATE: January 1978

PROJECT NO.: MA-06-0025

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KEYWORDS:

- |                         |                         |
|-------------------------|-------------------------|
| 1. Muck Haulage Systems | 5. Tunneling            |
| 2. Pneumatic Pipeline   | 6. Dewatering Equipment |
| 3. Hydraulic Pipeline   | 7. Crushing Equipment   |
| 4. Conveyor Belt        | 8. Survey               |
- 

This study was sponsored by the Office of Rail Technology, Office of Technology Development of the Urban Mass Transportation Administration of the U.S. Department of Transportation, and it was conducted under contract with the Transportation Systems Center for the Urban Rail Supporting Technology Program.

The view reflected herein is that if the advancement of the technology of muck removal does not keep pace with advances in tunneling machine technology, muck removal can become the limiting constraint on the forward movement of the tunnel face, and hence on the growth of tunneling. The objective of this study is to advance the technology of tunnel excavation by increasing the rate of muck removal from the tunnel face. The highlights in this report are on muck haulage systems by pipeline, and the emphasis is on investigating better techniques and technology, rather than costs.

This report updates muck quantities and to some extent, muck quality (in terms of its hardness and geology). Crushing equipment is examined more thoroughly as is extensible conveyor belt equipment. A survey of extensible equipment is made to aid in suggesting approaches for their application in tunnels to pipeline muck haulage. Recent headloss data for coarse slurries are presented for the hydraulic muck haulage system. Consideration is given to a jet pump eductor for feeding a centrifugal pump from a mixing tank. A more compact and less expensive dewatering system is also analyzed. Appendixes A through D provide background material for the systems and concepts herein and include: Pneumatic Pipeline Systems, CONOCO-CONSOL System, Dewatering Equipment, and Coal Hoisting in the U.K. A previous and related study, "Pneumatic-Hydraulic Material Transport System for the Rapid Excavation of Tunnels" (DOT-TSC-75-17), suggested a transportation system for muck haulage with a pneumatic pipeline or a slurry pipeline.

NTIS ORDER NO.: PB 281-103/AS

PRICE: A08

TITLE: IMPACT EVALUATION OF MORGANTOWN PRT 1975-1976 RIDERSHIP:  
INTERIM ANALYSIS  
Final Report

AUTHOR: Transportation Systems Center  
(Mary D. Stearns and K. H. Schaeffer)

DATE: June 1977

PROJECT NO.: MA-06-0026

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KEYWORDS:

1. Automated Guideway Transit
  2. Morgantown PRT
  3. Personal Rapid Transit
  4. Ridership
  5. Universities
- 

The Morgantown Personal Rapid Transit System (PRT) is a new type of public transportation system which was built as a research development and demonstration project by the Urban Mass Transportation Administration of the U.S. Department of Transportation. This system began passenger service in October 1975 and consists of three stations, 2.1 miles of two-lane guideway, and a 45-vehicle fleet. The Pre-PRT Phase of this Impact Evaluation (January-June 1975) recorded travel patterns and ridership by all modes prior to the initiation of PRT passenger service. The Pre-PRT Phase consists of three separate volumes: Volume I: Travel Analysis (PB 254-481); Volume II: Data Collection Procedure and Coding Manual (PB 254-482); and Volume III: Frequency Tabulations from Four Transportation Related Surveys (PB 254-483). The Post-PRT Phase of this Impact Evaluation Study has been postponed until January 1977.

This Interim Analysis report describes the Morgantown PRT system ridership levels and trends during its initial period of operation, which was the 1975-1976 academic year. This analysis is a part of the ongoing, multi-year, Morgantown PRT Impact Evaluation. It measures the impact on ridership of seven operating characteristics: fleet mileage, actual operating hours, system availability, trip reliability, vehicle availability, downtime frequency, and downtime duration. Data were obtained from West Virginia University Management reports on daily ridership, and system operation and analysis includes statistical tests and multivariate statistical procedures.

The findings show that ridership by day of the week was proportionately similar throughout the 1975-1976 academic year, that a substantial amount of the inter-weekly ridership variance is due to the university schedule, and that weekend ridership was similar throughout the time period. This report concludes that the PRT is a significant transportation mode for routine travel and that ridership is highly responsive to quantity of service offered.

NTIS ORDER NO.: PB 270-916/AS

PRICE: A05

TITLE: A COMPREHENSIVE FIELD TEST AND EVALUATION OF AN ELECTRONIC  
SIGNPOST AVM SYSTEM  
Final Report

AUTHOR: Hoffman Information Identification, Inc.  
(George W. Gruver)

DATE: August 1977

PROJECT NO.: MA-06-0041

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KEYWORDS:

- |  |                     |
|--|---------------------|
| 1. Automatic Vehicle Location System   | 5. Fixed-Route AVM  |
| 2. Automatic Vehicle Monitoring System | 6. Paratransit      |
| 3. Direct Proximity                    | 7. Random-Route AVM |
| 4. Electronic Signpost                 | 8. Taxis            |
- 

In September 1976, the Transportation Systems Center of the U.S. Department of Transportation entered into contracts with four companies for the design, development, and deployment of a multi-user Automatic Vehicle Monitoring (AVM) System which can be deployed in any city in the United States. This report contains the interim results obtained by one of the contractors, Hoffman Identification, Inc., and covers the activities of Phase I which involved the installation and test of a HI3 AVM system in Philadelphia, Pennsylvania, during the winter of 1976-1977. A summary report on all systems tested is available and titled: "Experiments on Four Different Techniques for Automatically Locating Land Vehicles" (PB 270-951).

Phase I tests were divided into two primary categories: 1) random-route tests (police, paratransit, taxi, etc.) and 2) fixed-route (transit). Special case tests, a third category, are also described and results are presented in this report. In the random-route tests, the system showed the capability of locating the vehicle to within 282 feet, at 95 percent of the sample points under a wide range of urban and environmental conditions. In the fixed-route tests, an odometer and 15 signposts provided the vehicle's location to within 105 feet, at 95 percent of the sample points along a 13-mile route. The time of passage of designated bus schedule "timepoint" was automatically determined to within 11 seconds, 95 percent of the time. Phase I consists of two volumes. Volume I: Test Results contains a description of all test configurations, test procedures, location algorithms, data processing, and test results. Volume II: Appendix to this report contains the test log sheets, test data, and detailed data processing results corresponding to all Phase I tests. The results presented in the Phase I report show that the HI3 AVM system proposed for Phase II can provide a transit dispatcher with the location of all buses to within an accuracy of 105 feet, 95 percent of the time. Phase II will include the design, development, implementation, test, and operational support of a modern transit management system using a reliable, economical AVM system.

NTIS ORDER NO.: Volume I: PB 272-907/AS  
Volume II: PB 273-436/AS

PRICE: A15  
A15

TITLE: EXPERIMENTS ON FOUR DIFFERENT TECHNIQUES FOR AUTOMATICALLY  
LOCATING LAND VEHICLES  
A Summary of Results

AUTHOR: Transportation Systems Center  
(Bernard E. Blood and Bernd W. A. Kliem)

DATE: June 1977

PROJECT NO.: MA-06-0041

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KEYWORDS:

1. Automatic Vehicle Monitoring Systems
  2. Bus
  3. Research, Activities
  4. Vehicle, Monitoring
- 

As one element in its overall program to develop and deploy new technologies for the improvement of urban transportation, the Urban Mass Transportation Administration of the U.S. Department of Transportation has sponsored research on Automatic Vehicle Monitoring (AVM) Systems as an evolving technology that offers potential in the near term for improving levels of service and reducing operating costs in bus-transit systems.

The experimental work summarized in this Phase I report was carried out in Philadelphia by Fairchild Space and Electronics Company, Hazeltine Corporation, Hoffman Information Identification, Inc., and Teledyne Systems Company, each under separate contract to the Transportation Systems Center (TSC). Phase I of this program was completed in March 1977. The Phase I objective was to formally test four different vehicle-location concepts against a technical performance specification prepared by TSC. Phase II of the AVM program will involve the selection of one of the tested location methods, the detailed design of an overall AVM system, and its deployment in a major urban area for test and evaluation in bus-transit and police operations.

During the winter of 1976-1977, four different technical methods for automatically locating surface vehicles were tested in both high and low-rise regions in Philadelphia, Pennsylvania. The tests were designed to evaluate the methods for their applicability as location subsystems of AVM systems. Two "signpost" concepts, one utilizing semi-passive transponders and the other utilizing active transmitters, as well as two "area-coverage" concepts, one employing Loran-C and the other employing a pulse trilateration method, were tested. This report outlines the experimental objectives, summarizes the test results, and presents major findings. The tables in this report chart out the Fairchild Test Results, the Hazeltine Test Results, the Hoffman Test Results, and the Teledyne Test Results. The Appendices contain: 1) a Statement of the Multiuser AVM Location Subsystem Performance Specification; 2) Location Subsystem Techniques; and 3) Basis of AVM Performance Specification.

NTIS ORDER NO.: PB 270-951/AS

PRICE: A04

TITLE: LORAN AUTOMATIC VEHICLE MONITORING SYSTEM, PHASE I  
Volume I: Test Results  
Volume II: Appendices

AUTHOR: Teledyne Systems Company  
(under contract to Transportation Systems Center)  
(R. Stapleton and F. Chambers)

DATE: August 1977

PROJECT NO.: MA-06-0041

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KEYWORDS:

1. Automatic Vehicle Monitoring (AVM)
2. LORAN-C
3. Fixed-Route
4. Vehicle, Monitoring
5. Paratransit

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In September 1976, the Transportation Systems Center of the U.S. Department of Transportation entered into contracts with four companies for the design, development, and deployment of a multi-user Automatic Vehicle Monitoring (AVM) System which can be deployed in any city in the U.S. During the winter of 1976-1977, four different techniques for automatically locating land vehicles were tested in both the low and high-rise regions in Philadelphia, Pennsylvania. This document contains the results obtained by one of the contractors, Teledyne Systems Company, and covers the activities of Phase I which involved the installation and test of the LORAN AVM System in Philadelphia. A summary report on all four systems tested is available and titled: EXPERIMENTS ON FOUR DIFFERENT TECHNIQUES FOR AUTOMATICALLY LOCATING LAND VEHICLES (PB 270-951).

This volume, Phase I, presents the results of the evaluation phase of a two-phase program to develop an AVM system for the Southern California Rapid Transit District in Los Angeles, California. Phase I tests were divided into three categories (random-route, fixed-route, and special cases) and are described herein. Performance characteristics measured include location accuracy, time of passage accuracy, and coverage. LORAN-C is an electronic navigation system that enables the user to determine very precisely his position anywhere within the designated coverage area. Currently the coverage area is more than 16 million square miles and additional coverage can be provided at any time through the addition of a portable LORAN transmitter station. It is this electronic grid which provides the basic location capability for Teledyne's LORAN vehicle location system.

The test results demonstrated that the LORAN AVM system is a leading candidate for the area-wide multi-user system under consideration. The LORAN AVM system has demonstrated its ability to meet fixed-route accuracy requirements. A method for meeting the time of passage and random-route accuracy requirements is presented herein. Phase I consists of two volumes: Volume I: Test Results and Volume II: Appendices. In Phase II the system will be fully developed and put into operational status at the Southern California Rapid Transit District in Los Angeles.

NTIS ORDER NO.: Volume I: PB 274-955/AS  
Volume II: PB 274-956/AS

PRICE: A13  
A08

**TITLE:** REPORT ON PHASE ONE TESTS OF FAIRCHILD AUTOMATIC VEHICLE MONITORING (AVM) SYSTEM

**AUTHOR:** Fairchild Space & Electronics Company  
(A.J. Pokorny and H. Briefel)

**DATE:** August 1977

**PROJECT NO.:** MA-06-0041

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**KEYWORDS:**

1. Automatic Vehicle Monitoring (AVM)
  2. Location Subsystems
  3. Electronic Signposts
  4. Fixed-Route
  5. Random-Route
- 

During the winter of 1976-77 four different techniques for automatically locating land vehicles were tested in both the low and high-rise regions in Philadelphia, Pennsylvania. The tests were carried out by four different companies under separate contract to the U.S. Department of Transportation, Transportation Systems Center. These tests were designed to evaluate the four techniques for their applicability as location subsystems for automatic vehicle monitoring (AVM) systems. A summary report on all four systems is available and titled: EXPERIMENTS ON FOUR DIFFERENT TECHNIQUES FOR AUTOMATICALLY LOCATING LAND VEHICLES (PB 270-951).

This document contains the results obtained by one of the contractors, Fairchild Industries, and covers the activities of Phase I which involved the instrumenting of a section of downtown Philadelphia with approximately 140 signposts. Part of the allocated section was used for conducting tests applicable to fixed-route (transit) systems, and part was used for random-route applications (police cars, taxis, paratransit, etc.). In addition to the Philadelphia tests a series of separate engineering tests were performed at the Fairchild Plant in Germantown, Maryland. This Fairchild Industries report states that the complete exercise served a two-fold purpose: 1) it proved the reliability of AVM systems and, 2) it performed as an invaluable learning tool from which all parties will profit.

This report states that as a result of the excellent performance accuracies achieved during the field testing, and the technological and production improvements being developed as a result of Fairchild Industries' intensive IR and D program, substantial cost reductions in the capital investment necessary to implement a Fairchild Location System will result.

NTIS ORDER NO.: PB 273-816/AS

PRICE: A09

TITLE: FLYWHEEL PROPULSION SIMULATION  
Final Report

AUTHOR: Alexander Kusko, Inc.  
(Charles M. King and Alexander Kusko)

DATE: May 1977

PROJECT NO.: MA-06-0044

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KEYWORDS: 1. Flywheels  
2. Propulsion Systems, Electric  
3. Vehicle, Monitoring  
4. Models

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Development of a bus propelled by a flywheel instead of by an engine or storage battery has long interested urban transportation planners. The kinetic energy stored in a flywheel supplants the need for petroleum-derived fuels and minimizes negative environmental impacts. Flywheel-driven vehicles depend on fossil-fuel, nuclear, or hydroelectric central station power. They have no emission fumes and low noise levels. A flywheel is a spinning disc which stores kinetic energy. Carried on board a rubber-tired vehicle, it can be charged or recharged using electric power at selected wayside station.

This report was prepared in support of the Urban Mass Transportation Administration's program in flywheel energy storage. This report develops and describes the analytical models and digital computer simulations that can be used for the evaluation of flywheel-electric propulsion systems employed with urban transit vehicles operating over specified routes and with predetermined velocity profiles. The computer simulation is divided into two sections. The first section simulates the dynamic behavior of the vehicle enroute, computes the energy and power requirements, and the power losses of each of the propulsion system components. The second section utilizes thermal models to compute the temperature rises of each of the propulsion system components. The simulations can be used to determine the suitability of a given flywheel-electric propulsion system for an intended mission. This report can be used for evaluating the degree to which the configuration of major components and the component ratings selected for a proposed propulsion system will optimize its performance. The modeling techniques herein can be applied to conventional battery-powered as well as flywheel electric-drive systems, and to any vehicle operating from wayside power. This report can be considered both an evaluation tool and a design tool.

The Appendices contain Mathematical Models, Input Constants for Computer Program, Parameter Listing for Computer Program, Tabular Outputs for Sample Run (One Round Trip), Manufacturers' Data for Major Components, and Report of Inventions.

NTIS ORDER NO.: PB 272-259/AS

PRICE A09



**TITLE:** A LIMITED INVESTIGATION INTO REGENERATIVE BRAKING AND  
ENERGY STORAGE FOR MASS TRANSIT SYSTEMS  
Final Report

**AUTHOR:** Charles Stark Draper Laboratory, Inc.  
(David Eisenhaure and Stephen O'Dea)

**DATE:** March 1978

**PROJECT NO.:** MA-06-0044

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**KEYWORDS:**

1. Brakes and Braking, Regenerative
  2. Energy Storage
  3. Flywheels
  4. Life Cycle Costing, Subways
  5. Subways, Life Cycle Costing
  6. Subways, Wayside Energy Storage
- 

This study examines the technical and economic aspects of a regenerative braking/flywheel energy storage subway system. In order to define the analytical models accurately, it was necessary to gather data on the trains, rail network, schedules, and ancillary equipment. Data on projected costs of flywheels, motors, rails, and other equipment were also gathered for use in the economic analysis. During this data gathering phase, it was decided that the Massachusetts Bay Transportation Authority (MBTA) Red Line would be the source of the most representative and complete data. The problem was to determine what, if any, combination of energy storage devices and high conductivity rails would yield a subway system with a lower life cycle cost. The primary goal of the study was to compare the system costs of wayside storage with those of on-board storage. Using data provided by MBTA, power levels versus time and rail losses were calculated and used to determine the sizing and location of energy storage units. From the amounts of energy storage required, the costs of the flywheels and i/o equipment were calculated. Utilizing these modules for load leveling was also considered. However, since the energy storage required for load leveling is much greater than that required for regenerative braking, a separate study is needed to examine this in detail.

The study indicates that for systems with station densities and traffic patterns similar to the MBTA Red Line, the inclusion of wayside flywheel modules has a significantly lower first cost, and can be justified on a purely economic basis. It was found that a wayside flywheel module could have a payback period as short as two years. The use of high conductivity (aluminum/steel) rails in conjunction with this storage would allow the elimination of four flywheel modules over the section of rail studied. Their inclusion can be further justified by the long term social advantages of energy conservation, such as reduced environmental impact and less foreign dependence. The study also indicates that wayside flywheel storage has economic advantages over competitive regenerative schemes, in particular, the on-board flywheel storage. However, further study should be undertaken to determine the most economical wayside storage modules for more general use, since there are differences in requirements within the MBTA system and other transit systems. This report addresses recommendations for future study, contains a bibliography, and Appendices A and B: "Vehicle Energy Requirements" and "Report of Inventions", respectively.

NTIS ORDER NO.: PB 284-611/AS

PRICE: A03

TITLE: ANALYSIS OF SHORT RAMPS FOR DUAL-MODE AND PRT STATIONS  
Final Report

AUTHOR: Transportation Systems Center and Alden Self-Transit  
Systems Corporation  
(R. D. Wright and R. P. Whitten)

DATE: July 1977

PROJECT NO.: MA-06-0048

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KEYWORDS:

- |                               |                           |
|-------------------------------|---------------------------|
| 1. Automated Guideway Transit | 5. Personal Rapid Transit |
| 2. Computer Applications      | 6. Ramps                  |
| 3. Dual-Mode                  | 7. Safety                 |
| 4. Headways                   | 8. Stations               |
- 

This report is the result of continuing efforts to understand the safe-headway trade-offs for Personal Rapid Transit (PRT) and dual-mode systems. It adds a new dimension to the traditional interactions among control complexity, safety, and acceleration. The work reported herein was performed by the Alden Self-Transit Systems Corporation and the Transportation Systems Center (TSC) of the U.S. Department of Transportation. TSC's primary participation was in the areas of the vehicle-follower computer program, the plotting routines, and the supplying of computer time on the Center's PDP-10. Alden's primary participation was the point-follower studies, the basic vehicle-follower equations and the analysis and design of the demonstration.

Analyses and computer programs are developed to determine how short it is possible to make the ramps leading into and out of off-line PRT stations. Simplified reference solutions are obtained and results are presented for state-of-the art, improved, and advanced system parameters. Potential savings in the costs of stations are very large, due to the high construction cost of station ramps.

Both point-follower and vehicle-follower control systems are considered. For point-follower control systems, the acceleration ramp can usually be eliminated. The deceleration ramp can usually be greatly shortened, particularly if main guideway headway is sufficient for successive cars to enter a station. The speed of through cars is not affected. For vehicle-follower control systems, small deviations in the speed of through cars allows both acceleration ramps and deceleration ramps to be appreciably shortened. The greater the velocity deviation, the shorter the ramps can be, limited only by the comfort, convenience, and time-loss limits on the through cars.

NTIS ORDER NO.: PB 272-351/AS

PRICE: A06

TITLE: AUTOMATED GUIDEWAY TRANSIT SERVICE  
AVAILABILITY WORKSHOP  
October 6-8, 1976

AUTHOR: Transportation Systems Center  
(C.W. Watt, Editor)

DATE: February 1978

PROJECT NO.: MA-06-0048

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KEYWORDS:

- |  |                       |
|--|-----------------------|
| 1. Automated Guideway Transit<br>Systems | 4. Rail Rapid Transit |
| 2. Life-Cycle Costing                    | 5. Workshops          |
| 3. Personal Rapid Transit                |                       |
- 

The Service Availability Workshop, sponsored by the Urban Mass Transportation Administration and arranged by the Transportation Systems Center, was held at Andover, Massachusetts, on October 6, 7, and 8, 1976. The workshop consisted of four panel sessions: Service Availability Definitions; Operator Experience in Operational Systems; Theoretical Aspects of AGT Service Availability; and User-Manufacturer Relationships. The workshop presented a wide spectrum of informed opinion on how to specify, predict, design, and measure the effectiveness of automated guideway transit systems.

This document contains the papers and remarks presented at the four panel sessions, the comments made during the question and answer period that followed, and a list of attendees. Minor editing was applied to the remarks presented and the discussions generated during the workshop sessions to provide continuity and clarity.

The discussions illustrated the wide spectrum of meaning currently given to the term "service availability." The positions taken by representatives of the various portions of the transit industry--properties, designers, researchers, and manufacturers--showed the variety of ways in which system performance is specified and evaluated today, and the reasons for such a variety.

NTIS ORDER NO.: PB 282-295/AS

PRICE: A17

**TITLE:** EFFECTS OF DECELERATION AND RATE OF DECELERATION ON LIVE SEATED HUMAN SUBJECTS

**AUTHOR:** Transportation Systems Center  
(C. N. Abernethy, G. R. Plank, and E. D. Sussman)

**DATE:** October 1977

**PROJECT NO.:** MA-06-0048

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**KEYWORDS:**

1. Automated Guideway Transit, Deceleration
  2. Deceleration Maximums
  3. Safety, Passenger
  4. Seats and Seating
- 

This report describes the testing of live, seated human subjects to determine the maximum deceleration and associated rate of change of deceleration (jerk) at which the majority of potential users of Automated Guideway Transportation Systems can remain securely in their seats. The study was designed to determine deceleration levels necessary to dislodge these passengers under normal seating conditions and to determine the optimum deceleration and jerk levels which will maximize the passenger flow rate while minimizing injuries to the passengers caused by decelerations. These typical seating, passenger, and stopping conditions suggested the choice of independent variables which were seat orientation (forward-facing, side-facing), seat tilt (normal, 5 degrees back), jerk level (low, high), and subject size (small, large). Under each set of conditions, the subjects, large and small, underwent various levels of deceleration and associated jerk in an instrumented vehicle. Switches placed in the seat pan indicated when the subject became dislodged from the seat.

The two groups of subjects chosen to represent anthropometric extremes of potential passengers were males larger than 90 percent of the male population, and females smaller than all but 10 percent of the female population. Based on these tests, an estimate of the maximum permissible emergency deceleration for forward-facing, seated AGT passengers is 0.47 g, and 0.41 g for side-facing passengers. The tests also indicated that tilting the entire seat assembly backward 5 degrees increased the estimated maximum permissible deceleration to 0.52 g. The tests support the use of forward-facing, back-tilted seating to permit high decelerations with a low incidence of passenger dislodgement. The small observed differences in the data obtained under different rates of change of deceleration are not attributable to treatment effects; nor are the small differences observed between the two different sizes of subjects. The study maintains that the results of this research should be cautiously applied as no attempt was made to distinguish independently among the effects, if any, of subject age, sex, and size. Although no significant effects of jerk were found, further studies of jerk should not be precluded.

NTIS ORDER NO.: PB 284-653/AS

PRICE: A03

TITLE: PROCEEDINGS OF WORKSHOP ON METHODOLOGY FOR EVALUATING  
THE EFFECTIVENESS OF TRANSIT CRIME REDUCTION MEASURES  
IN AUTOMATED GUIDEWAY TRANSIT SYSTEMS

AUTHOR: Transportation Systems Center  
(Editors: Walter Hawkins and E. Donald Sussman)  
(Contributors: B. Greenberg, D. Mackinnon, J. Marino,  
R. Pawlak, V. Rouse, and P. de Vise)

DATE: July 1977

PROJECT NO.: MA-06-0048

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KEYWORDS:

1. Automated Guideway Transit (AGT)
  2. Crime
  3. Security
  4. Vandalism
  5. Workshops
- 

The U.S. Department of Transportation/Urban Mass Transportation Administration, Office of New Systems and Automation sponsored a security workshop conducted by the Transportation Systems Center. The purpose of this workshop was to discuss methodologies for evaluating the effectiveness of transit crime and vandalism reduction measures which can be used on Automated Guideway Transit (AGT) Systems. Senior transit security staff, transit security researchers, and transit planners contributed papers and participated in this workshop.

The workshop focused on current methods of assessing the effectiveness of crime and vandalism reduction methods that are used in conventional urban mass transit systems, and on how they might be applied to new AGT systems. Conventional as well as novel methods of assessment were presented and discussed. Among the major issues discussed were the use of critical incident techniques to assess the community's needs with regard to transit security; the establishment of a board similar to the National Transportation Safety Board, which will focus on security issues; and the role of security specialists and management in transit planning.

The information presented herein should be of interest to transit security planners and researchers, law enforcement agencies, planners of AGT systems, and to those people who are concerned in general with the problems of crime and vandalism in transit systems.

NTIS ORDER NO.: PB 273-695/AS

PRICE: A06

TITLE: ATLANTA WHEELCHAIR ACCESSIBLE BUS STUDY  
Final Report

AUTHOR: Transportation Systems Center  
(Grant Paul and Robert Casey)

DATE: August 1978

PROJECT NO.: MA-06-0049

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KEYWORDS:

- |                               |                    |
|-------------------------------|--------------------|
| 1. Bus, Fixed-Route           | 6. Vehicle, Design |
| 2. Bus, Wheelchair Accessible | 7. Wheelchairs     |
| 3. Elderly                    |                    |
| 4. Handicapped                |                    |
| 5. Subscription Services      |                    |
- 

This report is one of a series of studies of wheelchair accessible bus implementations sponsored by the Service and Methods Demonstrations Office of the Urban Mass Transportation Administration of the U.S. Department of Transportation. The paper is based on a site visit and discussions with several individuals in the Atlanta area.

This document describes the implementation and operation of Metropolitan Atlanta Rapid Transit Authority's fixed-route, subscription service for handicapped individuals. Operational characteristics, including the early months of service, are presented as well as pictures and charts depicting the MARTA L-BUS vehicle, floor layout, lift design, lift operation, safety features, wheelchair securement, and problem areas. The subscription service, initiated in May 1977, began with a single bus operating three daily routes and has grown to seven buses operating 27 daily and two weekly routes. The buses are all lift equipped and most have 4 wheelchair positions and seventeen seats. As of May 1978, ridership has increased from 41 to 270 passenger trips per week.

New routes are established by grouping trip origin and destination requests into vehicle tours. At least four handicapped passengers must be able to be served in a single tour before that route is incorporated into the system. The dispersion of the desired trip origins and destinations has resulted in low productivities and in high passenger trip costs. The net direct operating cost, excluding the extra deadheading due to special garaging requirements, was \$12.54 per passenger trip for the first seven weeks of service with only very light reductions since that time. The major difficulty that users experience with the lift equipment has been getting onto the lift platform unaided. However, with the driver/others to assist them, their usage of the system has not been restricted. Mechanically, the lift equipment has performed better than the Authority's maintenance staff expected.

NTIS ORDER NO.: PB 285-938/AS

PRICE: A04

TITLE: COM-BUS: A SOUTHERN CALIFORNIA SUBSCRIPTION BUS SERVICE  
Final Report

AUTHOR: CACI, Inc. - Federal (under contract to Transportation Systems  
Center)  
(Chester H. McCall, Jr.)

DATE: May 1977

PROJECT NO.: MA-06-0049

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KEYWORDS:

1. Bus, Commuter
  2. COM-BUS
  3. Management, Operations and Techniques
  4. Subscription Services
  5. Travel Demand
- 

COM-BUS, as a self-sustaining subscription commuter bus service, has gained national recognition as one of two such services (the other being the Reston Commuter Bus Service from Reston, Virginia, to work destinations in the metropolitan Washington, D.C. area). COM-BUS is an outstanding example of private entrepreneurship entering the transit field and providing a service which continues to meet passenger demands at better than a 90 percent load factor and at a profit. COM-BUS provides this weekday work trip service through contracts with several charter bus companies. This document analyzes current COM-BUS operations, service management, and evolution. Supply, demand, and attendant productivities are discussed, and COM-BUS service characteristics and their potential transferability to other locales are set forth in this report.

COM-BUS is a privately owned organization operating at a profit without any form of subsidy. COM-BUS serves approximately 2,000 commuters per day on 47 routes which provide service in Ventura, Los Angeles, and Orange counties. A majority of the routes use chartered passenger buses with 38 to 47 seats. A fleet of eight 13 to 16-passenger minibuses are used on routes where demand is insufficient to warrant the larger buses. Service provides a fairly personalized morning pickup, with major portions of the runs to work destinations being express and using freeways. In the evening, passengers are picked up at their work locations, and runs to their initial origins are accomplished. Because of its method of management operations, COM-BUS maintains subscription levels (weekly seat reservations paid for in advance) at better than 90 percent. COM-BUS was organized and now operates with a minimum of capital outlay, and is managed by essentially volunteer support.

Travel times using COM-BUS are only slightly longer than those for private automobiles making the same trips. COM-BUS fares are considerably less than corresponding costs to operate a private automobile for a similar trip. The success of COM-BUS is important in view of the current heavy subsidies required for most transportation systems, and in view of the tendency of Southern California commuters to reject mass transit and to use private means instead.

NTIS ORDER NO.: PB 272-470/AS

PRICE: A06

**TITLE:** A COMPARATIVE ANALYSIS OF RESULTS FROM THREE RECENT NON-SEPARATED  
CONCURRENT-FLOW HIGH OCCUPANY FREEWAY LANE PROJECTS: BOSTON,  
SANTA MONICA AND MIAMI  
Final Report

**AUTHOR:** Transportation Systems Center  
(Howard J. Simkowitz)

**DATE:** June 1978

**PROJECT NO.:** MA-06-0049

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**KEYWORDS:**

- |                    |                                 |
|--------------------|---------------------------------|
| 1. Buses, Cost     | 6. Traffic Analysis, Congestion |
| 2. Buses, Express  | 7. Traffic Analysis, Control    |
| 3. Busways         | 8. Traffic Analysis, Flow       |
| 4. Carpools        | 9. Traffic Analysis, Peak-Hour  |
| 5. Lanes, Reserved | 10. Vehicles, High-Occupancy    |

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In order to move more people in fewer vehicles with limited capital investment, priorities for High Occupancy Vehicles (HOV) have been developed and implemented over the past several years. This study focuses on one of the options of HOV: non-separated concurrent-flow high occupancy lanes on freeways. Reserved lanes exist or have existed on Routes 101 and 280 in San Francisco, the Santa Monica Freeway in Los Angeles, the Banfield Freeway in Portland, the Southeast Expressway in Boston, I-95 in Miami, and the Moanalua Freeway in Honolulu. One freeway lane with an average occupancy of 1.3 persons per car can carry only 2600 persons per hour. When the occupancy is increased to 4 persons, the hourly person rises to 8000. However, the idealized outcomes have not been realized by reserved lane projects. Through a comparative analysis of results of the three most recent concurrent-flow projects: the Southeast Expressway, I-95, and the Santa Monica Freeway, this paper attempts to develop a better understanding of the issues that surround the reserved lane concept. These three sites were chosen because they represent recent experiments with the concept and because of their substantial differences. The issues addressed in this report are: 1) changes in travel times on the freeways and in transit level of service; 2) modal shift to carpooling and transit; 3) capital and operating costs; 4) changes in accidents and incidents, violation rates, and enforcement; 5) the public's attitude towards the reserved lane concept, the effect of advertising and media reports, and the role of politics; and 6) the design and operating environment appropriate to the concept.

The three projects met with differing degrees of success and failure, and those in Boston and Los Angeles have been terminated. Carpooling increased by about 70 percent and travel times for those using the lanes decreased. The weaknesses in the concept were the large number of violators and the difficulty of enforcement, the potential for accidents, the inability of the lanes to attract large numbers of new bus riders and carpoolers, and the political problems associated with removing an existing lane from general use. The evidence indicated that there should be a median strip between the two directions of flow and a permanent barrier between the reserved and regular lane access points. The study presents recommendations for future HOV priority projects. A Listing of References is contained herein.

NTIS ORDER NO.: PB 289-278/AS

PRICE: A04



TITLE: THE DOUBLE DECK BUS DEMONSTRATION PROJECT  
EXECUTIVE SUMMARY

AUTHOR: CACI, Inc. - Federal/under contract to Transportation  
Systems Center\*  
(C.H. McCall, Jr. and Howard Simkowitz\*)

DATE: May 1978

PROJECT NO.: MA-06-0049

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KEYWORDS:

1. Demonstrations
2. Double Deck Bus
3. Evaluation
4. High Occupancy Vehicle
5. Site Selection
6. Vehicle, Design

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This Executive Summary is one of three separate documents that constitute an evaluation of the Double Deck Bus (DDB) Demonstration Project sponsored by the Urban Mass Transportation Administration. The demonstration project was conducted in two cities, Los Angeles and New York (July 1974 through June 1977). The primary objective at the two sites was to assess potential increases in vehicle productivity in an express, limited busway service (L.A.) and in regular service (NYC). DDB carry from 68 to 84 passengers; conventional buses carry from 45 to 47 passengers. Both buses require a single transit employee, the driver.

In New York City, eight British Leyland double deckers operated on two Manhattan routes characterized by congested traffic, heavy passenger loads, frequent stops and frequent passenger turnover. Only seven months of revenue service data were analyzed, due to delays in manufacturing and in satisfying United States safety and environmental requirements. In Los Angeles, two types of service were provided by the two German Neoplan buses: during morning (CBD bound) and evening (suburb bound) peak periods, a park-and-ride express run utilizing approximately 15 miles of an exclusive express busway; and an all day revenue service run between Los Angeles CBD and the suburban community of Pomona. Eleven months of revenue service were analyzed, due to the necessity to correct original manufacturing deficiencies in both double deck buses. The evaluation considers passenger acceptance and perceptions of the DDB vis-a-vis the conventional bus. Statistics are presented on schedule adherence, dwell times, passenger throughput, vehicle reliability, on-board safety, repair and maintenance costs/capacity mile and fuel and oil consumption rates. It was concluded that: foreign production line vehicles, the Leyland and the Neoplan, should have been treated as prototypes and undergone extensive on-site testing and re-design before they were produced as standard production line vehicles and accepted for revenue service--this procedure is recommended for all future purchases of double deck vehicles; and experience with these vehicles has aided manufacturers and transit operators in the development of vehicle specifications appropriate for the American market.

NTIS NO.: PB 287-838/AS

PRICE: A03

TITLE: EVALUATION OF SERVICE AND METHODS DEMONSTRATIONS PROJECTS:  
PHILOSOPHY AND APPROACH  
Interim Report

AUTHOR: Transportation Systems Center  
(Mark Abkowitz, Carla Heaton, and Howard Slavin)

DATE: May 1977

PROJECT NO.: MA-06-0049

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KEYWORDS:

1. Management, Operation and Techniques
  2. Paratransit
  3. Socio-Economic Analysis
  4. Transportation Disadvantaged
  5. Travel Demand
- 

The Urban Mass Transportation Administration's (UMTA) Service and Methods Demonstration (SMD) Program has the objective of improving existing transit operations by sponsoring the development and implementation of new techniques and services on a nation-wide basis. The SMD Program pursues demonstration projects and studies in four major program areas: Traffic Management; Paratransit; Service for Transit Dependents; and Price and Service Improvements. An important aspect of the SMD Program is the performance of technically sound and objective evaluations of the individual demonstration projects. Under UMTA sponsorship, the Transportation Systems Center (TSC) of the U.S. Department of Transportation, conducts a broad program of demonstration evaluation, evaluation methodology development, and research in support of these activities. At present, TSC has technical and programmatic responsibility for a program of demonstration evaluation.

This document contains a summary description of the philosophy and technical approach underlying the evaluation of SMD projects. It describes the supply-demand framework for performing urban transportation impact evaluation and the application of this framework to the following demonstration topics: 1) background and setting; 2) project implementation and operations; 3) level of service (supply) changes; 4) travel behavior (demand) changes; 5) operator impacts and productivity; and 6) non-travel impacts.

The SMD Program attempts to maximize the quality and utility of information gained from the demonstrations by developing and employing a consistent, carefully structured approach to demonstration evaluation. Each evaluation is built around the basic analytical framework described in this report, with emphasis placed on using state-of-the-art data collection and analysis techniques which are consistent from the standpoint of efficiency, accuracy, and output.

NTIS ORDER NO.: PB 271-005/AS

PRICE: A02

TITLE: EVOLUTION AND OPERATIONS OF THE RESTON VIRGINIA  
COMMUTER BUS SERVICE  
Final Report

AUTHOR: CACI, Inc. - Federal for Transportation Systems Center  
(Robert E. Furniss)

DATE: August 1977

PROJECT NO.: MA-06-0049

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KEYWORDS:

1. Bus, Commuter
  2. Bus, Express
  3. Management, Operations and  
Techniques
- 

This report focuses on documenting and assessing the evolution and operations of the Reston Commuter Bus (RCB). RCB is a good example of a community group overcoming many legal, regulatory, and institutional constraints to develop and refine a viable commuter bus service for community residents. The success of the RCB experience has addressed issues of national concern in transportation, namely, the feasibility of community-based organizations providing effective transit services without public subsidy. The RCB approach to commuter bus service is of potential interest and applicability to other communities across the country. For these reasons, UMTA conducted this review and assessment of RCB under the aegis of UMTA's Service and Demonstration Program.

RCB is a community-based nonprofit corporation which operates a non-subsidized, weekday, peak-period express commuter bus service operating between Reston, Virginia, and Washington, D.C., area employment centers. RCB is managed essentially by volunteer support. Since 1968 RCB has contracted with public and private carriers to operate the service. The current RCB service is supplied by a private carrier. This report examines the current RCB service operations, the development of the service and the organization, as well as ridership, cost, and productivity data. It addresses the viability of RCB service in terms of the contractual costs of transportation weighed against the revenue generated by system ridership. System productivity is addressed over time by comparing actual and breakeven load factors. Finally, an assessment is performed to draw conclusions on the RCB experience as well as to extract transferable elements which may be of use in other locales.

RCB has grown from a single charter bus run in 1968 to its present size in 1976 of approximately 70 daily bus runs. The monthly ridership has increased from approximately 1,000 in March 1968 to more than 43,000 in February of 1976.

NTIS ORDER NO.: PB 275-792/AS

PRICE: A07

TITLE: MODELING DEMAND-RESPONSIVE FEEDER SYSTEMS  
IN THE UTPS FRAMEWORK

AUTHOR: Multisystems, Inc. (under subcontract to Cambridge Systematics,  
Inc./under contract to Transportation Systems Center)  
(H.R. Menhard, M. Flusberg, and L.S. Englisher)

DATE: July 1978

PROJECT NO.: MA-06-0049

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KEYWORDS:

- |  |                    |
|--|--------------------|
| 1. Demand-Responsive<br>Transportation | 4. Fixed-Route     |
| 2. Integrated Transit/<br>Paratransit  | 5. Models          |
| 3. Paratransit                         | 6. Planning, Tools |
|  | 7. UTPS            |
- 

In recent years, considerable attention has been focused on the use of demand-responsive transportation (DRT) systems to provide feeder service in low density areas. For the transit planner considering alternative future transit designs, there has been little in the way of analytical tools available to assess the impact of DRT systems. The intent of this report is to provide the Urban Transportation Planning System (UTPS) user with a methodology for incorporating DRT feeder systems in transit network analysis. The focus is on the use of DRT systems to provide feeder services to fixed transit routes in low density areas. A methodology for considering such services within the framework of UTPS modeling is presented .

A set of previously developed DRT supply models, representing many-to-many service, many-to-one cycled service, and many-to-one subscription service have been refined for the purposes of this report. These services are discussed and general guidelines for designing feeder services offered. The models themselves are described in detail (Appendix A), and program listings provided (Appendix C). In addition, a series of nomographs (Appendix B) based on model results have been developed to enable the analyst to predict the service levels of DRT feeder systems under a range of conditions. Examples of the use of these nomographs, and the overall approach to modeling DRT feeder systems within UTPS, are also included in Appendix B. This report also provides a bibliography and a glossary of terms.

NTIS ORDER NO.: PB 285-763/AS

PRICE: A08

TITLE: PRE-DEMONSTRATION ACTIVITIES OF THE WESTPORT INTEGRATED  
TRANSIT SYSTEM  
Interim Report

AUTHOR: CACI, Inc. - Federal  
(Robert E. Furniss)

DATE: July 1977

PROJECT NO.: MA-06-0049

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KEYWORDS:

1. Demand-Responsive Transportation
  2. Demonstration Project
  3. Shared-Ride Taxi
  4. Taxis
  5. Transportation Brokerage System
- 

In August 1976, the Urban Mass Transportation Administration (UMTA) of the U.S. Department of Transportation awarded a demonstration grant to the Westport Transit District (WTD) to examine the feasibility of combining shared-ride taxi service and other paratransit services with conventional bus services in Westport, Connecticut. This report documents and assesses the services to be provided and the planning and implementation process associated with this demonstration.

The Westport Demonstration addresses three objectives of the Service and Methods Demonstration Program of UMTA: 1) increased transit coverage; 2) increased transit vehicle productivity; and 3) improved transit service for the transit dependents. In addition, the Westport Demonstration emphasizes local taxi operator involvement in providing a shared-ride taxi service under the central management control of a public transit district. This paratransit service is integrated with the conventional fixed-route bus transit services provided by the WTD. Inherent in this project is the concept of a public transit authority acting as a transportation broker, contracting for services, serving as an agent to balance transportation supply and demand in a productive manner, and overseeing day-to-day operations.

This report focuses on documenting and assessing the brokerage role performed by the WTD in implementing shared-ride services. The contents include a discussion of the institutional and operational elements involved in contracting with local taxi operators to provide shared-ride service. In addition, arrangements for system maintenance, marketing, and public information dissemination are described. Implications from the Westport pre-demonstration experience are potentially of interest and applicability to other locales.

NTIS ORDER NO.: PB 271-998/AS

PRICE: A05

**TITLE:** THE RESTRAINT OF THE AUTOMOBILE IN AMERICAN RESIDENTIAL NEIGHBORHOODS  
Final Report

**AUTHOR:** Moore-Heder Architects (under contract to Transportation Systems Center)  
(Howard Simkowitz, Lajos Heder, and Edward Barber)

**DATE:** May 1978

**PROJECT NO.:** MA-06-0049

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**KEYWORDS:**

1. Auto Restricted Zones
2. Automobile Restraint, Residential
3. Human Factors
4. Parking, Regulations
5. Parking, Residential

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This paper reviews two techniques for restraining the use of the automobile: residential parking permit programs and traffic restraint devices. Residential parking permit programs are initiated in situations where parking by non-residents interferes with the parking needs of residents or with other neighborhood needs related to the environment, safety, and aesthetics. Traffic restraint devices are physical measures placed on residential streets to inhibit the flow of through-traffic and to divert this traffic to designated streets on the periphery of the protected area. While both of these approaches are aimed at restraining the use of the automobile in residential areas, they have little in common so far as appearance or specific purpose. For this reason, they are treated separately in this study. The first half of this paper discusses parking policies, the causes of the parking problem, the effects it has on the neighborhood and its residents, and the potential solutions. The focus is on the parking permit as a solution to this problem. Implementation, boundary problems, visitor permits, the relationship to rapid rail stations, and legal decisions are discussed. A summary of parking policies in 40 communities and case studies for Cambridge, MA, San Francisco, CA, and Washington DC are provided. The second half of the paper is devoted to the use of traffic restraint devices in residential neighborhoods. It discusses the problem of through-traffic and its negative effects on a residential neighborhood. Traffic restraint devices are singled out as the most readily available short-term solution to the problem, and issues related to their implementation and effectiveness are discussed. Traffic restraint devices that are used in the United States are described and the use of devices in 37 communities and case studies for Berkeley, CA and Seattle, WA are summarized. The report concludes that despite the problems related to the definition and treatment of boundaries, the issuance of visitor permits, and the adverse impacts on rapid transit and shopping accessibility, resident parking permit programs have become a popular means of restraining the use of the automobile in residential areas. The existing programs have been successful in accomplishing their state goals in which parking has been made available to local residents, non-resident traffic has been reduced, and the neighborhood environment has been improved. Most of the traffic restraint schemes have occurred in relatively less dense cities with grid street patterns and sufficient reserve street capacities to accommodate the diverted traffic without causing serious congestion.

**TITLE:** SAN DIEGO WHEELCHAIR ACCESSIBLE BUS STUDY  
Interim Report

**AUTHOR:** Transportation Systems Center  
(Robert F. Casey)

**DATE:** September 1977

**PROJECT NO.:** MA-06-0049

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**KEYWORDS:**

1. Buses, Cost
  2. Buses, Design
  3. Elderly
  4. Handicapped
  5. Transportation Disadvantaged
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This study was performed as part of a series of wheelchair accessible bus implementation. It describes the implementation and early operation of a pilot project of fixed-route, wheelchair accessible bus service. An update of the information contained in this paper is planned in the near future.

In 1976, a bus wheelchair lift was developed that met the safety and reliability requirements of the San Diego Transit Corporation (SDTC). As a result, the SDTC implemented a pilot program to demonstrate the need for this service. Two heavily patronized routes were selected which would: 1) offer a good destination choice set for handicapped and elderly; 2) serve areas where a reasonable number of handicapped and elderly might live; and 3) fit a four lift bus operation with reasonable headways.

During the first week of lift bus service, ridership averaged slightly less than two trips per day. Shortly thereafter, ridership had dropped to about one person per week. The factors that explain this include: 1) a lack of advertising of the lift service due to budget constraints; 2) the limited origins and destinations served by wheelchair buses; 3) the difficulty of accessing the bus stops or destinations near the stops due to street curbs and hilly terrain; 4) the competition from social service agency transportation services and from the City of San Diego Dial-A-Ride; and 5) the initial unreliability of the service due to late delivery of some of the vehicles and the absence of a back-up vehicle when the lift design improvements were being incorporated. In this study all relevant aspects of the current operation are covered, such as service and equipment, level of service, economics, demand, impacts, attitudes, and implications for transferability. The report also contains Appendix A, which is a Dial-A-Ride Passenger Survey. The conclusion of the study is that the lift is workable and is being continually improved as testing and operating experience is gained. However, a true measure of handicapped and elderly ridership will not be determined until a major portion of the external travel barriers are removed. Consequently, high initial ridership by the disabled should not be expected by cities contemplating or implementing this type of service.

NTIS ORDER NO.: PB 281-087/AS

PRICE: A03

TITLE: THE SANTA MONICA FREEWAY DIAMOND LANES  
Volume I: Summary  
Volume II: Technical Report

AUTHOR: SYSTAN, Inc. (under contract to Transportation Systems Center)  
(J. W. Billheimer, R. J. Bullemer, and C. Fratessa)

DATE: September 1977

PROJECT NO.: MA-06-0049

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KEYWORDS:

- |                    |                                 |
|--------------------|---------------------------------|
| 1. Buses, Express  | 5. Traffic Analysis, Congestion |
| 2. Busways         | 6. Traffic Analysis, Control    |
| 3. Carpools        | 7. Traffic Analysis, Flow       |
| 4. Lanes, Reserved | 8. Traffic Analysis, Peak-Hour  |

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The Santa Monica Freeway connects the City of Santa Monica and downtown Los Angeles. On March 16, 1976, the median lane in each direction of a 12-mile, 8-lane segment of the Freeway was reserved for the exclusive use of buses and carpools. These lanes, known locally as the Diamond Lanes, operated during the peak hours of traffic flow, and marked the first time preferential lanes had been created by taking busy freeway lanes out of existing service and dedicating them to the exclusive use of high-occupancy vehicles. The lanes operated amid much controversy for 21 weeks until August 9th, when the U.S. District Court in Los Angeles halted the project and ordered additional environmental studies prior to its continuation. This report summarizes the findings of the official, objective, independent evaluation of the project. It addresses a broad range of project impacts in the following areas: traffic speeds and travel times; traffic volumes and carpool information; bus operations and ridership; safety and enforcement; energy and air quality; media coverage; public response; and political and legal involvement. It also lists general suggestions for planning and implementing future preferential lane projects.

Much of the controversy surrounding the Diamond Lanes consisted of conflicting claims regarding the ability of the project to accomplish its stated objectives of conserving energy, improving air quality, and expanding effective freeway capacity by increasing the occupancy of buses and automobiles using the freeway. The project succeeded in increasing carpool ridership by 65% and the increased bus service accompanying the Diamond Lanes caused bus ridership to more than triple. Nonetheless, energy savings and air quality improvements were insignificant, freeway accidents increased significantly, non-carpoolers lost far more than carpools gained, and a heated public outcry developed which has delayed the implementation of other preferential treatment in Southern California, and has given planners and public officials in other areas ample cause for reflection before attempting similar projects. The final report has been published in two volumes: Volume I, The Summary, which contains an Executive Summary and Chapter 1 (a topic-by-topic condensation of the Technical Report), and Volume II, The Technical Report, which contains an Executive Summary, Chapters 2 through 10, and Appendices.

NTIS ORDER NO.: Volume I: PB 286-567/AS  
Volume II: PB 286-568/AS

PRICE: A07  
A22



TITLE: SERVICE AND METHODS DEMONSTRATION PROGRAM  
Annual Report

AUTHOR: Transportation Systems Center  
(Donald Kendall, et al.)

DATE: April 1977

PROJECT NO.: MA-06-0049

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KEYWORDS:

- |                           |                         |
|---------------------------|-------------------------|
| 1. Bus, Priorities        | 4. Guidelines           |
| 2. Demonstration Projects | 5. Handicapped          |
| 3. Elderly                | 6. Urban Transportation |
- 

This report contains a description of the Service and Methods Demonstration Program. Recently completed and current and future demonstration projects are described and project results from similar demonstrations are compared. The comparisons are made by grouping projects according to the program objectives addressed, which are: 1) decrease travel time; 2) increase transit reliability; 3) increase transit coverage; 4) increase transit vehicle productivity; and 5) improve the mobility of transit dependents.

Independent activities carried out in support of the demonstrations are described, such as the development of evaluation guidelines and improved methodologies for demonstration evaluation, analytical studies in support of the development of experimental demonstrations, studies of independent local innovations, and case studies of transit operations in small communities. Information dissemination mechanisms and activities intended to facilitate more widespread knowledge of effective approaches to improving transit are discussed.

NTIS ORDER NO.: PB 270-673/AS

PRICE: A24

**TITLE:** SOUTHEAST EXPRESSWAY HIGH OCCUPANCY  
VEHICLE LANE EVALUATION REPORT  
Final Report

**AUTHOR:** U.S. Department of Transportation/  
Transportation Systems Center  
(Howard Simkowitz)

**DATE:** May 1978

**PROJECT NO.:** MA-06-0049

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**KEYWORDS:**

1. Bus, Express
  2. Carpools
  3. Evaluation
  4. Lane, Reserved
- 

Unlike other reserved lane projects, implementation of the express lane on Boston's Southeast Expressway was timed to coincide with the mandatory reconstruction of portions of the roadway. The reserved lane was introduced as an action necessary to avoid total chaos on the Expressway. The purposes of this evaluation report were: 1) to measure the impacts of the project; 2) to identify measures to improve the operation of the Southeast Expressway reserved lane; and 3) to be able to make comparisons with other reserved lane projects to better understand the concept.

A non-separated concurrent-flow lane was instituted on the Expressway 4 May 1977. Construction of the roadway began in June 1977 reducing capacity at that point by 25 percent. This report describes the project development, implementation, and operations, and it addresses impacts in the following areas: travel times and alternate routes; transportation system use patterns; cost of express lane operation; violations, enforcement, and safety; and institutions and attitudes. By the end of the project the Expressway was carrying eight percent fewer people while the number of automobiles had declined 16 percent, reflecting a 71 percent increase in the number of carpools. Bus ridership increased by only 5 to 6 percent while ridership on rapid rail increased by 12 percent. The violation rate fell from 80 percent to 35 percent when enforcement was initiated. Enforcement proved to be an unpopular change in project operations.

Although the Southeast Expressway project was unexpectedly cancelled (2 November 1977) due to public criticism and lack of public support, the author concludes that the project's primary goal--to alleviate the potential congestion caused by the roadway reconstruction--was achieved.

NTIS ORDER NO.: PB 285-209/AS

PRICE: A04

**TITLE:** STREETS FOR PEDESTRIANS AND TRANSIT: EXAMPLES OF TRANSIT MALLS  
IN THE UNITED STATES  
Phase I - Final Report

**AUTHOR:** Crain & Associates (under contract to Transportation Systems Center)  
(David Koffman and Richard Edminster)

**DATE:** August 1977

**PROJECT NO.:** MA-06-0049

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**KEYWORDS:**

1. Cities, Improvement
  2. Malls, Pedestrian
  3. Malls, Transit
  4. Pedestrians
  5. Urban Development and Planning
- 

A transit mall is a street which has been improved for pedestrian use, but which retains a roadway reserved for transit vehicles integrated with the city-wide or regional transit system. This study focuses on transit malls that carry regular metropolitan transit routes, rather than on primarily pedestrian malls which use shuttle buses or trams. The study is intended to acquaint the planning community with the concept of transit malls, and to provide information about several of the most important and interesting projects to a wider audience. This is Phase I of a two-phase project. The second report, Phase II, is in preparation, and will be more analytical in nature, seeking to quantify the potential advantages and disadvantages of transit malls and to identify the circumstances which justify their construction.

The projects and plans of 6 cities (Minneapolis, MN; Philadelphia, PA; Portland, OR; Madison, WI; New York, NY; and Denver, CO), are described in detail in this report. These details include: 1) site descriptions including general geographic and demographic conditions; 2) general traffic/transit characteristics; 3) description of project streets before and after construction - including design characteristics, traffic/transit/pedestrian use, and funding; and 4) project histories. Where available, results such as indicators of transportation service and economic impact are presented. The text also includes a chapter which presents a comparison of the planning framework for each of the six transit malls.

The report contains a discussion of the contextual elements of mall development such as existing transportation services and the economic and political climates. Included is a description of the planning process itself, the gathering of support and opposition, the selection of alternatives, and the appearance and resolution of "bottlenecks" in the process. Together, these contextual and planning elements constitute project histories which should prove useful to other communities considering the transit mall idea.

NTIS ORDER NO.: PB 278-487/AS

PRICE: A09

**TITLE:** SUBSIDIZED TAXI PROGRAMS FOR ELDERLY AND HANDICAPPED PERSONS  
IN THE SAN FRANCISCO BAY AREA

**AUTHOR:** Crain and Associates  
(Pamela Bloomfield and Sydwell Flynn)

**DATE:** September 1977

**PROJECT NO.:** MA-06-0049

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**KEYWORDS:**

1. Elderly
  2. Handicapped
  3. Subsidies
  4. Taxis
  5. Transportation Disadvantaged
- 

This report examines subsidized taxi systems serving elderly and handicapped persons in six locations in the San Francisco Bay Area. The systems studied are San Leandro, Santa Clara County, Sunnyvale, Palo Alto, Lafayette, and Fremont. These systems are designed to deliver taxi service at a reasonable cost to target groups residing within the program areas. The objectives of this report are: 1) to describe six programs which deliver transportation service to elderly and handicapped persons utilizing the subsidized taxi mode; 2) to identify the essential similarities and differences among these programs; 3) to illustrate, in qualitative terms, the nature of the costs, efficiencies and impacts on taxi operators, subsidizers, and users of the six approaches; and 4) to interpret this information and identify those findings which appear to be transferable to planners in other localities.

The analysis is gathered from available existing data concerning the six programs studied as well as the perceptions of the administrators, taxi providers, and clients. In all locations, the subsidized taxi programs are successfully delivering transportation service to elderly and handicapped residents as evidenced by rising client enrollment and ridership volumes. Overall, response to the programs has been and continues to be extremely favorable. Also, the service furnishes additional revenues for the taxi providers, and evens out fluctuations in the demand for service during their base period. The subsidized taxi system offers much promise as a means of delivering service to most elderly and handicapped individuals.

NTIS ORDER NO.: PB 281-474/AS

PRICE: A04

TITLE: PARATRANSIT LABOR ISSUES

AUTHOR: Harvard University/under contract to  
Transportation Systems Center  
(Carter Brandon)

DATE: February 1978

PROJECT NO.: MA-06-0054

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KEYWORDS:

1. Labor, Costs
  2. Paratransit, Integration
  3. UMTA Act, Section 13(c)
  4. Unions, Wage Standards
- 

All paratransit services are labor intensive, second only to conventional taxis among transportation modes. As such, the manner in which the service is provided, the role of the labor force, and, in particular, the compensation afforded to drivers, have significant impact on the cost of system operation. The author believes that the establishment of dual labor standards for conventional and paratransit drivers, a precedent which has been set in Cleveland and Delaware, would fundamentally improve the future prospect of paratransit in large urban areas.

This report looks into paratransit labor costs as they relate to type of service, union affiliation, management strategies, and characteristics of the system location. Labor costs are analyzed in terms of wage scales, benefits, incentive payments, work rules, scheduling practices, and job definitions. The transit labor costs are analyzed separately from paratransit labor costs, and the relationship between the two is explored. Interwoven into this discussion of paratransit labor costs is a study of the cost impact of Section 13(c) of the Urban Mass Transportation Act. (This statute protects the employment conditions of transit employees against any adverse effects that may arise out of Federal transit assistance.)

This report concludes that real growth in paratransit over the coming years could effect the establishment of dual union wage standards for paratransit and conventional operators. Although the future of paratransit in small rural communities appears secure, the uncertainty and the high labor costs found in the larger cities make its future there more tentative. Greater cooperation is recommended between all levels of government, transit managers, and transit labor unions to further the development of paratransit labor standards and of integrated paratransit services.

NTIS ORDER NO.: PB 280-206/AS

PRICE: A05

TITLE: SHARED-RIDE TAXI COMPUTER CONTROL SYSTEM REQUIREMENTS STUDY  
Interim Report

AUTHOR: DAVE Systems (under contract to Transportation Systems Center)  
(G. J. Fielding, et al.)

DATE: August 1977

PROJECT NO.: MA-06-0054

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KEYWORDS:

1. Computer Programming
  2. Demand-Responsive, Dial-A-Ride
  3. Paratransit
  4. Schedules and Scheduling
  5. Taxis
- 

Shared-Ride Taxi (SRT) service refers to the sharing of the same taxi by two or more passengers with different origins and/or destinations. The technical problem of scheduling and routing SRT service is so great that only computers can handle it efficiently. This study is concerned with defining the requirements of such a computer system.

The major objective of this study is to develop the system requirements and perform a functional design of the Computer Control System (CCS) for an automated shared-ride taxi system. A SRT operation using a CCS offers a potential for increased taxi dispatching efficiency, improved driver productivity and profitability, improved quality of service, integration of taxis into areawide transit, and improved mobility for the transportation disadvantaged.

This interim report describes progress on the study, and indicates major findings to date. It is an executive-level summary, and it does not attempt to include all information or justify all statements. Rather, it is an overview of accomplishments leading to a concluding section which outlines preliminary system design requirements. These requirements are subject to change since the work in many areas is not yet complete.

The Appendices contain a Bibliography and a Report of Inventions.

NTIS ORDER NO.: PB 275-335/AS

PRICE: A04

TITLE: ASSESSMENT OF OPERATIONAL AUTOMATED  
GUIDEWAY SYSTEMS - JETRAIL

AUTHOR: Transportation Systems Center  
(G. Anagnostopoulos et al)

DATE: December 1977

PROJECT NO.: MA-06-0067

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KEYWORDS:

- |                               |               |
|-------------------------------|---------------|
| 1. Automated Guideway Transit | 5. Evaluation |
| 2. Demand-Responsive          | 6. Airport    |
| 3. Group Rapid Transit        | 7. Monorail   |
| 4. Jetrail                    |               |
- 

As part of the Urban Mass Transportation Administration's continuing Automated Guideway Technology Assessment Program, the Transportation Systems Center of the U.S. Department of Transportation has conducted an assessment of the Braniff International Airlines Jetrail system located at Love Field in Dallas, Texas.

This report is an assessment and evaluation of Jetrail, the first operational completely automated, demand-responsive, group-rapid, intra-airport transportation system. Braniff Airlines installed Jetrail for their passengers and guests. Jetrail connects a parking lot at the entrance to Love Field and the Braniff terminal with three-quarters of a mile of double-lane monorail and has ten suspended vehicles, a maintenance facility, and three stations. The system was intended to retain passengers in the face of increased congestion at Love Field. Jetrail operated successfully from April 1970 to January 1974, at which time Braniff moved to the new Dallas-Fort Worth Regional Airport. Over six million passengers were carried 1.3 million miles over this four-year period without a fatality or major mishap. The system did this in spite of the engineering novelty and early, low reliability of the propulsion and control systems.

The Jetrail system continues to be used as an engineering test-bed for a prototype linear induction motor propulsion system. This latter system, called Astroglide, is being developed by PRT Systems Inc. Since the motor has no moving parts, it is markedly simpler than the rotary motor and drive train of the Jetrail system.

This report provides information on the Jetrail operational experience and the Astroglide prototype for transportation planners, designers, developers, and operators of automated transit systems for intra-airport, urban, recreational, and freight applications.

NTIS ORDER NO.: PB 278-521/AS

PRICE: A13

**TITLE:** DEVELOPMENT/DEPLOYMENT INVESTIGATION OF CABINTAXI/CABINLIFT SYSTEMS  
Final Report

**AUTHOR:** Transportation Systems Center and SNV Studiengesellschaft  
Nahverkehr mbH  
(V. J. Hobbs, W. Heckelmann, N. G. Patt, and J. H. Hill)

**DATE:** December 1977

**PROJECT NO.:** MA-06-0067

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**KEYWORDS:**

1. Automated Guideway Transit
  2. Guideways
  3. Models and Modeling
  4. Vehicle, Design
- 

This study presents the results of an investigation of the Cabintaxi/Cabinlift Automated Guideway Transit (AGT) systems under development in The Federal Republic of Germany. It was conducted under a bilateral agreement between the U.S. Department of Transportation and the German Federal Ministry of Research and Technology, and was carried out jointly by The Transportation Systems Center (TSC) and The Studiengesellschaft Nahverkehr mbH (SNV), during the Fall of 1976 and Spring of 1977. It is one of several domestic and foreign assessments of AGT systems being conducted by UMTA. The Cabintaxi/Cabinlift system is a technological concept designed for versatile application to a cross section of transportation needs, rather than a specific system designed for a particular application at a predetermined site. This report therefore (which is available in both German and English), describes the overall design and development philosophy adopted by the manufacturers, the existing and planned technology and system concepts, the development experience to date, and the costs and performance levels achieved through several years of design refinement and test track experience. The system has not been deployed for use by the general public, with the exception of a single-vehicle shuttle system installed between two hospital buildings in Ziegenhain, Germany. Appendix A provides a brief description of the technology of this system.

The purposes of this study are to: (1) gather and exchange information on Automated Guideway Technology to better understand the state of technological advancement and to obtain synergistic improvements for future development; (2) review problems and solutions encountered during the design, development, implementation, and operation of AGT systems in order to improve the process based on experience; (3) obtain information on engineering, economic, operational performance, and public response which can be used in planning AGT systems; and (4) provide urban planners with information which will enable them to determine the applicability of AGT systems to their specific transportation problems.

The system concept is still evolving. Most of the components have reached a high level of maturity, while the technical development of others has just begun. The system has broad flexibility for application.

NTIS ORDER NO.: PB 277-184/AS

PRICE: A18



**TITLE:** THE DEVELOPMENT OF A COMPUTER SYSTEM FOR THE COST-EFFECTIVE MAINTENANCE OF RAIL EQUIPMENT IN URBAN MASS TRANSIT SYSTEMS  
Final Report

**AUTHOR:** Boston University, School of Management  
(J.D. Herniter, S.R. Rosenthal, and U.P. Welam)

**DATE:** June 1977

**PROJECT NO.:** MA-06-0073

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**KEYWORDS:**

- |  |                        |
|--|------------------------|
| 1. Computer                              | 5. MASSTRAM            |
| 2. Information Aids                      | 6. Models and Modeling |
| 3. Maintenance                           | 7. Rail, Equipment     |
| 4. Management, Operations and Techniques |                        |
- 

This document is intended as a management oriented guide to the rail vehicle maintenance scheduling problem and to the new model (MASSTRAM) developed for evaluating such schedules. This final report outlines and discusses a three phase project for the development of a conversational computer system for the cost-effective maintenance of heavy equipment in urban mass transit systems. Phases I and II consisted of operations analysis of maintenance activities at selected properties with a concentration on maintenance procedures at the Massachusetts Bay Transportation Authority (MBTA). Phase III consisted of the development of a model, called MASSTRAM (Maintenance Analysis and Scheduling System for Transit Management).

A new model, called MASSTRAM, has been designed to be compatible with whatever information system a transit property uses for collecting and storing information on vehicle maintenance and repair activities. MASSTRAM has the ability to evaluate the cost and service loss implications of any specified maintenance strategy, given the prevailing maintenance/breakdown relationships. In addition the model can be used to generate an "optimal" preventive maintenance schedule, i.e., one with the least cost of a given expected level of fleet service disruptions. A "User's Manual" has been written for MASSTRAM containing detailed explanations of all the options available. MASSTRAM is now operational. MBTA plans to incorporate MASSTRAM in their Computerized Maintenance Records System when their system is completed. The values of MASSTRAM rest with the use to which it is put by transit management and staff, and with the ability of existing information systems to provide the model with up-to-date accurate information in the required formats.

The other two MASSTRAM reports are: "User's Manual for MASSTRAM" (PB 285-450) and "MASSTRAM Source Listing" (PB 285-451).

**NTIS NO:** PB 285-449/AS

**PRICE:** A09

TITLE: AUTOMATED GUIDEWAY TRANSIT WORKSHOP ON PERFORMANCE MEASURES, EVALUATION TECHNIQUES, AND GOALS

AUTHOR: The Johns Hopkins University  
Applied Physics Laboratory  
(W.J. Roesler, Editor)

DATE: August 1976

PROJECT NO.: MD-06-0022

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KEYWORDS:

1. Automated Guideway Transit
  2. Automated Group Rapid Transit
  3. Downtown People Movers
  4. Socioeconomic Research
  5. Workshop
- 

The Office of Technology Development and Deployment of the Urban Mass Transportation Administration (UMTA) is sponsoring projects that require the development of performance measures that will be used to evaluate the cost effectiveness of current and planned Automated Guideway Transit (AGT) systems.

The purpose of this workshop was to identify performance parameters and develop measurement and computational techniques. The workshop centered around two specific objectives: 1) to review the status of parameter definitions; and 2) to review the techniques used for the measurement and evaluation of AGT system performance and establish significant trade-off items for further study.

This workshop, conducted by UMTA's Office of Technology Development and Deployment, discussed the meaning, specification, and measurement of performance in AGT systems. The workshop was organized according to the following areas: Socio-Economic Studies Project - AGT Assessments; Preliminary Performance Measures for AGT Urban Deployability; Preliminary Performance Measures for the Systems Operations Studies; Advanced Mass Transit Simulator; and Trade-Off Studies for AGRT.

This document contains the workshop presentation papers, discussion results, and list of attendees.

NTIS ORDER NO.: PB 277-046/AS

PRICE: A06

**TITLE:** GUIDELINE FOR RIDE-QUALITY SPECIFICATIONS  
BASED ON TRANSP0 '72 TEST DATA

**AUTHOR:** The Johns Hopkins University  
Applied Physics Laboratory  
(W.C. Caywood, H.L. Donnelly, and N. Rubinstein)

**DATE:** October 1977

**PROJECT NO.:** MD-06-0022

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**KEYWORDS:**

1. Automated Guideway Transit
2. Ride-Quality
3. Guidelines

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The study reported herein was undertaken to determine if new information suitable for use in Automated Guideway Transit (AGT) specifications of ride-quality could be derived from data taken during the tests of four prototype AGT systems (the Bendix Dashaveyor, the Ford Motor AGT, the Rohr Monocab, and the Otis TTD system) at the Dulles International Airport in conjunction with TRANSP0 '72.

The purpose of this work was to establish acceptable ride-quality levels for AGT vehicles and to define a means for measuring these motions. A set of acceleration and jerk values is presented for developing AGT ride-quality specifications in a universally accepted format for these measurements.

In this report, the ride-quality acceleration measurements and the ride-jury comfort ratings that were recorded during the Post-TRANSP0 '72 test program have been examined for possible use in establishing standards for the ride-quality of AGT systems. The four TRANSP0 systems, the techniques used for making the ride-comfort tests, and data processing and analysis methods are described.

Results are presented for the vibratory motions associated with travel at a constant speed over a straight guideway and for transient events associated with starting and stopping, traversing switch areas, and entering and exiting curves. Although the sample is small, and some anomalies are present, the TRANSP0 results were found to be a unique source of data for defining ride-quality standards.

**NTIS ORDER NO.:** PB 273-272/AS

**PRICE:** A03

TITLE: POINT-FOLLOWER AUTOMATIC VEHICLE CONTROL: A GENERIC ANALYSIS  
Final Report

AUTHOR: The Johns Hopkins University/Applied Physics Laboratory  
(S. J. Brown, Jr.)

DATE: May 1977

PROJECT NO.: MD-06-0022

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KEYWORDS:

1. Algorithms
  2. Automated Guideway Transit
  3. Automatic Control
  4. Personal Rapid Transit
- 

A class of new urban transportation systems currently receiving wide attention is characterized by small, automatically controlled (driverless) vehicles on dedicated guideways. The successful operation of such Automated Guideway Transit (AGT) Systems requires longitudinal control techniques that assure accurate vehicle speeds and spacings and high levels of reliability and safety at headways significantly smaller than those found in conventional transit. This report documents an investigation of the generic characteristics of the point-follower (or moving-cell) approach to the control of longitudinal speed and spacing of vehicles in an AGT system. The effort was carried out as part of the automatic vehicle control studies sponsored by the Urban Mass Transportation Administration of the U.S. Department of Transportation.

This document consists of a three-part study that examines the generic characteristics of the point-follower approach to vehicle control for AGT systems, under which vehicles are constrained to follow electronic signals that move along the guideway with predetermined speeds and spacings. The first part of this study involves a kinematic analysis of point-follower control during speed transitions and point-transfer maneuvers that are generally required to resolve merge conflicts. This analysis considers the effects of operational parameters such as line speed, acceleration and jerk limits, vehicle length, headway, and length of maneuvering regions to accomplish merges. The second part consists of a dynamic analysis of point-follower control, formulated as a problem in classic control theory. Classic control theory is applied to obtain a feedback control system that causes the vehicle to track the moving point with satisfactory accuracy in all nominal modes of operation and in the presence of transient or steady-state external forces such as wind loading. The final part addresses the traffic-merging problem by development of quasi-synchronous control algorithms for resolution of merge conflicts at network intersections of various geometries. The performance of each algorithm developed in the study was evaluated by computer simulation.

NTIS ORDER NO.: PB 270-354/AS

PRICE: A08

TITLE: A STATE-CONSTRAINED APPROACH TO VEHICLE-FOLLOWER CONTROL  
FOR SHORT-HEADWAY AGT SYSTEMS  
Final Report

AUTHOR: The Johns Hopkins University/Applied Physics Laboratory  
(J. A. Pue)

DATE: August 1977

PROJECT NO.: MD-06-0022

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KEYWORDS:

1. Automated Guideway Transit
  2. Electronic Vehicle Guidance
  3. Guideways
  4. Headways
  5. Vehicle, Monitoring
- 

Vehicle-following in an automated-guideway transit (AGT) system is a longitudinal control scheme where the state of a given vehicle is determined by the behavior of the preceding vehicle. This study represents the initial phase of an investigation that must be continued in order to determine the feasibility of implementing a state-constrained vehicle-following controller into a real system. This report documents an investigation into the automatic longitudinal control of vehicles using a vehicle-follower strategy in the short-headway range operation (0.5 to 3 s). The principal focus of this study is the recognition that the kinematic constraint (i.e., an inequality constraint on the state variables) must be included in the problem formulation.

This study states that at short-time headways a kinematic constraint on vehicle operation arises as a consequence of the velocity, acceleration, and jerk limits imposed to assure passenger comfort. This constraint requires a trailing vehicle to maintain a spacing such that it may react to nominal (non-emergency) preceding-vehicle maneuvers without collisions and without exceeding service jerk and acceleration limits. A nonlinear feedback controller is designed to force the vehicle to follow the kinematically required spacing until the desired headway is attained. The design is based on a technique that uses an optimal feedback control with state constraints. Several suboptimal controls with reduced informational requirements are also presented, thus producing an easily instrumentable controller that properly responds to all possible nominal maneuvers of a preceding vehicle.

This report presents the principal accomplishments of this effort, namely, for the first time the state constraints inherent in a vehicle-following strategy are expressed as part of the control scheme. It also concludes that the technique presented herein has been shown to admit a workable solution to the vehicle-following problem at short headways. Additional verification of its applicability to a real system leads to the suggested areas for investigation outlined in this report.

NTIS ORDER NO.: PB 272-239/AS

PRICE: A06

TITLE: A STUDY OF WHEELCHAIR ACCESS TO THE CURRENT TRANSIT BUS DESIGN  
Final Report

AUTHOR: AM General Corporation

DATE: April 1977

PROJECT NO.: MI-06-0017

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KEYWORDS:

1. Bus, Design
  2. Elderly
  3. Handicapped
  4. Vehicle Design
  5. Wheelchair Lift Platform
- 

Public debate currently exists on the best way to improve and increase use of public transit equipment by the elderly and handicapped. This document is the result of a study conducted by AM General under a contract with the Urban Mass Transportation Administration of the U.S. Department of Transportation, to investigate the feasibility and practicality of incorporating a wheelchair lift platform (level change) device for the standard 40-foot transit bus that would provide safe ingress and egress for wheelchair-bound passengers. This report describes the background and conceptual device to board such passengers. In addition, it also covers seating, wheelchair positioning, and securing the wheelchair once on board.

The recommended lift design for use on the standard 40-foot bus is controlled by the driver by a set of electric switches. This lift is under control of the seated driver at all times. It is powered by hydraulics from either an existing power steering pump or a separate pump. The platform folds into a normal step and stepwell configuration when in the stowed position and has no effect on normal bus operations. It adds approximately 400 pounds to the weight of the bus and has a recommended platform load capacity of 1,000 pounds. The estimated costs of a wheelchair lift and restraint system option are in the range of \$6,000 to \$8,000 per bus for equipment similar to the recommended design. The bus front entry door was selected as the best location for this lift device. Based on the installation of a prototype lift device on an AM General bus, no major problems are anticipated for the installation of such a device on any current design 40-foot transit bus.

NTIS ORDER NO.: PB 270-101/AS

PRICE: A04

**TITLE: THE NEW YORK CITY DOUBLE DECK BUS  
DEMONSTRATION PROJECT: AN EVALUATION**

**AUTHOR: CACI, Inc.- Federal\*/under contract to  
Transportation Systems Center\*\*  
(C.H. McCall, Jr.\* and H.J. Simkowitz\*\*)**

**DATE: May 1978**

**PROJECT NO.: NY-06-0044**

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**KEYWORDS:**

- |                           |                    |
|---------------------------|--------------------|
| 1. Demonstrations         | 5. Site Selection  |
| 2. Double Deck Bus        | 6. Vehicle, Design |
| 3. Evaluation             |                    |
| 4. High-Occupancy Vehicle |                    |

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This report is the second of three documents that constitute an evaluation of the Double Deck Bus (DDB) Project sponsored by the Urban Mass Transportation Administration. The DDB involved the purchase and operation of contemporary double deck buses in New York City and Los Angeles (July 1974-June 1977). The primary objective at the two sites was to assess potential increases in vehicle productivity in an express, limited busway service (L.A.) and in regular service (NYC). DDB carry from 68-84 passengers; and conventional buses carry from 45-47 passengers. Both buses require a single transit employee, the driver. This report provides a comparative evaluation between the eight British Leyland double deck buses and four conventional GM buses in New York.

In New York City, eight Leyland double deck buses replaced eight conventional buses on two bus routes characterized by congested traffic, heavy passenger loads, frequent stops, and frequent passenger turnover. Only seven months of revenue service data were analyzed, due to delays in manufacturing and in satisfying U.S. safety and environmental requirements. The evaluation considers passenger acceptance/perceptions of the DDB vis-a-vis the conventional bus. Statistics are presented on schedule adherence, dwell times, passenger throughput, vehicle reliability, on-board safety, repair and maintenance costs, and fuel and oil consumption. This report concludes that: passengers preferred the DDB; there were no serious problems with the use of internal stairs nor with crime or vandalism on the second level; the DDB project was hampered by problems related to the purchase of foreign vehicles and their re-design to meet American requirements; and the results favored the incorporation of the double decker into the American bus fleets from both an economic and level-of-service point of view. Other reports are: "The Double Deck Bus Demonstration Project: Executive Summary," May 1978 (UMTA-MA-06-0049-78-7); and "The Los Angeles Double Deck Demonstration Project: An Evaluation," May 1978 (UMTA-CA-06-0069-78-1).

**NTIS NO.: PB 287-836/AS**

**PRICE: A09**

**TITLE: A STUDY OF FLYWHEEL ENERGY STORAGE FOR URBAN TRANSIT VEHICLES  
PHASE I - FINAL REPORT**

**AUTHOR: Corporate Research and Development/  
General Electric Company**

**DATE: September 1977**

**PROJECT NO.: NY-06-0062**

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**KEYWORDS:**

1. Buses	6. Propulsion Systems, Electric
2. Electric Vehicles	7. Propulsion Systems, Flywheel
3. Energy Storage	8. Life-Cycle Costing
4. Flywheels	9. Trolley
5. Propulsions Systems, Diesel	

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This report documents the Phase I results of a program--Study of Flywheel Energy Storage--investigating the use of flywheel storage as applied to fixed-route, multistop, rubber-tired, urban transit vehicles. The program, established by the Urban Mass Transportation Administration of the U.S. Department of Transportation in 1976, has an ultimate objective of hastening the changeover to electric propulsion from today's petroleum-powered transit vehicles.

The objective of Phase I was to evaluate the application of flywheel energy storage to a broad spectrum of electrically powered urban transit vehicles and to identify the systems which could meet the established mission requirements as well as use state-of-the-art technology that can be in service in the next 24 months.

This document is the final report for Phase I of this flywheel storage program, and it summarizes the results of each of the six tasks of Phase I: Requirements Study; System Concept Study; Supporting Engineering Design and Analysis; Life-Cycle Cost; Development Plan for Phase II; and Technological Advancements. Charts, tables, major conclusions and recommendations are provided. The Appendixes (A-L) chart out such items as system requirements; flywheel/motor energy storage packages; life-cycle cost analysis, methodology, and worksheets; modularity in design; and a list of references. This report concludes that flywheel energy storage is a promising technique for reducing dependence upon petroleum fuels by urban transit buses as well as offering environmental improvement potentials to transit operators. The study recommends that a hardware development program be initiated for flywheel propulsion systems applicable to urban transit vehicles.

Other related Phase I reports are available in 5 separate volumes, respectively: "Executive Summary" (PB 282-652); "Systems Analysis" (PB 282-653); "System Mechanization" (PB 282-654); "Life-Cycle Costs" (PB 282-655); and "Vehicle Tests" (PB 282-656).

**NTIS ORDER NO.: PB 282-929/AS**

**PRICE: A10**



TITLE: CLEVELAND NEIGHBORHOOD ELDERLY TRANSPORTATION DEMONSTRATION PROJECT  
Final Report

AUTHOR: Crain and Associates

DATE: April 1977

PROJECT NO.: OH-06-0018

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KEYWORDS:

1. Demand Responsive Systems
  2. Demonstrations
  3. Elderly
  4. Handicapped
  5. Transportation Disadvantaged
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This document is a final evaluation of the Cleveland Neighborhood Elderly Transportation (NET) System. The Cleveland NET project was implemented in March 1975 with the purpose of providing personalized door-to-door transportation services for elderly persons within three inner-city neighborhoods. Operations and vehicle maintenance were provided by the Cleveland Transit System/Regional Transit Authority on a daily basis with 12 buses specifically designed and equipped to serve the elderly and the elderly-handicapped. Service was obtained at 10 cents per ride by telephoning a scheduling/dispatching center.

This document describes the Cleveland NET Demonstration Project in terms of the description and operation of the transportation system, the operational agencies involved, the test area, and the operational results. It also includes an analysis of the operational problems encountered, the costs incurred, and the suggested means for improving service and reducing the costs. Results of the surveys of users and non-users of the service are also presented in an attempt to assess the social impacts and benefits relative to costs. Observations are presented on the end results of the demonstration, the type of post-demonstration system that has been implemented by the local agencies, and the analysis/decision making process used by these agencies in formulating their plans. A specific section is included on the transferability of results to other areas.

This report concludes that significant cost reductions would be possible if certain operational changes were made which would limit hours of operation and advance reservations of certain trips.

NTIS ORDER NO.: PB 269-860/AS

PRICE: A08

TITLE: INCIDENCE RATES AND TRAVEL CHARACTERISTICS OF THE TRANSPORTATION  
HANDICAPPED IN PORTLAND, OREGON  
Final Report

AUTHOR: Crain and Associates (under contract to Transportation Systems  
Center)  
(John Crain and William Courington)

DATE: April 1977

PROJECT NO.: OR-06-0004

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KEYWORDS:

1. Incidence Rates
  2. Surveys
  3. Transportation Handicapped
  4. Travel Patterns
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This report presents incidence rates, characteristics, and travel patterns of transportation handicapped and able-bodied elderly (65 and over) persons. A functional definition of handicap is used based on a person's ability to perform eight activities often required in traveling. Those identified as transportation handicapped are further classified as moderately or severely handicapped.

Tables and discussions are presented on demographics, health problems, use of mobility aids, and trip rates, purposes and modes, and origin/destination patterns. A section is devoted to functional problems in using public transportation versus handicap classification, health problems, and use of mechanical aids. Respondents are evaluated in their ability to use six different transit modes ranging from a fixed-route regular bus to a door-to-door bus with a lift. Wheelchair/walker users are analyzed separately.

Data for this report was derived from a 6,000 household survey conducted in Portland. The survey design, questionnaires and field procedures are described in this report.

NTIS ORDER NO.: PB 269-859/AS

PRICE: A05

TITLE: TRI-MET  
AUTOMATED FARE BILLING SYSTEM

AUTHOR: The MITRE Corporation/METREK Division  
(Lester R. Strickland and Peter Wood)

DATE: December 1977

PROJECT NO.: OR-06-0004

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KEYWORDS:

1. Fare, Collection
  2. Fare, Passes
  3. Elderly
  4. Handicapped
- 

For several years the Urban Mass Transportation Administration (UMTA) has been evaluating alternative fare structures and fare collection techniques for use in mass transit. One of the techniques is that of automated billing, where information on each ride is recorded and a passenger is billed at the end of the month for the ride. The first use and successful operation of an automated billing system was in the Valley Transit District, serving the Naugatuck Valley, Connecticut. Hence, UMTA has decided that a similar system should be implemented in conjunction with a demonstration of special transportation services for the elderly and handicapped in a medium sized city. Portland, Oregon, was the site chosen for this demonstration; the Tri-County Metropolitan Transportation District of Oregon (TRI-MET) is the operating agency.

This report describes the TRI-MET Automated Billing System that has been successfully introduced into service in Portland. TRI-MET is using an automated billing system as part of its Special Needs Transportation Project (The Lift) serving the elderly and handicapped. Users of the service are issued an encoded credit-card-sized plastic bus pass. Each time a passenger rides the bus the card is inserted in an on-board car reader unit which records the code and other appropriate data on a tape cassette. At the end of each day's operation data on the cassettes are transmitted to a computer center. Itemized billings and statistical reports are produced monthly. The authors state that although the TRI-MET Credit Card Fare Collection does not represent the last word in fare collection, it is a major step forward in the introduction of cashless systems.

The chapters of this report are: "The Lift" Special Transportation Service; The TRI-MET Automated Fare Billing System; System Hardware; System Software; and Future Developments.

NTIS ORDER NO.: PB 275-661/AS

PRICE: A03

TITLE: TECHNOLOGY DELIVERY FOR A NEW PARATRANSIT VEHICLE  
Final Report

AUTHOR: Gellman Research Associates, Inc.  
(J. P. Price, Alain Kornhauser, and Joseph Phillips)

DATE: July 1977

PROJECT NO.: PA-06-0039

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KEYWORDS:

1. Elderly
  2. Handicapped
  3. Marketing
  4. Paratransit
  5. Taxis
- 

None of the current sedan-type vehicles which constitute the basic taxicab adequately meet the needs of the marketplace in terms of comfort, capacity, and accommodation of the elderly and handicapped. This report reflects the view that a number of technological opportunities are available for solving this long-standing American transportation need--a large, comfortable taxicab/paratransit vehicle, and that the success of the paratransit program may depend on the technology delivery process, since innovation does not occur until a new product or service has successfully been accepted in the marketplace. This report highlights the need to take the existing state-of-the-art in vehicle technology and to convert it into a disseminated vehicle in the marketplace so that it would be profitable to manufacturers, operators, and users. Specifically, this report focuses on the barriers to delivering a new paratransit vehicle to the industry and it identifies the key issues which will become relevant in the future as innovators attempt to market a vehicle and its concomitant services to the riding public. This report outlines UMTA's role with delivering this new technology into the marketplace for paratransit services through the sponsorship of a demonstration project for approximately 200 vehicles, that is, a demonstration in which a new paratransit vehicle undergoes extensive revenue-service performance.

The basic theme throughout this paper is that the process of technology delivery is hampered by uncertainties/risks facing the manufacturers, operators, and users. This report identifies such uncertainties/risks as actuarial data, driver training requirements, vehicle performance characteristics, vehicle economics, market structure, insurance, and local and federal regulations. There are Flow Charts/Figures that aim to visualize the problems related to the Technology Delivery Process and the Innovation Process. The Appendices contain a view of the Chrysler Corporation and the Checker Motors regarding the paratransit mode. This report also contains a summary of findings and includes general recommendations regarding the paratransit mode and its success.

NTIS ORDER NO.: PB 272-128/AS

PRICE: A05

**TITLE:** RESEARCH, DEVELOPMENT AND DEMONSTRATION PROJECTS

**AUTHOR:** U.S. Department of Transportation/Urban Mass Transportation Administration

**DATE:** June 1972

**PROJECT NO.:** RDD-72

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**KEYWORDS:**

- |                                |                                 |
|--------------------------------|---------------------------------|
| 1. Bibliographies              | 6. Government, State            |
| 2. Bus Transit, Bibliographies | 7. Rail Transit, Bibliographies |
| 3. Government, County          |                                 |
| 4. Government, Federal         |                                 |
| 5. Government, Local           |                                 |
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The purpose of the Urban Mass Transportation's RD&D Program is to provide information about a wide spectrum of possible improvements to urban mass transportation systems which communities can use in selecting the best way to deal with their particular transportation requirements. The principle means of providing this information is to publish annually a compilation of reports on the status of UMTA's projects. Research projects are intended to produce information about possible improvements in urban mass transportation. The products of research projects are reports or studies. Development projects involve fabrication, testing and evaluation of new equipment, facilities, systems or methods, and the products of these projects include prototype hardware, test results, and reports. Demonstration projects introduce, on an experimental basis, new methods, equipment or systems of urban mass transportation into a representative urban environment.

This volume lists and summarizes the research, development and demonstration projects funded under Section 6(a) of the UMTA Act, as amended (78 Stat. 302, 49 U.S.C. 1601 et seq.), and comprises summaries of all RD&D projects, either initiated, active or completed as of 30 June 1972. Also included are projects funded under an earlier pilot program of demonstration grants, authorized by the Housing Act of 1961. Not included are activities funded for general technical support only, rather than for the conduct of a discrete study. Since this compilation is cumulative, previous editions may be discarded without loss. However, those who wish to have a full record of UMTA's RD&D activity, are advised to retain this edition. Future compilations will be supplements to this volume, containing descriptions of only those projects which will have been either initiated or completed during the preceding fiscal year. Contained in this report are Appendix A: "New Systems Studies" and Appendix B: "Conversion Tables of the Revised Project Numbering Systems". The annual supplements that comprise UMTA's RD&D projects are: "Improving Urban Mobility: A Directory of Research, Development and Demonstration Projects in Public Transportation, June 1973" and "Innovation in Public Transportation: A Directory of Research, Development and Demonstration Projects, 30 June 1974 and Fiscal Years 1975 and 1976" (three separate reports with the same title). All of these reports are available from the National Technical Information Service. The Annual Report for FY 1977 will be available within the near future.

NTIS ORDER NO.: PB 213-228

PRICE: A14

**TITLE:** IMPROVING URBAN MOBILITY: A DIRECTORY OF RESEARCH, DEVELOPMENT AND DEMONSTRATION PROJECTS IN PUBLIC TRANSPORTATION

**AUTHOR:** U.S. Department of Transportation/Urban Mass Transportation Administration

**DATE:** June 1973

**PROJECT NO.:** RDD-73

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**KEYWORDS:**

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|--------------------------------|---------------------------------|
| 1. Bibliographies              | 6. Government, State            |
| 2. Bus Transit, Bibliographies | 7. Rail Transit, Bibliographies |
| 3. Government, County          |                                 |
| 4. Government, Federal         |                                 |
| 5. Government, Local           |                                 |
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The purpose of the Urban Mass Transportation's RD&D Program is to provide information about a wide spectrum of possible improvements to urban mass transportation systems which communities can use in selecting the best way to deal with their particular transportation requirements. The principle means of providing this information is to publish annually a compilation of reports on the status of UMTA's projects. Research projects are intended to produce information about possible improvements in urban mass transportation. The products of research projects are reports or studies. Development projects involve fabrication, testing and evaluation of new equipment, facilities, systems or methods, and the products of these projects include prototype hardware, test results, and reports. Demonstration projects introduce, on an experimental basis, new methods, equipment or systems of urban mass transportation into a representative urban environment.

This report is a supplement to the 1972 comprehensive volume, and contains updated descriptions of research, development and demonstration projects sponsored and funded by UMTA, and which were initiated, active or completed in FY 1973. These projects were conducted under the authority of Section 6(a) of the UMTA Act, as amended. It contains an index which is broken down by project number, contractor, geographical location, and subject. The project numbering scheme used in this volume was changed in FY 1972 and conversion tables from "old" to "new" project numbers are provided in the 30 June 1972 report compilation, but are not repeated in this supplement. The annual volumes that comprise UMTA's RD&D projects are: "Research, Development and Demonstration Projects, 30 June 1972" (this report is an historical record of all projects funded earlier under authorization of the Housing Act of 1961, and is available from the National Technical Information Service, NTIS Order Number PB 213-228), and "Innovation in Public Transportation: A Directory of Research, Development and Demonstration Projects, 30 June 1974" and for Fiscal Years 1975 and 1976 (three separate reports with the same title), which are also available from NTIS. The Annual Report for FY 1977 will be available within the near future.

NTIS ORDER NO.: PB 285-427/AS

PRICE: A10

TITLE: INNOVATION IN PUBLIC TRANSPORTATION: A DIRECTORY OF RESEARCH,  
DEVELOPMENT AND DEMONSTRATION PROJECTS

AUTHOR: U.S. Department of Transportation/Urban Mass Transportation  
Administration

DATE: June 1974

PROJECT NO.: RDD-74

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KEYWORDS:

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|--------------------------------|---------------------------------|
| 1. Bibliographies              | 5. Government, Local            |
| 2. Bus Transit, Bibliographies | 6. Government, State            |
| 3. Government, County          | 7. Rail Transit, Bibliographies |
| 4. Government, Federal         |                                 |
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The purpose of the Urban Mass Transportation's RD&D Program is to provide information about a wide spectrum of possible improvements to urban mass transportation systems which communities can use in selecting the best way to deal with their particular transportation requirements. The principle means of providing this information is to publish annually a compilation of reports on the status of UMTA's projects. Research projects are intended to produce information about possible improvements in urban mass transportation. The products of research projects are reports or studies. Development projects involve fabrication, testing and evaluation of new equipment, facilities, systems or methods, and the products of these projects include prototype hardware, test results, and reports. Demonstration projects introduce, on an experimental basis, new methods, equipment or systems of urban mass transportation into a representative urban environment.

This publication is a supplement to the 1972 comprehensive volume, and contains updated descriptions of research, development and demonstration projects sponsored and funded by UMTA, and which were initiated, active or completed in FY 1974, under Section 6(a) of the UMTA Act, as amended. The report contains Appendices 1 and 2: "Availability of Information on Federal Research and Development in Urban Mass Transportation" and "Federal Grant and Procurement Contracts for Research and Development in Urban Mass Transportation", respectively, and an index broken down by project number, contractor, and subject. The annual supplements that comprise UMTA's RD&D projects are: "Research, Development and Demonstration Projects, June 1972" (this report is an historical record of all projects funded earlier under authorization of the Housing Act of 1961, and is available from the National Technical Information Service, Order Number PB 213-228); "Improving Urban Mobility: A Directory of Research, Development and Demonstration Projects in Public Transportation, June 1973"; and "Innovation in Public Transportation: A Directory of Research, Development and Demonstration Projects, Fiscal Years 1975 and 1976" (two separate reports with the same title). All of these reports are available from the National Technical Information Service. The Annual Report for Fiscal Year 1977 will be available within the near future.

NTIS ORDER NO.: PB 285-244/AS

PRICE: A08

TITLE: SAFETY IN URBAN MASS TRANSPORTATION: RESEARCH REPORT  
Final Report

AUTHOR: Battelle/Columbus Laboratories  
(E. S. Cheaney, J. A. Hoess, R. E. Thompson, and R. L. Svehla)

DATE: March 1976

PROJECT NO.: RI-06-0005

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KEYWORDS:

1. Guides and Guidance, Safety
  2. Management, Operations and Techniques
  3. Safety, Human Factors
  4. Safety, Transportation Systems
- 

This report describes a study in which Battelle's Columbus Laboratories, through contract with the Naval Underwater Systems Center and under the auspices of the Urban Mass Transportation Administration, undertook a systematic examination of safety in urban mass transportation. Its purpose was to provide data, information, and analyses as support for preparing a Safety Guidelines Manual. The work undertaken resulted in two documents. The report summarized here: Safety in Urban Mass Transportation: Research Report, presents the results of the exploratory studies of safety which resulted in a definition of the nature and extent of the safety problems projected for urban mass transportation and a formulation of a strategy for solving them. This report served as a conceptual basis of the second document: Safety in Urban Mass Transportation: Guidelines Manual (PB 245-413). The Guidelines Manual was addressed to the programmatic implementation of the strategy through the application of system safety principles in the transit industry.

This research report covers three major topics: 1) an analysis of the current state of safety; 2) determination of acceptable safety levels; and 3) development of the Safety Guidelines Manual. Safety performance in several modes of transportation are compared as a basis for assessing the safety situation. Methods of establishing acceptable safety levels and setting safety goals are analyzed. A safety program is formulated for the urban mass transportation industry wherein system safety principles are applied in this industry's technical and institutional environment.

Conclusions are drawn that urban mass transportation, although inherently hazardous, is not troubled by immediate, severe safety problems. However, the study points out that these problems will confront the industry as it moves into use of new, high-performance technology where traditional approaches to safety will not suffice. Also, less severe, but real problems with occupant injuries and non-occupant fatalities and injuries concern the industry today and merit remedial action. Management and methodological approaches are recommended for meeting these safety problem areas.

This report contains a Listing of References.

NTIS ORDER NO.: PB 287-872/AS

PRICE: A09



TITLE: EVOLUTION OF THE KNOXVILLE TRANSPORTATION BROKERAGE SYSTEM  
Interim Report

AUTHOR: CACI, Inc. - Federal (under contract to Transportation Systems  
Center)  
(A. Jeffrey Skorneck)

DATE: October 1976

PROJECT NO.: TN-06-0006

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KEYWORDS:

1. Brokers and Brokerage
  2. Paratransit
  3. Vanpooling
- 

A demonstration project designed to explore the feasibility and transportation service impacts of the transportation brokerage concept is currently underway in Knoxville, Tennessee. The transportation broker seeks to identify and match transportation supply and demand across a wide range of users, providers, and modes. The two-year (July 1975-July 1977) demonstration project is funded by the Urban Mass Transportation Administration as part of the Service and Methods Demonstration Program.

This interim report describes the brokerage system concept and documents the activities leading to the implementation of the brokerage system in Knoxville. Included is a discussion of the various institutional and regulatory barriers to participation by private providers (a key element of supply) and how some of these were overcome. The Knoxville pre-operational experience is potentially of interest and applicability to other locales. Information for this report was gathered through an in-depth review of existing documentation, and personal interviews with representatives of the University of Tennessee, City of Knoxville, and various legal agencies.

NTIS ORDER NO.: PB 270-103/AS

PRICE: A04

**TITLE:** THE KNOXVILLE TRANSPORTATION BROKERAGE PROJECT  
Volume II: Operations and Management

**AUTHOR:** The University of Tennessee Transportation Center  
(John D. Beeson, Frank W. Davis, Jr., and Frederick J. Wegmann)

**DATE:** October 1977

**PROJECT NO.:** TN-06-0006

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**KEYWORDS:**

1. Brokerage
2. Carpools
3. Vanpools

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This report is a description of the operational development of the commuter transportation brokerage system that was in operation in Knoxville, Tennessee from 23 October 1975 through 30 June 1977. When the Knoxville Commuter Pool (KCP) was established, the concept of a transportation broker came into effect with the intention that if it proved workable, it would become an arm of the proposed City Department of Transportation. Commuter services were the primary object of the effort, since commuters composed the group which was most easily identifiable and the area where the greatest possible benefit would be felt. The initial purpose of this research was to develop and operationalize a multi-modal public and private transportation service throughout the Knoxville metropolitan area. This plan would allow each form of transportation to provide the service that it could most effectively furnish, and would offer transportation options to most parts of the community that could not be served at that time. The instrument through which the project objectives would be obtained was the transportation broker who could coordinate all modes of transportation. The broker would not promote one mode of transportation over another, but would promote all modes in order that the broad objectives of the community would be met. Each individual commuter or group requesting service would be provided with a series of transportation alternatives that permitted the highest level of service at the lowest possible cost. These alternatives included vanpooling, which this study addresses extensively.

Although this report covers a two-year period, only approximately 18 months were used for operational purposes. KCP is now working under the City Department of Transportation, and its future plans include a continued effort to find better ways to promote all forms of ridesharing within the metropolitan area. There was not time to realize the full potential of the brokerage concept by 30 June 1977. However, sufficient accomplishments were achieved to show that the concept has the potential to solve many of the transportation problems with which cities are now faced. Also, Volume I: Philosophy and Institutional Issues, will be published within the near future.

NTIS ORDER NO.: PB 282-248/AS

PRICE: A07

**TITLE:** URBAN MASS TRANSPORTATION ABSTRACTS  
Volume No. 4

**AUTHOR:** U.S. Department of Transportation  
Urban Mass Transportation Administration

**DATE:** December 1977

**PROJECT NO:** TRIC-77-1

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**KEYWORDS:**

1. Abstracts
  2. Bibliographies
  3. Technical Reports
  4. Indexing
  5. Subject-Indexing
- 

This volume is a reference document prepared by the Urban Mass Transportation Administration (UMTA) and serves as a guide to 313 reports generated under contract to UMTA. This document reflects UMTA's continuing commitment to the dissemination of technical report information to government, state, and local transportation planning bodies, private industry, and the general public.

The types of documents abstracted in this volume are, by section: I) Technical Studies; II) Research, Development, and Demonstration Project Reports; and III) University Research and Training Reports. Section IV contains complete indexes to the volume by report title, personal author, corporate author, geographic location, and keywords.

All reports in this document are available for sale at the National Technical Information Service (NTIS), Springfield, Virginia. Each abstract contains an NTIS order number and price for paper copy. Most documents are also available in microfiche. Volumes I, II, and III of the URBAN MASS TRANSPORTATION ABSTRACTS are also available at NTIS. The order number for Volume I (October 1972) is PB 213-212; the order number for Volume II (September 1973) is PB 225-368; and the order number for Volume III (July 1976) is PB 264-905.

**NTIS ORDER NO.:** PB 277-290/AS

**PRICE:** A16

TITLE: INNOVATION IN PUBLIC TRANSPORTATION: A DIRECTORY OF RESEARCH,  
DEVELOPMENT AND DEMONSTRATION PROJECTS

AUTHOR: U.S. Department of Transportation/Urban Mass Transportation  
Administration

DATE: Fiscal Year 1975

PROJECT NO.: UPA-1

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KEYWORDS:

- |                                |                                 |
|--------------------------------|---------------------------------|
| 1. Bibliographies              | 5. Government, Local            |
| 2. Bus Transit, Bibliographies | 6. Government, State            |
| 3. Government, County          | 7. Rail Transit, Bibliographies |
| 4. Government, Federal         |                                 |
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The purpose of the Urban Mass Transportation's RD&D Program is to provide information about a wide spectrum of possible improvements to urban mass transportation systems which communities can use in selecting the best way to deal with their particular transportation requirements. The principle means of providing this information is through annual publication of the compilation of reports on the status of individual projects. Research projects are intended to produce information about possible improvements in urban mass transportation. The products of research projects are reports or studies. Development projects involve fabrication, testing and evaluation of new equipment, facilities, systems or methods, and the products of these projects include prototype hardware, test results, and reports. Demonstration projects introduce, on an experimental basis, new methods, equipment or systems of urban mass transportation into a representative urban environment.

This volume is a supplement to the 1972 comprehensive volume. Most of completed RD&D projects included in this supplement have reports already published or in the publication process, under the authorization of Section 6(a) of the UMTA Act, as amended. Volumes of Fiscal Years 1973 and 1974 serve as supplements to the 1972 issue, since they contain only updated descriptions of those projects active in the fiscal year cited in addition to projects initiated or completed during that year. This issue also contains Appendices 1, 2 and 3: "Project Reports"; "Availability of Information on Federal Research and Development in Urban Mass Transportation"; and "Federal Grant and Procurement Contracts for Research and Development in Urban Mass Transportation", respectively, and indices broken down by project number, subject, and contractor. The annual supplements that comprise UMTA's RD&D projects are: "Research, Development and Demonstration Projects, June 1972" (this report is an historical record of all projects funded earlier under authorization of the Housing Act of 1961); "Improving Urban Mobility: A Directory of Research, Development and Demonstration Projects in Public Transportation, June 1973"; and "Innovation in Public Transportation: A Directory of Research, Development and Demonstration Projects, 30 June 1974 and FY 1976 (two separate reports with the same title). All of these reports are available from the National Technical Information Service. The Annual Report for Fiscal Year 1977 will be available from NTIS within the near future.

NTIS ORDER NO.: PB 285-245/AS

PRICE: A06

TITLE: INNOVATION IN PUBLIC TRANSPORTATION: A DIRECTORY OF RESEARCH,  
DEVELOPMENT AND DEMONSTRATION PROJECTS

AUTHOR: U.S. Department of Transportation/Urban Mass Transportation  
Administration

DATE: Fiscal Year 1976

PROJECT NO.: UPA-1

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KEYWORDS:

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|--------------------------------|---------------------------------|
| 1. Bibliographies              | 5. Government, Local            |
| 2. Bus Transit, Bibliographies | 6. Government, State            |
| 3. Government, County          | 7. Rail Transit, Bibliographies |
| 4. Government, Federal         |                                 |
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The purpose of the Urban Mass Transportation's RD&D Program is to provide information about a wide spectrum of possible improvements to urban mass transportation systems which communities can use in selecting the best way to deal with their particular transportation requirements. The principle means of providing this information is to publish annually a compilation of reports on the status of UMTA's projects. Research projects are intended to produce information about possible improvements in urban mass transportation. The products of research projects are reports or studies. Development projects involve fabrication, testing and evaluation of new equipment, facilities, systems or methods, and the products of these projects include prototype hardware, test results, and reports. Demonstration projects introduce, on an experimental basis, new methods, equipment or systems of urban mass transportation into a representative urban environment.

This publication is a supplement to the 1972 comprehensive volume and contains descriptions of current RD&D projects sponsored and funded by UMTA, under authorization of Section 6(a) of the UMTA Act, as amended. Volumes of Fiscal Years 73, 74, and 75 serve as supplements to the 1972 issue since they contain only updated descriptions of those projects active in the fiscal year cited in addition to projects initiated or completed during that year. This issue contains Appendices 1, 2 and 3: "Project Reports"; "Availability of Information on Federal Research and Development in Urban Mass Transportation"; and "Federal Grant and Procurement Contracts for Research and Development in Urban Mass Transportation", respectively, and indices broken down by project number, subject, and contractor. The annual supplements that comprise UMTA's RD&D projects are: "Research, Development and Demonstration Projects, June 1972" (this report is an historical record of all projects funded earlier under authorization of the Housing Act of 1961); "Improving Urban Mobility: A Directory of Research, Development and Demonstration Projects in Public Transportation, June 1973"; and "Innovation in Public Transportation: A Directory of Research, Development and Demonstration Projects, 30 June 1974 and Fiscal Year 1975" (two separate reports with the same title). All of these reports are available from the National Technical Information Service. The Annual Report for Fiscal Year 1977 will be available from NTIS within the near future.

NTIS ORDER NO.: PB 285-246/AS

PRICE: A05

TITLE: ABSTRACTS FOR UNIVERSITY RESEARCH PROJECTS  
UMTA University Research and Training Program

AUTHOR: U.S. Department of Transportation  
Urban Mass Transportation Administration  
University Research and Training Program

DATE: February 1978 PROJECT NO.: UPP-35

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KEYWORDS:

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|--------------------------------|------------------------|
| 1. Abstracts                   | 5. Guides and Guidance |
| 2. Bibliographies              | 6. Information Aids    |
| 3. University Research Reports |                        |
| 4. Subject-Indexing            |                        |
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This publication is a reference document prepared by the Urban Mass Transportation Administration (UMTA) of the U.S. Department of Transportation and serves as a guide to 285 research reports generated by UMTA's University Research and Training Grant Program. UMTA's University Research and Training Grant Program was initiated in 1970 with award of the first grants that were authorized by Section 11 of the Urban Mass Transportation Act of 1964, as amended. This document reflects UMTA's continuing commitment to the dissemination of information to government, state and local planning bodies, private industry, and the general public.

The purpose of this document is to provide a listing of abstracts of published reports for research projects supported by UMTA's University Research and Training Grant Program. The reports abstracted in this document are divided into 30 subject categories. Categories are arranged alphabetically

This document and all reports herein are available for purchase at the National Technical Information Service (NTIS), Springfield, Virginia 22161. Loan copies have been deposited with TRISNET Regional Centers at the Transportation Library, Northwestern University, Evanston, Illinois 60201, and the Institute of Transportation Studies Library, University of California-Berkeley, California 94720.

NTIS ORDER NO.: PB 278-646/AS

PRICE: A12

TITLE: INCREASING TRANSIT RIDERSHIP: THE EXPERIENCE OF SEVEN CITIES

AUTHOR: Department of Transportation/Urban Mass Transportation Administration  
(James E. Sale)

DATE: November 1976

PROJECT NO.: UPP-S

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KEYWORDS:

1. Fare, Reductions
2. Marketing
3. Ridership, Attraction
4. Routes and Routing
5. Transportation System Management

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During the last five years, several transit systems have experienced large and sustained increases in ridership. The objectives of this study were to identify and analyze the factors to which the ridership increases are attributed and the techniques used to gain ridership that are transferable to other systems.

The seven systems chosen for evaluation and the percentages of change in ridership between 1971 and 1975 were: Eugene, Oregon, 411%; Madison, Wisconsin, 49%; Minneapolis-St. Paul, Minnesota, 40%; Portland, Oregon, 57%; Salt Lake City, Utah, 118%; San Diego, California, 114%; and Vancouver, British Columbia, 57%. All of these cities possessed a common set of ingredients essential to their successes in increasing ridership. These ingredients were strong public and political support which resulted in the availability of substantial financial resources.

It was found that most ridership gains were in large part attributable to service expansion, especially the expansion and addition of routes in areas that previously had been poorly served. Fares remained constant or were reduced in all of the cities studied. Furthermore, the energy crisis was credited with having an immediate positive effect on transit use.

The types of techniques used in increasing ridership, which are transferable to other systems, are in the areas of: 1) planning, scheduling, monitoring, and evaluation; 2) marketing; 3) transportation system management; and 4) route structure.

NTIS ORDER NO.: PB 271-071/AS

PRICE: A03

TITLE: AN AUTOMATED INFORMATION DIRECTORY SYSTEM (AIDS)  
Review and Specifications

AUTHOR: The Mitre Corporation/Metrek Division  
(M. P. Munkasey, M. L. Noonchester, and D. F. O'Sullivan)

DATE: July 1977

PROJECT NO.: VA-06-0038

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KEYWORDS:

1. Guides and Guidance
  2. Information Aids
  3. Transit Management
- 

An Automated Information Directory System (AIDS) will provide assistance to transit systems in disseminating transit information to patrons by telephone. This document presents the performance and technical specifications for AIDS, an Urban Mass Transportation Administration sponsored project, to be demonstrated and evaluated in service at the Washington Metropolitan Area Transit Authority (WMATA). The objective of this demonstration is to develop and evaluate a usable and effective computer aided transit information system that can be used throughout the United States, particularly where properties operate a complex transit network.

Specifications for an AIDS are divided into two parts: a generic part that can be used by most transit systems as a component of a request for proposal, and a list of the characteristics specific to WMATA. These characteristics include a description of WMATA's present transit system and an estimate of future transit patronage. A glossary describes some of the terms unique to the AIDS.

NTIS ORDER NO.: PB 272-253/AS

PRICE: A08



**TITLE:** AUTO RESTRICTED ZONE/MULTI-USER VEHICLE SYSTEM STUDY  
Volume I: Auto Restricted Zones: Background and Feasibility

**AUTHOR:** Alan M. Voorhees and Associates, Inc. (In association with  
Cambridge Systematics, Inc. and Moore-Heder Architects)  
(William S. Herald)

**DATE:** December 1977

**PROJECT NO.:** VA-06-0042

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**KEYWORDS:**

- |                          |   |
|--------------------------|---|
| 1. Auto Restricted Zones | 5. Site Selection, Auto Restricted Zones      |
| 2. Malls, Pedestrian     | 6. Structural Analysis, Auto Restricted Zones |
| 3. Malls, Transit        | 7. Traffic Analysis, Control                  |
| 4. Pedestrians           | 8. Urban Development and Planning             |
- 

This report (Volume I) discusses the first phase of the Auto Restricted Zone/Multi-User Vehicle System Study undertaken on behalf of the Urban Mass Transportation Administration. The purpose of the study is to: 1) investigate existing experience with auto restricted zones and multi-user vehicle systems; 2) evaluate their feasibility as concepts applicable to urban transportation systems; 3) identify and evaluate potential sites for suitable demonstration projects; and 4) design demonstration programs for selected sites. The general goals are to preserve and enhance the attractiveness and vitality of urban centers, to improve environmental quality of urban areas, and to encourage increased utilization of non-auto modes of transport.

An auto restricted zone (ARZ) is a geographic area in which one or more factors place limitations upon vehicular traffic. The underlying characteristic of an ARZ as discussed in this study is that of a district or zone distinguished by a higher degree of control over vehicular traffic than the surrounding area. This report discusses a wide range of techniques for ARZ which have been identified and categorized as physical, operational, economic, and regulatory control measures. Within the focus of this study on physical and operational measures of restraint, the techniques identified are already in common use and are therefore familiar and available for immediate implementation. The investigation of existing experience with ARZ focuses on U.S. cities and on European cities where the concept is most advanced, such as in Copenhagen, Amsterdam and Vienna, and discusses its similarities and differences. The investigation into the background and feasibility of ARZ indicated that there are substantial opportunities for ARZ in American cities. A number of key factors are identified for its successful implementation, such as urban activity patterns, urban design issues, transportation infrastructure, accessibility maintenance, ARZ size, transportation policy impacts, and institutional and legal factors.

This report contains Appendices A and B: Bibliography and Characteristics of Pedestrian Areas in European Cities, respectively. Volumes II through IV of this study are: Multi-User Vehicle Systems: Feasibility Assessment; Auto Restricted Zones: Plans for Five Cities; and Site Selection Methodology, respectively. The five Technical Appendices are: Boston, Burlington, Memphis, Providence, and Tucson Auto Restricted Zone Studies.

NTIS ORDER NO.: PB 286-313/AS  
PB 286-312/SET

PRICE: A07  
E20

**TITLE:** AUTO RESTRICTED ZONE/MULTI-USER VEHICLE SYSTEM STUDY  
Volume II: Multi-User Vehicle Systems: Feasibility Assessment

**AUTHOR:** Alan M. Voorhees and Associates, Inc. (In association with  
Cambridge Systematics, Inc. and Moore-Heder Architects)  
(William S. Herald)

**DATE:** December 1977

**PROJECT NO.:** VA-06-0042

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**KEYWORDS:**

- |                          |                                   |
|--------------------------|-----------------------------------|
| 1. Auto Restricted Zones | 5. Traffic Analysis, Control      |
| 2. Carpools              | 6. Urban Development and Planning |
| 3. Paratransit           | 7. Vehicles, Multi-User Systems   |
| 4. Public Ownership      |                                   |

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Volume II was produced as part of the Auto Restricted Zone/Multi-User Vehicle System Study sponsored by the Urban Mass Transportation Administration. It documents the results of an investigation into the feasibility of Multi-User Vehicle Systems (MUVS) as a mode of urban transportation and which is often suggested as one solution to the problem of transportation within congested urban areas. Under Phase I of this study, a review of existing experience, an examination of key factors, and an assessment of MUVS feasibility was conducted as the first stage in a potentially in-depth research and experimental effort.

MUVS is a paratransit mode of transportation which consists of a fleet of small user-operated vehicles available for rental between terminals within a well-defined service area. Although this study considered a wide array of potential vehicles, the basic concept examined herein is similar to the various short-term rental cars. The goals and objectives of the MUVS concept are to: 1) alleviate congestion and improve traffic flow; 2) increase mobility; 3) provide an additional choice of mode; 4) reduce air pollution from vehicle emissions; 5) reduce noise; 6) conserve energy; and 7) reduce land requirements for parking. An MUVS may be described in terms of its operating environment, fixed facility system characteristics, vehicle design characteristics, and operating policy. These characteristics will have a direct bearing on the system's level of service, costs and patronage. A discussion of the detailed examination of the existing experience with MUVS as a Central Business District (CBD) circulation service is presented. This type of system is explored in Amsterdam and in Montpellier, France. Institutional factors, operating area characteristics, vehicle design, operating policies, fare structure, and strengths and weaknesses of each system are identified and compared.

The basic conclusion of the feasibility of MUVS is that while it serves specific needs in particular situations, it is unlikely that it could provide a vital and viable modal alternative for intra-CBD service with or without auto restrictions. This finding of negative feasibility is discussed. A bibliography on MUVS is also contained herein. Volumes I, III and IV of the study are: Auto Restricted Zones: Background and Feasibility; Auto Restricted Zones: Plans for Five Cities; and Site Selection Methodology, respectively. The five Technical Appendices are: Boston, Burlington, Memphis, Providence, and Tucson Auto Restricted Zone Studies.

NTIS ORDER NO.: PB 286-314/AS  
PB 286-312/SET

PRICE: A06  
E20

**TITLE:** AUTO RESTRICTED ZONE/MULTI-USER VEHICLE SYSTEM STUDY  
Volume III: Auto Restricted Zones: Plans for Five Cities

**AUTHOR:** Alan M. Voorhees and Associates, Inc. (In association with  
Cambridge Systematics, Inc. and Moore-Heder Architects)  
(William S. Herald)

**DATE:** December 1977

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**KEYWORDS:**

- |                          |  |
|--------------------------|--|
| 1. Auto Restricted Zones | 5. Pedestrians                           |
| 2. Demonstrations        | 6. Site Selection, Auto Restricted Zones |
| 3. Malls, Pedestrian     | 7. Traffic Analysis, Control             |
| 4. Malls, Transit        | 8. Urban Development and Planning        |

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This report (Volume III) discusses the final phase of the Auto Restricted Zone/Multi-User Vehicle System Study undertaken on behalf of the Urban Mass Transportation Administration. The purpose of the study is to: 1) investigate existing experience with auto restricted zones (ARZ) and multi-user vehicle systems; 2) evaluate their feasibility as concepts applicable to urban transportation systems; 3) identify and evaluate potential sites for suitable demonstration projects; and 4) design demonstration programs for selected sites. This report documents the demonstration program designs for five cities. In earlier phases of this study, techniques for traffic restraint were outlined. This volume discusses the application of some of these techniques to downtown areas of five American cities: Boston; Burlington; Memphis; Providence; and Tucson. While these cities were not selected as being representative samples of American cities, they do cover a wide range of sizes and conditions and have many characteristics which are shared by other cities. This shows the adaptability of the ARZ concept to different conditions and reinforces the conclusion that city size is not critical to ARZ success and that complete prohibition of traffic is not the only option.

In each city, the approach of the ARZ planning team was keyed to local plans and problems. Emphasis was on tailoring an ARZ plan to each specific urban environment rather than imposing a preselected ARZ strategy. The process began with a systematic examination of the existing downtown infrastructure, which included such elements as recent downtown economic trends, characteristics of street network, traffic flow, transit services, patronage, parking and goods movement. Current plans and projects already underway were also assessed for impact toward ARZ planning. Objectives and opportunities for ARZ were formulated and plans for each city concluded with an examination of impacts, costs, and the necessary steps for implementation. It now appears that new forms or applications of ARZ in the U.S. will evolve from existing downtown malls. However, in the absence of major new programs to rebuild the central city, a slow evolution of programs for auto restriction is expected. Volumes I, II and IV of this study are: Auto Restricted Zones: Background and Feasibility; Multi-User Vehicle Systems: Feasibility Assessment; and Site Selection Methodology, respectively. The five Technical Appendices are: Boston, Burlington, Memphis, Providence, and Tucson Auto Restricted Zone Studies.

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PB 286-312/SET

PRICE: A12  
E20

**TITLE:** AUTO RESTRICTED ZONE/MULTI-USER VEHICLE SYSTEM STUDY  
Volume IV: Site Selection Methodology

**AUTHOR:** Alan M. Voorhees and Associates, Inc. (In association with  
Cambridge Systematics, Inc. and Moore-Heder Architects)  
(William S. Herald)

**DATE:** December 1977

**PROJECT NO.:** VA-06-0042

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**KEYWORDS:**

1. Auto Restricted Zones
  2. Demonstrations
  3. Site Selection, Auto Restricted Zones
  4. Traffic Analysis, Control
  5. Urban Development and Planning
  6. Vehicles, Multi-User Systems
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Volume IV was produced as part of the Auto Restricted Zone/Multi-User Vehicle System Study sponsored by the Urban Mass Transportation Administration. It presents methodology followed in the selection of sites for auto restricted zone (ARZ) demonstrations. Of more than 75 applicants, five cities were selected for participation: Boston; Burlington; Memphis; Providence; and Tucson. The report includes the design of site specific programs to demonstrate this methodology in the five selected cities. The program was structured into seven major work elements which are outlined in the study. In the review process for each city, the consulting team looked for indicators of past performance, present commitment, future planning in institutional performance, transportation factors, and urban form and opportunities. Strong emphasis was placed on revitalization of the Central Business District (CBD), which would be conducive to successful ARZ/MUVS demonstration programs. Six basic criteria were submitted to each city, and are presented in the report. Forty-five cities responded in a positive manner. The client and consultants reviewed this criteria to assess potential for a successful demonstration. The review notes and assessments were presented to the client in a separate report: Review of Potential Demonstration Sites. As a result of the initial evaluation process, the cities were classified into one of three groups: cities with the highest potential; apparent high potential; and limited potential. The clients, TSC, and UMTA made the final selection of sites, using a four-point process: city contact; initial screening; second stage screening; and recommendation.

Several cities have developed the framework of a comprehensive approach to the entire CBD. Other cities have instituted programs that, in time, will restructure the transport balance within the center city. However, the efforts to locate a suitable demonstration site and program for MUVS were unsatisfactory, as none were identified. Further effort to identify a situation for an MUVS demonstration offers promise if further evaluation is judged to be worthwhile. Appendix A: City Contact Documentation, Initial Contact Letter, and Information Request and Appendix B: City Summary Fact Sheets, are contained herein. Volumes I, II and III of the study are: Auto Restricted Zones: Background and Feasibility; Multi-User Vehicle Systems: Feasibility Assessment; and Auto Restricted Zones: Plans for Five Cities, respectively. The five Technical Appendices are: Boston, Burlington, Memphis, Providence, and Tucson Auto Restricted Zone Studies.

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PB 286-312/SET

PRICE: A04  
E20

**TITLE:** AUTO RESTRICTED ZONE/MULTI-USER VEHICLE SYSTEM STUDY  
Technical Appendix: Boston Auto Restricted Zone Study

**AUTHOR:** Alan M. Voorhees and Associates, Inc. (In association with  
Cambridge Systematics, Inc., Moore-Heder Architects, and  
A. T. Kearney and Company, Inc.)  
(William S. Herald)

**DATE:** December 1977

**PROJECT NO.:** VA-06-0042

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**KEYWORDS:**

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|--------------------------|--|
| 1. Auto Restricted Zones | 6. Site Selection, Auto Restricted Zones |
| 2. Center City           | 7. Traffic Analysis, Control             |
| 3. Demonstrations        | 8. Urban Development and Planning        |
| 4. Malls, Pedestrian     | 9. Urban Goods Movement                  |
| 5. Pedestrians           |  |
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This report is an Appendix to the Auto Restricted Zone/Multi-User Vehicle System Study sponsored by the Urban Mass Transportation Administration. It is a proposal for an auto restricted zone (ARZ) and for revised circulation patterns in downtown Boston. In the City of Boston, the main problems can be summarized as congestion, conflict of pedestrian and traffic, and confusion, rather than a lack of basic vitality. This study seeks to remedy the current imbalance of pedestrian versus auto use, and to reduce the prevailing congestion in the older downtown. The objective is not to eliminate vehicles, but to promote a more appropriate balance in the use of public spaces, which would enhance the long-range economic future as well as the environment of the downtown area. The need to eliminate these problems, to create an appropriate environment for the existing or potential activities, and to improve connections among major activity areas are the basic factors for an Urban Design Plan. The intent is to rely heavily on making the most of what is already there. The goal for undertaking this proposed ARZ plan is to encourage the continued physical and economic revitalization of downtown Boston. The general objectives are to: 1) set up a more balanced circulation framework; 2) make the streets more attractive through an ongoing program; and 3) set up improved environmental management programs for the area. The urban design issues related to the general objectives are stated more specifically within the text.

The report is comprised of Appendices A through D, which are: Urban Design; Transit and Travel Demand; Traffic and Parking; and Goods Movement. These Appendices are broken down into detailed chapters that discuss the development, description, impact and evaluation of the Plan concepts and address the ARZ plan proposals. It is expected that the program proposed here could aid the City in further capitalizing on the substantial investments already made in the downtown, and could assist with solving the general downtown congestion. The other Technical Appendices in this study are: Burlington, Memphis, Providence, and Tucson Auto Restricted Zone Studies. Volumes I through IV are: Auto Restricted Zones: Background and Feasibility; Multi-User Vehicle Systems: Feasibility Assessment; Auto Restricted Zones: Plans for Five Cities; and Site Selection Methodology, respectively.

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PB 286-312/SET

PRICE: A08  
E20

**TITLE:** AUTO RESTRICTED ZONE/MULTI-USER VEHICLE SYSTEM STUDY  
Technical Appendix: Burlington Auto Restricted Zone Study

**AUTHOR:** Alan M. Voorhees and Associates, Inc. (In association with  
Cambridge Systematics, Inc., Moore-Heder Architects, and  
A. T. Kearney and Company, Inc.)  
(William S. Herald)

**DATE:** December 1977

**PROJECT NO.:** VA-06-0042

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**KEYWORDS:**

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|--------------------------|--|
| 1. Auto Restricted Zones | 6. Site Selection, Auto Restricted Zones |
| 2. Center City           | 7. Traffic Analysis, Control             |
| 3. Demonstrations        | 8. Urban Development and Planning        |
| 4. Malls, Pedestrian     | 9. Urban Goods Movement                  |
| 5. Pedestrians           |  |

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This report is an Appendix to the Auto Restricted Zone/Multi-User Vehicle System Study sponsored by the Urban Mass Transportation Administration, and is a proposal for an auto restricted zone (ARZ) for the City of Burlington. With an improving downtown retail district, the City is faced with increased competition from a proposal for a major suburban shopping mall, as well as internal competition from a recently completed shopping arcade in the downtown area. Such competition pressure has been a primary incentive for local efforts to drastically improve the character of the existing downtown retail area through auto restriction and pedestrian improvements. The increases in the economic health of the City have also created strong pressures for physical change and for improving the quality of public space. This concern has culminated in the current proposal for construction of a four-block pedestrian mall. Also, while the City has made progress in establishing a popular public transit system, bus stops and shelters are needed to make the system attractive and comfortable as a major form of access to the downtown. Prior to Burlington's consideration of an ARZ, it has been pursuing several Urban Design Plans which are either complete or still in planning stages, and several of the projects now comprise the main urban design components of the ARZ plan proposed for the City. Four existing characteristics were assessed to test the potential of an ARZ: quality of pedestrian environment; quality of transit environment; retail environment; and real estate development and historical rehabilitation. The Urban Design Plan consists of two sets of elements: a circulation framework and a street improvement program. The circulation framework described in the text summarizes the way different circulation elements have been coordinated and fitted into the downtown street system, and a technical description of the functioning of each element is provided. The street improvement program addresses a series of projects for the streets of the older business district. This report is comprised of Appendices A through D: Urban Design; Transit and Travel Demand; Circulation and Parking; and Goods Movement, which are broken down into detailed chapters that discuss the development, description, impact, and evaluation of the Plan concepts and address the ARZ plan proposals. The other Technical Appendices in this study are: Boston, Memphis, Providence, and Tucson ARZ Studies. Volumes I through IV are: Auto Restricted Zones: Background and Feasibility; Multi-User Vehicle Systems: Feasibility Assessment; Auto Restricted Zones: Plans for Five Cities; and Site Selection Methodology, respectively.

NTIS ORDER NO.: PB 286-318/AS  
PB 286-312/SET

PRICE: A07  
E20

**TITLE:** AUTO RESTRICTED ZONE/MULTI-USER VEHICLE SYSTEM STUDY  
Technical Appendix: Memphis Auto Restricted Zone Study

**AUTHOR:** Alan M. Voorhees and Associates, Inc. (In association with  
Cambridge Systematics, Inc., Moore-Heder Architects, and  
A. T. Kearney and Company, Inc.)  
(William S. Herald)

**DATE:** December 1977

**PROJECT NO.:** VA-06-0042

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**KEYWORDS:**

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|--------------------------|--|
| 1. Auto Restricted Zones | 6. Site Selection, Auto Restricted Zones |
| 2. Center City           | 7. Traffic Analysis, Control             |
| 3. Demonstrations        | 8. Urban Development and Planning        |
| 4. Malls, Pedestrian     | 9. Urban Goods Movement                  |
| 5. Pedestrians           |  |

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This report is an Appendix to the Auto Restricted Zone/Multi-User Vehicle System Study sponsored by the Urban Mass Transportation Administration, and presents technical analysis, data, and supplementary information developed in the preparation of the Memphis ARZ Demonstration Plan. The general approach of the ARZ study has centered on the identification and development of opportunities existing in American cities for a reorientation to transit and pedestrian travel. Much of that opportunity is defined by characteristics of the vehicular and pedestrian networks and the traffic that uses them. The circulation framework that is eventually developed as a principal element of the ARZ plan requires coordination in the reallocation of street space among transit riders, pedestrians, auto users, and goods movements.

The approach taken in planning the circulation framework for the Memphis ARZ was somewhat different than that used in the other demonstration design cities. Memphis had recently implemented a major change in its downtown circulation system by closing ten blocks of the former Main Street and creating the Mid-America Mall. The Mall is an active place at midday during the week, but the evenings and weekends are quiet. Given the density, auto orientation, and customary use patterns of its citizens, the downtown is not likely to benefit from major street closings or changes in traffic patterns. However, selective and modest additions could extend the Mall to a larger district, provide better facilities for the now disadvantaged transit riders, and encourage public/private joint development projects that could improve street environment and support conversion of now-vacant buildings. At this level, an ARZ demonstration could enhance the environment and activity potential of downtown Memphis. This report is comprised of Appendices A through D: Urban Design; Transit and Travel Demand; Circulation and Parking; and Goods Movement, which are broken down into detailed chapters that discuss the development, description, impact, and evaluation of the Urban Design Plan and address the ARZ proposals. The other Technical Appendices in this study are: Boston, Burlington, Providence, and Tucson ARZ Studies. Volumes I through IV are: Auto Restricted Zones: Background and Feasibility; Multi-User Vehicle Systems: Feasibility Assessment; Auto Restricted Zones: Plans for Five Cities; and Site Selection Methodology, respectively.

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PB 286-312/SET

PRICE: A09  
E20

**TITLE:** AUTO RESTRICTED ZONE/MULTI-USER VEHICLE SYSTEM STUDY  
Technical Appendix: Providence Auto Restricted Zone Study

**AUTHOR:** Alan M. Voorhees and Associates, Inc. (In association with  
Cambridge Systematics, Inc., Moore-Heder Architects, and  
A. T. Kearney and Company, Inc.)  
(William S. Herald)

**DATE:** December 1977

**PROJECT NO.:** VA-06-0042

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**KEYWORDS:**

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|--------------------------|--|
| 1. Auto Restricted Zones | 6. Site Selection, Auto Restricted Zones |
| 2. Center City           | 7. Traffic Analysis, Control             |
| 3. Demonstrations        | 8. Urban Development and Planning        |
| 4. Malls, Pedestrian     | 9. Urban Goods Movement                  |
| 5. Pedestrians           |  |
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This report is an Appendix to the Auto Restricted Zone/Multi-User Vehicle System Study sponsored by the Urban Mass Transportation Administration. It presents technical analysis, data, and supplementary information developed in the preparation of the Providence Auto Restricted Zone (ARZ) Demonstration Plan. Several existing urban design factors are critical to assess the potential for an ARZ in downtown Providence. They are: pedestrian environment; connections between downtown districts; quality of transit environment; historical quality and development potential; quality of economic environment; and management of public spaces. These issues are discussed in the text and the urban design proposals address these as problems that the ARZ should help resolve.

The City of Providence built a mall in 1965, which was intended to compete with the increasing number of suburban shopping centers and to reestablish the downtown as the activity center of the City. However, while pedestrian volumes still remain high, several stores on the mall have closed. This trend suggests that the downtown may need solutions other than just pedestrianization. Several plans and developments that relate to the ARZ study have been proposed or are being prepared. The City has advanced proposals to expand the mall along with a major rehabilitation of its existing ARZ. This report addresses these proposals and the feasibility of creating a major expanded ARZ in the downtown. The program for Providence is expected to offer significant benefits. It will offer new energy and a different direction for the downtown and the program will be a building block to reestablish this area as the center of life in the City. However, this can only be accomplished if a balanced program of physical changes and growth of fresh activity is pursued.

This report is comprised of Appendices A through D: Urban Design; Transit and Travel Demand; Circulation and Parking; and Goods Movement, that discuss the development, description, impact, and evaluation of the Urban Design Plan and address the ARZ proposals. The other Technical Appendices in this study are: Boston, Burlington, Memphis, and Tucson ARZ Studies. Volumes I through IV are: Auto Restricted Zones: Background and Feasibility; Multi-User Vehicle Systems: Feasibility Assessment; Auto Restricted Zones: Plans for Five Cities; and Site Selection Methodology, respectively.

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PB 286-312/SET

PRICE: A10  
E20



**TITLE:** AUTO RESTRICTED ZONE/MULTI-USER VEHICLE SYSTEM STUDY  
Technical Appendix: Tucson Auto Restricted Zone Study

**AUTHOR:** Alan M. Voorhees and Associates, Inc. (In association with  
Cambridge Systematics, Inc., Moore-Heder Architects, and  
A. T. Kearney and Company, Inc.)  
(William S. Herald)

**DATE:** December 1977 **PROJECT NO.:** VA-06-0042

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**KEYWORDS:**

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|--------------------------|--|
| 1. Auto Restricted Zones | 6. Site Selection, Auto Restricted Zones |
| 2. Center City           | 7. Traffic Analysis, Control             |
| 3. Demonstrations        | 8. Urban Development and Planning        |
| 4. Malls, Pedestrian     | 9. Urban Goods Movement                  |
| 5. Pedestrians           |  |

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This report is an Appendix to the Auto Restricted Zone/Multi-User Vehicle System Study sponsored by the Urban Mass Transportation Administration. It is a proposal for the preparation of an auto restricted zone (ARZ) in Tucson. In order to revitalize the downtown, the City plans include reinforcement of the public transit system, construction of a major private office building and a public library, studies for rehabilitation of in-town historic residential neighborhoods, and attempts to attract new residential development downtown. The revitalization has made considerable progress, but has not yet succeeded in the critical area of attracting people downtown or keeping the workers there for other activities. The government center and the financial district are active during the work day, but are deserted in the evenings; the new Civic Center is underused; and the shopping areas are declining. In spite of the impressive physical improvements, the downtown is still perceived by many as a confusing and unattractive place. In considering an ARZ for Tucson, the main questions that had to be answered were whether it could help in overcoming downtown's negative image, in attracting and keeping people there, in unifying and clarifying the new and old districts, and in creating economic activity. If accompanied by transit-related improvements; clarification of parking access; and regularly programmed cultural, recreational, and promotional activities, an ARZ could greatly improve the attractiveness of downtown. The Urban Design Plan for Tucson consists of two sets of elements: a circulation framework and a street improvement plan. A technical description of the functioning of each element is addressed in detail in the text. The report is comprised of Appendices A through D: Urban Design; Transit and Travel Demand; Traffic and Parking; and Goods Movement. These Appendices are broken down into detailed chapters that discuss the development, description, impact, and evaluation of the Urban Design Plan and the ARZ proposals.

The other Technical Appendices in this study are: Boston, Burlington, Memphis, and Providence Auto Restricted Zone Studies. Volumes I through IV are: Auto Restricted Zones: Background and Feasibility; Multi-User Vehicle Systems: Feasibility Assessment; Auto Restricted Zones: Plans for Five Cities; and Site Selection Methodology, respectively.

NTIS ORDER NO.: PB 286-321/AS  
PB 286-312/SET

PRICE: A08  
E20

TITLE: ASSESSMENT OF BATTERY BUSES  
Final Report

AUTHOR: Trans Systems Corporation

DATE: July 1977

PROJECT NO.: VA-06-0044

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KEYWORDS:

1. Buses, Design
  2. Propulsion Systems, Diesel
  3. Propulsion Systems, Electric
  4. Propulsion Systems, Hybrid
  5. Surveys
- 

This is a study of the performance and operations of electric battery buses. This report presents a comprehensive assessment/survey of the performance of electric battery buses operating in passenger-carrying services in the United States, Europe, Japan, and Australia. The survey assessed a total of 16 different systems from 15 suppliers, operating under 18 public transit authorities. These operations varied from single demonstration vehicles to a fleet of 20 buses which provide all the transit service on three routes. The status of electric battery bus development is reflected in the fact that 57 buses have accumulated more than 3.4 million kilometers (2.1 million miles) in passenger-carrying service.

This assessment was accomplished through on-site data collection and data analyses. Data analysis included translating the information acquired from overseas visits and reducing the data on performance and technical features to common terms for comparison. In all, 36 agencies were contacted during the survey. This study also addresses hybrid propulsion systems such as the trolley-battery and diesel-battery hybrids. Hybrid bus systems assessed by this study include the Dornier Duo-Bus, the Mercedes-Benz OE305, and the Tokyo Transportation Bureau models built by Kawasaki. The scope of this report includes visiting the operating organization, description of buses and propulsion systems, operational profiles, operating experience, and analysis of data and conclusions about the problems and constraints in the procurement and operation of electric buses. There are tables that summarize the characteristics of the battery and hybrid buses, the cost comparison of Duo-Bus, and the site data for the bus operations. The Appendices contain a listing of the contributors to the Electric Battery Bus Assessment as well as a Bibliography.

NTIS ORDER NO.: PB 271-321/AS

PRICE: A08

TITLE: SAN BERNARDINO FREEWAY EXPRESS BUSWAY  
EVALUATION OF MIXED-MODE OPERATIONS  
Final Report

AUTHOR: Crain & Associates/for Southern  
California Association of Governments

DATE: July 1978

PROJECT NO.: CA-09-0059

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KEYWORDS:

- |                       |                            |
|-----------------------|----------------------------|
| 1. Buspools           | 6. Lane, Separation        |
| 2. Bus, Commuter      | 7. Intermodal, Integration |
| 3. Bus, Rapid Transit | 8. Planning                |
| 4. Busway             | 9. Vanpooling              |
| 5. Carpooling         |                            |
- 

Evaluation of the San Bernardino Freeway Express Busway has been going on since it was opened in January 1973. Beginning in October 1976 and continuing through June 1978, carpools of three or more were permitted on this previously bus-only facility from 6-10 am and 3-7 pm. This report evaluates mixed-mode (bus and carpool) operations of the busway; it includes a summary of the bus-only phase (Jan. 1973-Oct. 1976) as well as implications of this research to other possible busway developments.

Data was collected from traffic studies and from written and oral surveys. All of the surveys are described in detail in Appendixes A through D of this report. This project has shown that busways can be cost-effective, non-controversial, and a way of attracting substantial numbers of solo auto drivers into buses and carpools. There are about 2600 people now carpooling as a direct result of mixed-mode busway operations. Surveys show that public opinion at all levels support the mixed-mode operation of the busway.

The San Bernardino Freeway Express Busway is an 11-mile, double-lane, exclusive roadway for high occupancy vehicles, running eastward from downtown Los Angeles. The busway lanes are physically separated by either concrete or flexible barriers from those lanes which serve auto traffic, making it a true rapid transit system for buses and carpools. This \$57 million system is the most complete facility of its kind in the country, with off-line stations, park-ride facilities, two uni-directional bus lanes, feeder bus lines, outlying park-pool lots, and supplemented by a downtown reserved lane. This busway offers a service that is competitive with automobile commuting on the semi-congested freeway. The report concludes that the user-cost savings, for busway-induced carpools and bus riders only, cover two-thirds of the annual (capital and operating) costs of the busway.

NTIS NO: PB 285-913/AS

PRICE: A10

**TITLE:** KCMR DIAL-A-RIDE STUDY - REPORT NO.1: DIAL-A-RIDE SERVICE  
POTENTIAL IN THE KANSAS CITY METROPOLITAN REGION

**AUTHOR:** The Huron River Group, Inc./Missouri Transportation Associates  
and Bishop Engineers, Inc.

**DATE:** March 1977

**PROJECT NO.:** IT-09-0047

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**KEYWORDS:**

1. Demand-Responsive Transportation Systems
  2. Dial-A-Ride
  3. Paratransit
- 

This study is comprised of 6 reports that encompass all of the major facets of a demand-responsive system. It is designed to assist the Mid-America Regional Council and local government agencies in the detailed service planning of Dial-A-Ride services in the Kansas City Metropolitan Region. It specifically develops model services for two major areas of the KCMR. A small pilot system was applied in Independence, Missouri, and a larger pilot system was applied in Johnson County, Kansas. The study presents observations and recommendations for potential long range service development in the entire KCMR, and points out that Dial-A-Ride service requires ongoing review and updating in order to maintain its viability and usefulness.

Report 1 presents background and existing developments of demand-responsive systems in the KCMR. It presents relationships between general public systems vs. specialized systems (which are provided for the elderly and handicapped). It compares the various services, their applicability and potential, funding, and points out the limits and limitations of the Dial-A-Ride program.

It was found that Dial-A-Ride service to the general public should be seriously considered for expansion of public transportation in major portions of the KCMR, and especially in medium and lower density suburban areas, and that specialized Dial-A-Ride service for the handicapped is strongly encouraged over the entire transit area.

The study includes the following separate reports: Report No.2 - "Dispatching and Communications"; Report No.3 - "Personnel and Training for Dial-A-Ride"; Report No.4 - "Vehicles, Maintenance, Fare Collection"; Report No.5 - "Management Information Systems"; and Report No.6 - "Marketing and Public Information".

NTIS ORDER NO.: PB 275-686/AS

PRICE: A04

**TITLE:** KCMR DIAL-A-RIDE STUDY - REPORT NO.2: DISPATCHING AND COMMUNICATIONS

**AUTHOR:** Bishop Engineers, Inc.

**DATE:** April 1977

**PROJECT NO.:** IT-09-0047

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**KEYWORDS:**

1. Communications equipment, Dial-A-Ride
  2. Demand-Responsive Transportation Systems
  3. Dial-A-Ride
  4. Glossaries, Radio Terminology
  5. Paratransit
- 

This study is comprised of 6 reports that encompass all of the major facets of a demand-responsive system. It is designed to assist the Mid-America Regional Council and local government agencies in the detailed service planning of Dial-A-Ride services in the Kansas City Metropolitan Region. It specifically develops model services for two major areas of the KCMR. A small pilot system was applied in Independence, Missouri, and a larger pilot system was applied in Johnson County, Kansas. The study presents observations and recommendations for potential long range service development in the entire KCMR, and points out that Dial-A-Ride service requires ongoing review and updating in order to maintain its viability and usefulness.

Report No.2 describes the dispatching and communication requirements for small Dial-A-Ride systems, such as the small pilot system in Independence, Missouri, and for a large integrated system, such as the one proposed for Northeastern Johnson County, Kansas. The report presents operating procedures and design and cost considerations for the equipment of the systems, as well as a glossary of radio terminology.

It was found that Dial-A-Ride service to the general public should be seriously considered for expansion of public transportation in major portions of the KCMR, and especially in medium and lower density suburban areas, and that specialized Dial-A-Ride service for the handicapped is strongly encouraged over the entire transit area.

The study includes the following separate reports: Report No.1 - "Dial-A-Ride Service Potential in the Kansas City Metropolitan Region"; Report No.3 - "Personnel and Training for Dial-A-Ride"; Report No.4 - "Vehicles, Maintenance, Fare Collection"; Report No.5 - "Management Information Systems"; and Report No.6 - "Marketing and Public Information".

NTIS ORDER NO.: PB 275-687/AS

PRICE: A03

**TITLE:** KCMR DIAL-A-RIDE STUDY - REPORT NO.3: PERSONNEL AND TRAINING FOR DIAL-A-RIDE

**AUTHOR:** The Huron River Group, Inc./Missouri Transportation Associates

**DATE:** June 1976

**PROJECT NO.:** IT-09-0047

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**KEYWORDS:**

1. Demand-Responsive Transportation Systems
  2. Dial-A-Ride
  3. Management, Operations and Techniques, Dial-A-Ride
  4. Management, Training Techniques, Dial-A-Ride
  5. Manpower and Personnel, Dial-A-Ride
  6. Paratransit
- 

This study is comprised of 6 reports that encompass all of the major facets of a demand-responsive system. It is designed to assist the Mid-America Regional Council and local government agencies in the detailed service planning of Dial-A-Ride services in the Kansas City Metropolitan Region. It specifically develops model services for two major areas of the KCMR. A small pilot system was applied in Independence, Missouri, and a larger pilot system was applied in Johnson County, Kansas. The study presents observations and recommendations for potential long range service development in the entire KCMR, and points out that Dial-A-Ride service requires ongoing review and updating in order to maintain its viability and usefulness.

Report No.3 is aimed at providing prospective operators of relatively small Dial-A-Ride systems (up to about 20 vehicles) or subsystem modules, with tested and workable guidelines for the recruitment, scheduling, and training of personnel. The report describes the basic personnel operations of the small and large systems, and lists the necessary duties of the Dial-A-Ride project director; the operations supervisor; the dispatcher; and the driver. Sample lesson plans, training sessions, map and routing exercises, dispatcher and driver evaluation checklists, and a self-training worksheet are included.

It was found that Dial-A-Ride service to the general public should be seriously considered for expansion of public transportation in major portions of the KCMR, and especially in medium and lower density suburban areas, and that specialized Dial-A-Ride service for the handicapped is strongly encouraged over the entire transit area.

The study includes the following separate reports: Report No.1 - "Dial-A-Ride Service Potential in the Kansas City Metropolitan Region"; Report No.2 - "Dispatching and Communications"; Report No.4 - "Vehicles, Maintenance, Fare Collection"; Report No.5 - "Management Information Systems"; and Report No.6 - "Marketing and Public Information".

NTIS ORDER NO.: PB 275-688/AS

PRICE: A03

**TITLE:** KCMR DIAL-A-RIDE STUDY - REPORT NO.4: VEHICLES, MAINTENANCE,  
FARE COLLECTION

**AUTHOR:** The Huron River Group/Missouri Transportation Associates

**DATE:** August 1976

**PROJECT NO.:** IT-09-0047

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**KEYWORDS:**

1. Buses, Maintenance
2. Buses, Specifications
3. Demand-Responsive Transportation Systems
4. Dial-A-Ride
5. Fare, Collection
6. Fare, Prepayment
7. Paratransit

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This study is comprised of 6 reports that encompass all of the major facets of a demand-responsive system. It is designed to assist the Mid-America Regional Council and local government agencies in the detailed service planning of Dial-A-Ride services in the Kansas City Metropolitan Region. It specifically develops model services for two major areas of the KCMR. A small pilot system was applied in Independence, Missouri, and a larger pilot system was applied in Johnson County, Kansas. The study presents observations and recommendations for potential long range service development in the entire KCMR, and points out that Dial-A-Ride service requires ongoing review and updating in order to maintain its viability and usefulness.

Report No.4 is concerned with the maintenance and specifications of Dial-A-Ride vehicles (or small buses). Considerations in vehicle acquisition is discussed, such as procurement, leasing, specification guidelines, and provisions for wheelchairs. Transit fare collection equipment and related functions are discussed, and alternatives to cash fares are presented, such as tickets or prepayment. However, an exact fare policy is strongly recommended, preferably with provision for change-making with scrip, as its acceptance is high for conventional transit, and it has simplified operations and effectively reduced robberies.

It was found that Dial-A-Ride service to the general public should be seriously considered for expansion of public transportation in major portions of the KCMR, and especially in medium and lower density suburban areas, and that specialized Dial-A-Ride service for the handicapped is strongly encouraged over the entire transit area.

The study includes the following separate reports: Report No.1 - "Dial-A-Ride Service Potential in the Kansas City Metropolitan Region"; Report No.2 - "Dispatching and Communications"; Report No.3 - "Personnel and Training for Dial-A-Ride"; Report No.5 - "Management Information Systems"; and Report No.6 - "Marketing and Public Information".

NTIS ORDER NO.: PB 275-689/AS

PRICE: A03

**TITLE:** KCMR DIAL-A-RIDE STUDY - REPORT NO.5: MANAGEMENT INFORMATION SYSTEMS

**AUTHOR:** Bishop Engineers, Inc.

**DATE:** April 1977

**PROJECT NO.:** IT-09-0047

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**KEYWORDS:**

1. Demand-Responsive Transportation Systems
2. Dial-A-Ride
3. Management, Operations and Techniques, Dial-A-Ride
4. Management, Planning and Analysis, Dial-A-Ride
5. Paratransit

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This study is comprised of 6 reports that encompass all of the major facets of a demand-responsive system. It is designed to assist the Mid-America Regional Council and local government agencies in the detailed service planning of Dial-A-Ride services in the Kansas City Metropolitan Region. It specifically develops model services for two major areas of the KCMR. A small pilot system was applied in Independence, Missouri, and a larger pilot system was applied in Johnson County, Kansas. The study presents observations and recommendations for potential long range service development in the entire KCMR, and points out that Dial-A-Ride service requires ongoing review and updating in order to maintain its viability and usefulness.

Report No.5 discusses the role of management in a demand-responsive system. Management's primary role is the continual modification of service, in order that it may remain responsive to the needs of the users. Data generated through the daily operation of the system must be reviewed and analyzed, and the primary sources of this data are the records developed by dispatchers and drivers, and periodic surveys of users and potential users. The report shows how this data may best be used by management in its decision making process. Sample tables, graphs, and surveys are included.

It was found that Dial-A-Ride service to the general public should be seriously considered for expansion of public transportation in major portions of the KCMR, and especially in medium and lower density suburban areas, and that specialized Dial-A-Ride service for the handicapped is strongly encouraged over the entire transit area.

The study includes the following separate reports: Report No.1 - "Dial-A-Ride Service Potential in the Kansas City Metropolitan Region"; Report No.2 - "Dispatching and Communications"; Report No.3 - "Personnel and Training for Dial-A-Ride"; Report No.4 - "Vehicles, Maintenance, Fare Collection"; and Report No.6 - "Marketing and Public Information".

NTIS ORDER NO.: PB 275-690/AS

PRICE: A03



**TITLE:** KCMR DIAL-A-RIDE STUDY - REPORT NO.6: MARKETING AND PUBLIC INFORMATION

**AUTHOR:** The Huron River Group, Inc./Missouri Transportation Associates

**DATE:** July 1976

**PROJECT NO.:** IT-09-0047

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**KEYWORDS:**

1. Demand-Responsive Transportation Systems
2. Dial-A-Ride
3. Management, Operations and Techniques, Dial-A-Ride
4. Management, Planning and Analysis, Dial-A-Ride
5. Marketing, Dial-A-Ride
6. Paratransit

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This study is comprised of 6 reports that encompass all of the major facets of a demand-responsive system. It is designed to assist the Mid-America Regional Council and local government agencies in the detailed service planning of Dial-A-Ride services in the Kansas City Metropolitan Region. It specifically develops model services for two major areas of the KCMR. A small pilot system was applied in Independence, Missouri, and a larger pilot system was applied in Johnson County, Kansas. The study presents observations and recommendations for potential long range service development in the entire KCMR, and points out that Dial-A-Ride service requires ongoing review and updating in order to maintain its viability and usefulness.

Report No.6 deals with marketing (news coverage, displays, promotion, advertising, etc.). It discusses the needs of the users and how to arouse and hold the interest of current and potential users. The marketing process for Dial-A-Ride systems are functions which need to be performed by management. However, they are not necessarily all to be vested in one department or one individual. Marketing suggestions (brochures, newspaper clippings, etc.), are included.

It was found that Dial-A-Ride service to the general public should be seriously considered for expansion of public transportation in major portions of the KCMR, and especially in medium and lower density suburban areas, and that specialized Dial-A-Ride service for the handicapped is strongly encouraged over the entire transit area.

The study includes the following separate reports: Report No.1 - "Dial-A-Ride Service Potential in the Kansas City Metropolitan Region"; Report No.2 - "Dispatching and Communications"; Report No.3 - "Personnel and Training for Dial-A-Ride"; Report No.4 - "Vehicles, Maintenance, Fare Collection"; and Report No.5 - "Management Information Systems".

NTIS ORDER NO.: PB 278-812/AS

PRICE: A03

TITLE: RIDER BEHAVIOR ON AN IN-LINE ACCELERATING WALKWAY

AUTHOR: The Johns Hopkins University/Applied Physics Laboratory  
(Under contract to the Port Authority of New York and New Jersey)  
(R. W. Blevins, J. W. Gebhard, and R. M. Hanes)

DATE: September 1977

PROJECT NO.: IT-09-0126

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KEYWORDS:

1. Conveyor Systems
  2. Pedestrians
  3. Sidewalks
  4. Walkways, Accelerating
- 

This UMTA-sponsored study was conducted under contract from the Port Authority of New York and New Jersey. The existing prototype walkway at the Applied Physics Laboratory (APL), an experimental tool, is the only in-line system available. This study was undertaken as part of an overall assessment of accelerating moving walk systems by the Port Authority of New York and New Jersey.

In this report, bunching is defined as the crowding of pedestrians to such an extent that free movement is severely restricted. This report evaluates and presents bunching as a potential problem on in-line accelerating walkways. If riders move forward on the constant-speed section, they may be spaced uncomfortably close together during deceleration at the exit when the standing area is decreased due to a reduction in the treadway surface.

This report studies the problem of bunching by a review of the available literature, an examination of pedestrian area occupancies, a demonstration of the behavior of 20 middle-aged riders on an engineering model of such a walkway, and an interview. It was concluded that bunching on an accelerating moving walkway requires a specialized set of conditions that normally would not occur, particularly if the problem is recognized and suggested pedestrian controls are introduced to limit the effect.

NTIS ORDER NO.: PB 277-677/AS

PRICE: A03

TITLE: EQUITY OF TRANSIT SERVICE  
VOLUME I  
Final Report

AUTHOR: W.V. Rouse Associates, Ltd.  
(David R. Miller)

DATE: June 1977

PROJECT NO.: IT-09-9004

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KEYWORDS:

1. Civil Rights
  2. Guides and Guidance
  3. Government, Grants
  4. Survey
- 

Recipients of grants from the Urban Mass Transportation (UMTA) of the U.S. Department of Transportation are required to comply with Title VI of the Civil Rights Act of 1964, as amended. The purpose of this research project, conducted for UMTA's Office of Civil Rights, was to develop a set of guidelines for UMTA grant recipients to use in applying for certification of compliance with Title VI of the Civil Rights Act of 1964, as amended.

This study presents guidelines for grant recipients to use in submitting proof of compliance with Title VI, and it provides standards for Office of Civil Rights' reviewers to apply to the material submitted to make a determination of compliance. The guidelines and standards were developed after field surveys and pilot testing.

This research project consists of two volumes. Volume I contains an Executive Summary and Guidelines for Applicants. Volume I summarizes the project, that is, it summarizes the history, scope, and findings of research conducted on the subject of equity in transit service during the period from September 1975 to January 1977. Guidelines in Volume I are to be used by urbanized areas applying for annual certification of compliance with Title VI. There are four sections to the guidelines with instructions preceding each section. Volume II, a separate report, contains detailed information on the field studies and their results. Volume II presents the rationale for each data item requested and compares the guidelines with the previously requested material (Exhibit N). Review standards are included in Volume II. The Appendixes in Volume II contain detailed information of the field tests and a listing of the 5 cities visited as well as the persons contacted during field visits.

NTIS ORDER NO.: PB 279-073/AS

PRICE: A03

TITLE: EQUITY OF TRANSIT SERVICE  
VOLUME II  
Final Report

AUTHOR: W.V. Rouse Associates, Ltd.  
(David R. Miller)

DATE: June 1977

PROJECT NO.: IT-09-9004

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KEYWORDS:

1. Civil Rights
  2. Guides and Guidance
  3. Government, Grants
  4. Survey
- 

Recipients of grants from the Urban Mass Transportation (UMTA) of the U.S. Department of Transportation are required to comply with Title VI of the Civil Rights Act of 1964, as amended. The purpose of this research project, conducted for UMTA's Office of Civil Rights, was to develop a set of guidelines for UMTA grant recipients to use in applying for certification of compliance with Title VI of the Civil Rights Act of 1964, as amended.

This study presents guidelines for grant recipients to use in submitting proof of compliance with Title VI, and it provides standards for Office of Civil Rights' reviewers to apply to the material submitted to make a determination of compliance. The guidelines and standards were developed after field surveys and pilot testing.

This research project consists of two volumes. Volume I contains an Executive Summary and Guidelines for Applicants. Volume I summarizes the project, that is, it summarizes the history, scope, and findings of research conducted on the subject of equity in transit service during the period from September 1975 to January 1977. Guidelines in Volume I are to be used by urbanized areas applying for annual certification of compliance with Title VI. There are four sections to the guidelines with instructions preceding each section. Volume II, a separate report, contains detailed information on the field studies and their results. Volume II presents the rationale for each data item requested and compares the guidelines with the previously requested material (Exhibit N). Review standards are included in Volume II. The Appendixes in Volume II contain detailed information of the field tests and a listing of the 5 cities visited as well as the persons contacted during field visits.

NTIS ORDER NO.: PB 279-074/AS

PRICE: A05

TITLE: TRANSIT MOBILITY FOR ELDERLY AND HANDICAPPED PERSONS.

AUTHOR: Wichita-Sedgwick County Metropolitan Area Planning Department

DATE: May 1977

PROJECT NO.: KS-09-0005

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KEYWORDS:

1. Elderly
  2. Handicapped
  3. Ridership
  4. Surveys
  5. Travel Demand
- 

Elderly persons, who are defined for this study as persons 65 or more years in age, constitute 8.7% of the Sedgwick County population and 9.7% of the Wichita population. The Metropolitan Transit Authority (MTA) provides the elderly and handicapped persons with a half-fare program that is in effect on all lines during all days and hours of service. This half-fare program has been in effect since January 1974, for persons who are 65 or more years in age, and was expanded in January 1976 to include handicapped persons. This half-fare program allows elderly and handicapped individuals to ride MTA buses for 15 cents with free transfers.

The purpose of this report was to determine the size and location of the elderly and handicapped population of Sedgwick County, Kansas, identify the transportation resources available to this group, study their transportation needs and problems, analyze alternative solutions and, based on these findings, recommend actions designed to improve the mobility of these persons. Major data sources for this study include the annual Sedgwick County Intergovernmental Enumeration, a survey of social service agencies and adult care homes, and a survey of handicapped persons. An ad hoc Advisory Committee for the Transportation Needs of the Handicapped, composed of several handicapped individuals and representatives of agencies that serve handicapped persons, offered constructive comments and criticisms during preparation of this report. One of the more important recommendations of this report is to provide special transit services, such as peak-hour subscription service and off-peak dial-a-ride, to wheelchair users and other handicapped persons.

This report presents recommendations regarding the transportation needs of the elderly and handicapped. The Appendices contain forms used for Survey of Elderly Persons, for Wichita Bus Rider Survey, for Survey of Agencies and Care Homes, for Survey of the Handicapped, and for 1976 Intergovernmental Enumeration.

NTIS ORDER NO.: PB 272-443/AS

PRICE: A08

**TITLE:** AN ANALYSIS OF TRANSPORTATION PLANNING EFFECTIVENESS  
Final Report

**AUTHOR:** U.S. Department of Transportation  
Transportation Systems Center  
(Mary D. Stearns, Edward Cooper, and K.H. Schaeffer)

**DATE:** July 1977

**PROJECT NO.:** MA-09-9003

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**KEYWORDS:**

1. Planning
2. Technical Study Grants
3. Measuring and Measurements
4. Transportation Systems Management

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This document analyzes the impact of the Urban Mass Transportation Administration (UMTA) Section 9 Technical Study Grants program on urban areas' transportation planning effectiveness. It documents a novel methodology and analysis procedure for measuring a program's effect, and it is based on data from case studies of a representative group of twenty urban areas, conducted during 1976, which are reported in a companion report titled "Transportation Planning Effectiveness: Twenty Case Studies."

This analysis was designed to determine how Technical Study Grants have impacted local transportation policy and decision-making and have guided capital investments and service improvements. Specifically, the study reports the influence of Grants on transportation planning effectiveness which is measured by the development of professional planning capability, acquisition of new capital equipment, introduction of new or improved services with existing facilities, and alterations in the local institutional climate.

Data are drawn from case studies of urban areas which have received at least one Technical Study Grant as of March 31, 1975. The twenty urban areas represent all UMTA regions, a range of population sizes, residential densities, and demographic characteristics. The case studies are reported in a uniform format which focuses on transportation planning effectiveness but also includes the urban areas' socio-economic and travel characteristics, transit and transportation planning history. Appendix A of this report summarizes the twenty case studies.

The conclusions suggest that the Technical Study Grants have been directly responsible for upgrading the quality of local transportation planning as well as for facilitating capital acquisitions and service changes.

**NTIS ORDER NO.:** PB 272-756/AS

**PRICE:** A05

TITLE: BALTIMORE REGION RAPID TRANSIT SYSTEM  
PHASE I

AUTHOR: Daniel, Mann, Johnson & Mendenhall/Kaiser Engineers  
(prepared for Mass Transit Administration, Maryland  
Department of Transportation)

DATE: January 1974

PROJECT NO.: MD-09-0006

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KEYWORDS:

1. Planning
  2. Rail, Rapid Transit
  3. Rail, Systems and Planning Design
- 

Significant transportation planning for Baltimore was begun in the early 1960's with an analysis of the long-range and specific urban transportation requirements of the region; the long-term planning and preliminary design process was accomplished between 1962 and 1973. The T9-6 (September 1971-December 1973) is one more step in the continuing planning and design process leading to the construction and operation of a public rapid transit system in the Baltimore region; it is administered and supervised by the Mass Transit Authority.

This report presents a review of the work completed and the results achieved by the T9-6 Baltimore Rapid Transit project, and summarizes the rapid transit development program to date, as well as the current and future program leading to Phase I implementation. The purpose of the T9-6 project was to provide preliminary engineering designs, design criteria and guide specifications for the Phase I system; and to develop additional studies and analyses relative to cost, schedule, and other technical aspects to provide a basis for the current Phase I project.

The Phase I system includes the Northwest and South lines (about 28 miles of line structure and 20 stations). The two Phase I lines are completely grade separated along routes extending northwest and south from Charles Center, and will provide frequent, high-speed, automated rapid transit service utilizing modern steel wheel vehicles traveling on steel rails. The two Phase I lines and corresponding stations are illustrated herein. Final design is not included in this report. It is anticipated that final design for the Phase I system will proceed in subsequent work programs.

This report lists related studies--subcontracts and future programs, and charts out the Phase I System and future service corridors.

NTIS ORDER NO.: PB 276-588/AS

PRICE: A07

TITLE: AUTOMATED SMALL VEHICLE FIXED GUIDEWAY SYSTEMS STUDY

AUTHOR: Twin Cities Area Metropolitan Transit Commission  
(DeLeuw, Cather and Company, Inc.; Bather-Ringrose-Wolsfeld, Inc.;  
and Honeywell, Inc.)

DATE: March 1975

PROJECT NO.: MN-09-0010

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KEYWORDS:

1. Automated Guideway Transit
  2. Group Rapid Transit
  3. Social Benefits and Costs
  4. Urban Development and Planning
- 

This report presents the findings of the Small Vehicle Fixed Guideway System (SVS) Study conducted for the Twin Cities Area Metropolitan Transit Commission (MTC). The purpose of this SVS study is to provide sufficient and reliable information to citizens and public officials of the Twin Cities Metropolitan Area as a basis for determination of the best form of automatic fixed guideway system to satisfy the needs of the area. The overall objective of the SVS study is to develop small vehicle alternatives which would be comparable in cost to the 57-mile Intermediate Capacity Rapid Transit (ICRT) system approved by the MTC in December 1972, and to offer a more demand-responsive service. Hence, the two major points addressed in this report are: 1) the selection of the optimum small vehicle system for the Twin Cities and 2) the comparison of this small vehicle system with ICRT system plan.

This report presents the study background, policy direction, and development of criteria for evaluation of candidate systems for the Twin Cities Area. It also includes an analysis of the urban design and community acceptance issues of a small vehicle system from the standpoint of visual and environmental impact, safety and security, cost and service as well as the industry's ability to deliver an SVS from the standpoint of technology and satisfaction of travel demands.

Group Rapid Transit (GRT) is recommended as the candidate small vehicle system for the Twin Cities Area. This GRT network consists essentially of distribution systems in the Minneapolis and St. Paul metropolitan centers. The ICRT and the GRT alternatives are compared in relation to each of the evaluation criteria presented in this report. Alternative systems are paired for overall comparison of dominant advantages and disadvantages. The Appendices include the Act of the Minnesota Legislature authorizing the planning of the SVS, and the interim transportation policies of the Metropolitan Council.

NTIS ORDER NO.: PB 270-297/AS

PRICE: A12



**TITLE:** COUNTY-WIDE TRANSIT DEPENDENT STUDY - LINCOLN/LANCASTER  
COUNTY, NEBRASKA  
Final Report

**AUTHOR:** Wilbur Smith and Associates  
(W. G. Stringfellow, et al.)

**DATE:** December 1977

**PROJECT NO.:** NE-09-0009

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**KEYWORDS:**

1. Demand Responsive Systems
2. Elderly
3. Handicapped
4. Transportation Disadvantaged

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This report describes the analyses and findings resulting from a technical study to investigate the special transportation requirements of the handicapped, elderly, and economically disadvantaged persons in Lancaster County, Nebraska. It inventories the existing transportation available to transit dependents, defines target groups and latent trip demand, establishes ridership objectives, and evaluates the costs and benefits of various alternative improvement concepts. Four entities in the Lincoln area are currently providing transportation to transit dependent groups. These are the Lincoln Transportation System (LTS) regular fixed-route systems, the LTS Handi-Bus (a significant demand responsive service to urban and rural elderly and handicapped persons), taxis, and social service agencies. However, the key to the overall focus and purpose of this study is to ensure that the mobility needs of urban and rural transit dependent groups in Lancaster County are being adequately met, and that their role in the planning and development of improved transit services is secured.

In order to achieve these goals, a program has been initiated which consists of the following elements: 1) maintain the existing Handi-Bus system; 2) institute procedures to increase system productivity; 3) increase weekend and evening hours of operation; 4) implement shared-ride taxi service as a supplement to the Handi-Bus service; 5) institute a reduced fare program on regular fixed-route service for qualified low-income persons; 6) expand Handi-Bus service to rural areas; 7) give additional study to a medical service shuttle on the regular LTS system; 8) expand the Handi-Bus system if shared-ride taxi service cannot be implemented; and 9) ensure that the transit dependent groups are included in the continuing planning process for special transportation needs.

The study points out that the program must include continuous review and monitoring and should be updated annually. It is intentionally flexible in order that various elements can be modified, added, or deleted as necessary, based on the results of the monitoring and surveillance program actions of appropriate decision-making bodies. The report also contains Appendices A through H and Appendix I, which is a bibliography.

NTIS ORDER NO.: PB 281-640/AS

PRICE: A09

TITLE: ERIE SHORT-RANGE TRANSIT TECHNICAL STUDY

AUTHOR: Simpson and Curtin

DATE: January 1977

PROJECT NO.: PA-09-0028

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KEYWORDS:

- |                |                                      |
|----------------|--------------------------------------|
| 1. Elderly     | 4. Management, Planning and Analysis |
| 2. Fare        | 5. Marketing                         |
| 3. Handicapped | 6. Transportation Systems Management |

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The Erie Metropolitan Transit Authority (EMTA) is the major carrier operating regular route service in both the Erie City and County area. Since EMTA acquired the bus system from the Erie Coach Company in 1967, it has implemented a comprehensive program of transit improvements that has turned around the ridership decline that was apparent up to 1967 with the result that annually over 5.5 million passengers are now carried on EMTA buses compared to the 3 million in 1967. The purpose of this study is to update EMTA's 1969 Transit Development Program, that is, to maintain planning and capital certification, and therefore remain eligible for State and Federal funds. This document contains the Transit Element of Erie's Transportation System Management Program. The program's findings and recommendations serve as the six-year plan for maintaining and improving mass transit in Erie. Improvements to transit in Erie have been identified in five major areas: management, marketing, fare structure, service, and capital.

This report presents the results of the transit update study which are: 1) background information which includes a description of existing services and an evaluation on how well services correlate with specific community characteristics; 2) an examination of community attitudes toward transit; 3) an evaluation of the adequacy of existing service in terms of PennDOT standards and service; and 4) an examination of capital, management, and marketing improvements. Interviews, discussions, and two public meetings were conducted in order to obtain the attitudes and views of both the general public and the community leaders regarding mass transit services in Erie. The Appendix contains a synopsis of interviews with social service agency representatives in Erie. This report suggests that the future for mass transit in Erie will continue to be one where buses, rather than more elaborate modes, will provide the basis intra-community public transportation service.

NTIS ORDER NO.: PB 270-214/AS

PRICE: A08

**TITLE:** SEPTA MANAGEMENT STUDY  
FINAL REPORT

**AUTHOR:** Booz, Allen & Hamilton Inc./for Delaware Valley  
Regional Planning Commission

**DATE:** May 1978

**PROJECT NO.:** PA-09-0039

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**KEYWORDS:**

- |                                     |  |
|-------------------------------------|--|
| 1. Evaluation                       | 4. Management, Operations & Techniques |
| 2. Fare, Collection                 | 5. Planning                            |
| 3. Financing Mass<br>Transportation |  |

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In 1964, State Act 450 created the Southeastern Pennsylvania Transportation Authority (SEPTA) to provide for integrated mass transportation services in the five-county Pennsylvania portion of the Philadelphia metropolitan area. Annual revenues approximates \$95 million with another \$30 million of commuter rail revenue collected by ConRail. These revenues do not cover operating costs (\$175 million for year ending 30 June 1978 plus \$80 million for ConRail commuter rail). The SEPTA Management Study was commissioned by SEPTA's funding governments to evaluate how well this mission was being performed in consideration of the agency's budget constraints, and to make specific improvement recommendations. This is the Final Report and Executive Summary resulting from consultant efforts.

The SEPTA Study uses a series of diagnostics (peer group comparison, case studies, flow charts, and organizational analysis) to identify areas where SEPTA performance appeared unusual. Serious deficiencies were identified in nine functional areas (Cash Handling; ConRail Purchase-of-Service Agreement; Surface Transit Operations Planning; Vehicle Utilization; Surface Transit Maintenance; Capital Project Management; Pension Management; Quality of Transit Service; and Regional Fare Integration) and seven additional improvement areas, along with specified improvement objectives. A key question raised during this study relates to the roles of the SEPTA Board and SEPTA's funding agencies. A calendar for the most important milestones is presented on a quarter-by-quarter basis over the next two years. This Study concludes that SEPTA currently faces formidable management challenges in a number of areas. There are two Study findings which the author states are unusual to SEPTA: 1) The number of specific, severe, problem areas that were identified in this report, and 2) The attitudes within the organization such as, complacency and "fatalism" that were also identified.

**NTIS NO:** PB 285-010/AS

**PRICE:** A04

TITLE: INCREASING EFFICIENCY IN BUS MAINTENANCE OPERATIONS  
Final Report

AUTHOR: University of Puerto Rico  
(Dr. Louis A. Martin-Vega)

DATE: September 1976

PROJECT NO.: PR-09-0004

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KEYWORDS:

1. Bus
  2. Maintenance, Equipment
  3. Maintenance, Facilities
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The Commonwealth of Puerto Rico Metropolitan Bus Authority is in the process of an overall improvement program directed towards upgrading both the level and quality of service provided to its customers. Despite the work that has been carried out in the planning and scheduling aspects of the improvement program, the number of buses in service has continued to decline below adequate service levels. Management identifies this situation with inefficient maintenance operations; therefore, such a situation provides the justification for this study.

This report presents the results of an extensive analysis of data collected by the maintenance workshop staff. Both a fleet analysis and shop analysis are carried out to evaluate shop performance, and initial estimates concerning shop productivity are also determined. An integrated control system is developed for routine utilization of shop data and monitoring of future shop performance. The details and documentation of these systems are contained in the Appendix of this report. Conclusions as well as recommendations for increasing maintenance efficiency are also presented in this report. The results contained herein are based on data collected from March 21, 1975 to June 18, 1976 (298 working days).

NTIS ORDER NO.: PB 270-919/AS

PRICE: A04

TITLE: 1973 TRANSIT PATRON ORIGIN AND DESTINATION SURVEY  
Final Report

AUTHOR: Puget Sound Council of Governments  
(Metro Transit/City of Seattle Joint Project)

DATE: March 1975

PROJECT NO.: WA-09-0006

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KEYWORDS:

1. Computer, Applications
  2. Management, Planning and Analysis
  3. Ridership, Profiles
  4. Surveys
  5. Trip Generation, Distribution
- 

The purpose of this bus survey was to provide a current data base which would assist in the rational planning and marketing of public transportation in King County, Washington. This report presents the methods and preliminary results of the transit patron origin and destination survey conducted on May 23 and 24, 1973, on the Municipality of Metropolitan Seattle (Metro) Transit System which primarily serves King County. The survey consisted of two parts, including a one-way (inbound) questionnaire distributed to approximately 58,000 passengers who boarded buses outside the Seattle Central Business District (CBD), and a complementary survey questionnaire distributed to approximately 33,000 persons boarding inside the Seattle CBD.

The results of the bus survey were processed and stored in machine-readable form on magnetic tape. Data was summarized on both a geographic and demographic basis. Results of the survey were used in several transit related projects during the data reduction phase of the survey, and the Seattle Engineering Department, Traffic and Transportation Division, is furnishing survey data to several local agencies for projects now in progress. The survey produced data which compares well with previous surveys. About seven of ten bus riders had no automobile available and were "captive" riders. Six out of ten trips were either to or from work. Two thirds of all riders were women, and about one third of all bus riders transfer at least once to complete their trip. According to this report, the objectives of this study have been met satisfactorily.

The most important product of this survey is a data tape which represents the trips made on the bus system on a typical weekday. The data processing program which was used to produce the statistical summaries in this report is called SPSS (Statistical Package for the Social Sciences). This is a standardized program available locally at several computer centers. There are many special purpose plots and tabulations that have been produced from this survey tape and are currently available. Prospective data users should contact the Traffic and Transportation Division, Seattle Engineering Department, for further information concerning survey data.

NTIS ORDER NO.: PB 272-362

PRICE: A06

TITLE: I-90 HIGHWAY/TRANSIT ALTERNATIVES  
Phase II

AUTHOR: Puget Sound Council of Governments (PSCOG)

DATE: December 1975

PROJECT NO.: WA-09-0010

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KEYWORDS:

1. I-90 Alternatives
  2. Land Use
  3. Mass Transit Alternatives
  4. Planning
- 

The purpose of this Phase II report is to provide information in a consistent, comparable format on a wide range of alternative means of providing for the travel demand in the I-90 corridor across Lake Washington. This report presents the findings of Phase II of the study of withdraw and substitution, providing evaluations of the performance and impacts of alternative concepts which were initially developed in Phase I (PB 269-909). The Phase I report study of withdraw and substitution alternatives presented 47 mass transit projects for the Seattle/King County area which were eligible for federal-aid funding as substitutes for Interstate 90 across Lake Washington. The PSCOG reviewed the Phase I information and designed Phase II to address specifically those transit alternatives which provided for improvements across Lake Washington. In this report, Phase II, eight alternatives are described at a conceptual level of detail as well as the sub-variations. All alternatives are developed in the general context of the region's adopted 1990 Transportation Systems Plan, that is, nearly all data in this report is based upon forecasts of travel conditions in the year 1990.

This report presents data on a wide range of alternatives for serving cross-lake travel, including guideway transit systems, bus transit improvements, and combinations of bus/highway improvements. Current federal laws and regulations regarding Interstate withdrawal and substitution are discussed so as to point out important consequences of these laws and regulations for decisions on I-90. Other major areas reviewed in this report are: 1) land use and regional development; 2) transportation system performance; 3) economic and fiscal feasibility; 4) environmental impacts; and 5) social impacts.

The PSCOG makes no recommendations in this report concerning a final solution of cross-lake travel questions. The data serves to inform and to facilitate dialogue concerning the alternatives so that a consensus among responsible local officials and the concerned public may ultimately be reached.

NTIS ORDER NO.: PB 270-377/AS

PRICE: A07

TITLE: A SURVEY OF MASS TRANSIT ALTERNATIVES TO INTERSTATE 90

AUTHOR: Puget Sound Governmental Conference

DATE: July 1975

PROJECT NO.: WA-09-0010

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KEYWORDS:

1. Guideways, Fixed Facility
  2. I-90 Alternatives
  3. Land Use
  4. Mass Transit Alternatives
  5. Planning
- 

Over the past decade, attempts to complete the Interstate Highway 90 (I-90) project across Lake Washington, have been frustrated by legal and public controversy. The 1973 Federal-Aid Highway Act added a new policy for local officials, which was to withdraw an interstate segment from the nationwide Interstate System and to substitute a mass transit project in the same urbanized area. The purpose of this report is to respond to the desire of local officials to learn more about the range of eligible and available transit opportunities to assist them in a decision as whether or not to withdraw and substitute. This report does not recommend one transit alternative, but rather describes five alternative concepts for transit investment to serve the region with specific project options within each alternative.

This report deals with mass transit substitution alternatives to I-90. It is Phase I of a two-phase study of the mass transit substitution question and provides a physical and operational description of the characteristics of many transit alternatives to I-90 in terms of location in the same corridor or elsewhere, in terms of different technologies, and in terms of route mileage and costs. Phase II of this study (PB 270-377) will evaluate the impacts of these transit alternatives in terms of travel demand forecasting; mode split analysis; compatibility with regional growth trends and policies; economic and fiscal feasibility; and social, economic, and environmental impacts.

This report provides background information as to the purposes, organization, history and legal setting of this study, and summarizes the major findings related to the alternative technologies and system concepts described herein. Relationships are explored between cross-lake travel demand and public policy for growth, development, and highway and transit service levels. Finally, this report elaborates the legal history, current status, and technical nuances of the I-90 project and mass transit substitution provisions of Federal law.

NTIS ORDER NO.: PB 269-909/AS

PRICE: A08

TITLE: MAGIC CARPET EVALUATION STUDY  
Final Report

AUTHOR: Municipality of Metropolitan Seattle

DATE: May 1977

PROJECT NO.: WA-09-0012

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KEYWORDS:

1. Bus, Intracity
  2. Fare, Free
  3. Inner City
  4. Planning
  5. Surveys
- 

The Municipality of Metropolitan Seattle (METRO) is a special-purpose government serving all of King County, Washington, including the City of Seattle and the surrounding suburban cities. METRO assumed responsibility in 1972 for planning and operating public transit in King County, and it merged the existing Seattle Transit System with suburban transit systems.

Magic Carpet is the name of the Seattle fare-free Central Business District (CBD) bus service that was initiated in a 105 block area of the CBD on September 9, 1973, and it is available 24 hours a day, seven days a week. This fare-free zone was initially proposed as a one year experiment to provide answers to whether or not the concept of free downtown bus service was desirable. The overall objective of Magic Carpet service is to attract auto person trips to a more efficient means of transportation, which is the transit bus.

This report presents the fare-free zone, Magic Carpet, evaluation project. It consists of a series of surveys aimed at measuring the effectiveness of downtown free buses in achieving the following objectives: 1) improvement of downtown air quality; 2) reduction of traffic congestion; 3) conservation of gasoline; 4) encouragement of CBD peripheral parking; 5) encouragement of mobility; 6) increase of midday patronage (transit shopping trips); and 7) stimulation of retail trade. Surveys in this report indicate that fare-free bus service is responsible for attracting \$5,000,000 in retail sales. The number of daily fare-free bus trips counted in June 1974 was 12,258, as opposed to the 4,100 daily bus trips made in the same area in 1973. The findings of this study have encouraged the Seattle and Metro Councils to continue the Magic Carpet service for at least two more years, at a cost to the city of \$100,000 per year. The Seattle experience emphasizes that downtown transportation systems can be designed and operated to give greater emphasis to within-CBD circulation, as opposed to the traditional emphasis of improving transportation system capacity to and from downtown. This report concludes that fare-free service produced exceptionally positive results and is worth continuing. The data in this report should enable other cities to estimate how fare-free service would fit in their communities.

NTIS ORDER NO.: PB 271-214/AS

PRICE: A06



TITLE: DEVELOPMENT OF PERFORMANCE INDICATORS FOR TRANSIT

AUTHOR: University of California at Irvine  
(Gordon J. Fielding, Roy E. Glauthier, and Charles A. Lave)

DATE: December 1977

PROJECT NO.: CA-11-0014

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KEYWORDS:

1. Evaluation
  2. Management, Planning and Analysis
  3. Quantitative Analysis
  4. Transit Performance
  5. University Research
- 

Rapidly rising operating costs in transit over the past decade have increased the emphasis on improved management and better utilization of existing facilities. With these changes in priorities, techniques to assist the evaluation of public transit performance are needed.

The objective of this research is to establish a rationale for the development of performance indicators for transit; to analyze potential indicators; and to apply a limited set of indicators to data collected from transit properties in the states of California and Washington. The focus herein is on the Federal and State levels of government. The procedure is designed to develop and test criteria for the evaluation of performance of transit properties in different locations, of differing size, and with different operational procedures.

This document presents the rationale and developmental structure for the evaluation of transit performance through quantitative performance indicators. It specifies efficient and effective transit service as appropriate goals to be encouraged by Federal and State governments and identifies three efficiency and six effectiveness indicators which focus on significant aspects of performance. Using operating and financial data collected from 47 public transit operators in California and 5 operators in Washington, the selected performance indicators are analyzed for comparability of values between different modes of transit, different service area population densities, and different organizational types. The performance indicator values for selected transit properties are individually interpreted to demonstrate the analytic use and limitations of indicators. Potential uses of performance indicators are identified and areas requiring additional research are described. The Appendices include the following: Literature Search; Listing of Properties; Operating and Financial Data; and a Glossary.

NTIS ORDER NO.: PB 278-678/AS

PRICE: A07

**TITLE:** ELEMENTARY ANALYSIS-MANUAL METHODS TRIP DISTRIBUTION MODELING  
Final Report

**AUTHOR:** Urban Systems Laboratory/University of Illinois at Chicago Circle  
(Siim Soõt and Ashish Sen)

**DATE:** March 1978

**PROJECT NO.:** IL-11-0008

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**KEYWORDS:**

1. Elementary Analysis
  2. Models and Modeling, Trip Distribution
  3. Trip Distribution Modeling, Elementary Analysis
- 

The purpose of this paper is to examine and report on the potentials of simplifying the activity of trip distribution modeling. The method suggested is elementary analysis, which is a systematic procedure for extracting column and row effects from a matrix of data, which yield a residual matrix. Requisite for the method is an O-D matrix, which is first transformed to logarithms before column and row averages are subtracted, resulting in a residuals matrix. The same operation is performed on a matrix of distances among the zones analyzed above, yielding a distance residuals matrix. These two residuals are graphed to determine the friction term of the gravity model. This friction factor, computed for a sample from a suburban circumferential corridor was applied to another sample from the same corridor. Using the gravity model, with the pull and push factors of the zones estimated with the friction factor, the origin-destination matrix is estimated. These estimates are computed in a straight forward, non-iterative manner, yet they are remarkably similar to the actual trip matrix.

In this paper, this method is applied to sample work trip data in the Chicago area to demonstrate how the distance effect (friction factor) is extracted and the method is then applied to another data set as an empirical test. Since the examples in this study required only a few hours to compute with a small calculator, the method is considered to be a useful trip distribution modeling and forecasting technique whenever the study is relatively small and quick results are desired. Larger problems may use the same method, but require computer analysis.

Based on the sample application and the applications of both real and hypothetical examples performed by the authors, but not included in this report, the performance of the method can be considered to be good, particularly since few resources need be invested. When the method is applied manually, the user becomes intimately involved and can learn more from the procedure while being able to add insight to the interpretation to a degree uncommon in computer processed analyses. For these reasons, the authors believe the method should be given serious consideration for gravity model calibration and trip distribution estimation. This report contains references.

NTIS ORDER NO.: PB 285-179/AS

PRICE: A02

**TITLE:** MARKET SEGMENTATION ANALYSIS:  
THE POTENTIALS OF CARTOGRAPHIC ANALYSIS AND CENSUS DATA

**AUTHOR:** University of Illinois at Chicago Circle  
(Siim Soot and Ashish Sen)

**DATE:** March 1978

**PROJECT NO.:** IL-11-0008

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**KEYWORDS:**

- |                          |                    |
|--------------------------|--------------------|
| 1. Census Data           | 4. Modal, Split    |
| 2. Cartographic Analysis | 5. Trip Generation |
| 3. Market, Segmentation  |                    |
- 

Segmentation of transportation markets is based on the principle that areas within the metropolitan region which have similar attitudinal and/or demographic characteristics will have similar transportation needs. This study examines several ways in which these homogeneous subareas of the city may be identified and in turn how they relate to transportation (work trip) patterns, namely, mode split.

The purpose of this study is to illustrate the strength of the relationships between demographic characteristics and modal choice patterns using census data. Most of the arguments developed use a cartographic based analysis supplemented by statistical measures; hence, the arguments rely extensively on visual interpretation. It is contended herein that such interpretations can, in some cases, be as powerful and convincing as numerically based evaluations. The maps produced in this study use the U.S. Bureau of the Census Urban Transportation Planning Package (UTPP) as input data.

The authors demonstrate and conclude the validity/utility of three basic premises: 1) there are distinct areas within the metropolitan region which can be delimited by demographic variables which correspond to mode specific areas for the purpose of market segmentation; 2) the U.S. Bureau of the Census UTPP data can be easily used to easily and quickly perform such an analysis; and 3) this analysis can be conducted principally with maps to give visual credence to the relationships discussed. The authors point out the main advantage of the UTPP data, namely, that it can be readily mapped. The maps drawn in the Chicago area, according to the authors, have proven to be a valuable tool of description and analysis, with statistical measures of association assisting in the completion of the discussions of spatial and numerical interrelationships.

**NTIS NO.:** PB 285-056/AS

**PRICE:** A03

TITLE: METHODOLOGY FOR IDENTIFYING URBAN TRANSPORTATION TECHNOLOGY  
ALTERNATIVES  
Final Report

AUTHOR: University of Illinois at Chicago Circle  
(Edward W. Walbridge)

DATE: March 1977

PROJECT NO.: IL-11-0008

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KEYWORDS:

1. Automated Guideway Transit Systems
  2. Information Aids
  3. People Movers
  4. Planning
  5. Travel Demand
- 

This report reflects the view that existing urban transportation planning processes tend to ignore new transportation technologies, such as Personal Rapid Transit (PRT), Automated Guideway Transit (AGT), accelerating moving walkway systems, and shared taxis. The information system described in this report aims to remedy this deficiency by specifying all the alternative technologies, new or old, that can satisfy a need. This system fits into the planning process after distribution. The intent herein is that this system be useful to transportation planners and agencies.

This report describes an information system which accepts as input a set of characteristics describing a particular transportation need and yields as output a list of transportation technologies capable of satisfying that need. A broad range of transportation need situations can be fed into this system. The system, however, is concerned with people movement rather than with goods movement. The user of the system specifies the nature and extent of demand, as well as certain service requirements. A transportation technology is defined as suited to a particular need situation when the technology meets the demand and the service requirements, and does so at reasonable costs. The technologies identified by the system as suitable to a need are examined to select the one best alternative. This final selection process is not part of the system. The system consists of two tables. The procedure used to develop these tables is discussed. Their use is described and examples are presented in this report. The system specifies new transportation technologies as well as old. This report recommends that a more comprehensive version of this system be developed in the future.

NTIS ORDER NO.: PB 271-225/AS

PRICE: A03

TITLE: A MODAL SPLIT MODEL FOR  
HIGH DENSITY URBAN CORRIDORS

AUTHOR: University of Illinois at Chicago Circle,  
Urban Systems Laboratory  
(Siim Soot, Ashish Sen, and Efi Pagitsas)

DATE: March 1978

PROJECT NO.: IL-11-0008

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KEYWORDS:

- |                     |                     |
|---------------------|---------------------|
| 1. Bus              | 5. Park and Ride    |
| 2. Corridors, Urban | 6. Planning         |
| 3. Modal Split      | 7. Trip, Generation |
| 4. Models           | 8. Stations         |
- 

The objective of this study was to develop a modal split model that would be relatively simple (frequently non-computer based), require little lead time, use readily available data, and be sensitive to policy alternatives. The model was designed to contribute to the evaluation of such policy options as station closing, new route alternatives, addition of park and ride facilities, skip stop policies, and increasing capacity.

This study produces modal split models specifically for high density urban corridors. In a two stage process, splits are established between the automobile and public transportation, and then bus and rapid transit. The aggregate, trip interchange models are calibrated using weighted least squares, with modal disutility functions, service characteristics, and trip end densities as independent variables. The disutility functions based on weighted trip segments, proved to be significant. The data used are from readily available sources, the census UTPP data aggregated in the Chicago area by 1/4 square mile zones and public transportation fares and travel times. The background for the modeling procedure is established by producing a multitude of computer generated maps displaying the modal split patterns and by graphing the socioeconomic correlates of modal split in the Chicago area. Special attention was given to a thorough application of the model to Howard Corridor with Chicago Transit Authority rail rapid transit service. The application estimated the effects of closing selected peak period reverse commuting platforms to expedite service. In the process the model was improved. The modified model estimated a ridership increase of approximately two percent, but much of the diversion was from bus rather than the automobile.

The Appendixes are: An Application of the Modal Split Model; The Effect of Station Closing on Transit Ridership; Calibration of the Binary Logit Curve; Alternative Modal Split Processes; and Summary of Application Procedures.

NTIS NO.: PB 284-745/AS

PRICE: A07

**TITLE:** MONETIZATION OF TRANSPORTATION IMPACTS:  
POLICY EVALUATION METHODOLOGY

**AUTHOR:** University of Illinois at Chicago Circle  
(Steven M. Rock)

**DATE:** April 1978

**PROJECT NO.:** IL-11-0008

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**KEYWORDS:**

- |                          |              |
|--------------------------|--------------|
| 1. Evaluation Techniques | 5. Comfort   |
| 2. Planning              | 6. Pollution |
| 3. Monetization          | 7. Land Use  |
| 4. Accidents             | 8. Crime     |
- 

This document was produced as part of a program of Research and Training in Urban Transportation sponsored by the Urban Mass Transportation Administration of the U.S. Department of Transportation.

The impacts of transportation investments are often measured in units that make comparisons difficult. Converting the units of an impact into equivalent dollar values (called monetization) will allow the combination of diverse effects measured in different inherent units. The result of this monetization process should provide additional objective and useful information in the decision-making process, and thus improve the analysis of investment alternatives.

This report, Task 2 of Project 4, concentrates on those impacts that are relatively easy to monetize (travel time, energy use) and those impacts that are relatively difficult to monetize (pollution, accidents). Monetization for current values only is considered herein; values of impact over time will be considered in Task 3 of this project. This report consists of nine parts: an introduction and summary of the findings plus eight appendixes detailing the monetization process for a number of transportation impacts. The eight appendixes are as follows: Monetization of Intangibles; The Case of Pollution; The Cost of Crime for Transportation Planning; Accident Costs in Transportation Planning; Monetization of Comfort; The Costs of Displacement; Monetization of Local Area Effects; The Value of Travel Time: State of the Art; and Monetization of Energy Use. The author concludes that this report represents a step forward in facilitating the analysis of investment alternatives and that the monetization technique can lead to better decision-making and thus should be pursued, advanced, and refined by further research.

**NTIS NO:** PB 284-585/AS

**PRICE:** A07

TITLE: THE ROLE OF SECURITY IN MARKETING URBAN MASS TRANSPORTATION  
Final Report

AUTHOR: University of Illinois at Chicago Circle  
(Laurence P. Feldman and David B. Vellenga)

DATE: February 1977

PROJECT NO.: IL-11-0008

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KEYWORDS:

1. Community Response
  2. Marketing
  3. Qualitative Analysis
  4. Security
  5. Surveys
- 

This paper was produced as part of a program of Research and Training in Urban Transportation sponsored by the Urban Mass Transportation Administration of the U.S. Department of Transportation.

This study reflects the view that advocates of the application of marketing techniques to encourage transit patronage have tended to ignore the security problem as a factor in consumer choice behavior. The purpose of this study is to provide input on the security-oriented attitudes and perceptions of users and non-users of public transportation for use in a large scale transit marketing study of the Chicago metropolitan area. Using verbatim responses of the subjects involved, this study reports on the use of Focus Group Interviews to gather information on urban mass transportation. A focus group interview is a qualitative tool for collecting information in which a number of respondents simultaneously discuss a given topic under the influence of a moderator. In contrast with the questionnaire and survey techniques which rely on relatively limited responses from many respondents, the focus group provides the depth and color of response obtained by exploring the probed responses of a relatively few subjects.

Information obtained from eight groups of users and non-users, representing a broad cross-section of Chicago metropolitan area residents, suggests that personal security plays a potentially important role in attempts to market urban mass transportation. Although the data are qualitative and not scientifically projectible, the findings tend to support the results of other, large scale studies of the role of security in the urban mass transportation patronage decision. Some practical, relatively low cost measures are suggested to help convince present and potential patrons that authorities are both concerned with, and prepared to do something about, alleviating the security problem. The findings of this study suggest that people's perception of, and attitude towards, the security of urban mass transportation in the central cities is largely a reflection of their experience.

NTIS ORDER NO.: PB 271-224/AS

PRICE: A03

TITLE: URBAN CORRIDOR TRIP DISTRIBUTION MODELS: A STUDY OF THE CHICAGO AREA USING THE CENSUS UTPP DATA

AUTHOR: University of Illinois at Chicago Circle/Urban Systems Laboratory (Ashish Sen, et al.)

DATE: September 1977

PROJECT NO.: IL-11-0008

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KEYWORDS:

1. Corridors
  2. Models and Modeling
  3. Research, Activities
  4. Trip Distribution
  5. Trip Generation
- 

This review focuses on the historical application of the Newtonian gravity formula to model human spatial interaction. The report states that whatever the interaction being modeled, the underlying assumption in the use of the formula was that the phenomenon being modeled is directly proportional to a characteristic of the locations and inversely proportional to distance.

The purpose of trip distribution models is to forecast an origin-destination (O-D) matrix. Several different models are briefly discussed in this report. However, the trip distribution model highlighted in this report is the gravity model.

This report consists of four major segments: 1) a theoretical discussion of the gravity model demonstrating how it can be interpreted as a dual logit model; 2) a discussion of the history of trip distribution models; 3) a practical discussion of the difficulties of calibrating the gravity model using least squares procedures; and 4) an empirical evaluation of alternative calibration methods. The methods evaluated include several variations of regression and elementary analyses, such as weighted regression to correct for heteroscedasticity. Also median and mean elementary analyses are examined; both two-way and three-way.

Even though some of the results are not final, two-way elementary analyses using means with the resulting residuals regressed against corridor segment distances, appears to hold the most promise.

NTIS ORDER NO.: PB 275-161/AS

PRICE: A04



**TITLE:** SOURCES OF NONFEDERAL SUPPORT FOR PUBLIC  
TRANSPORTATION PROGRAMS IN NONURBANIZED AREAS

**AUTHOR:** North Carolina A&T State University  
(Alice E. Kidder)

**DATE:** June 1978

**PROJECT NO.:** NC-11-0004

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**KEYWORDS:**

1. Financing Mass Transportation
2. Nonurbanized Areas
3. Planning
4. Social Benefits and Costs
5. Intergovernmental Relations

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The purpose of this study was to find out the extent to which states and localities are spending nonfederal funds in support of public transportation in nonurbanized areas. A detailed survey was administered to state officials in transportation or highway departments, to social service agencies of the state whose budgets include significant funding for client transportation, to ascertain current and projected expenditures.

This report presents the results of a survey of twenty-five states, estimating the extent of nonfederal support for public transportation programs in rural (nonurbanized) areas. The survey found \$36 million dollars of state funds, and three million dollars of substate funds supporting public transportation in these areas. Based upon these figures, it is estimated that at least \$78 million are spent annually from nonfederal sources, and that the trend in such funding is upward. Passage by Congress of operating assistance programs for rural areas would enlarge the figure.

The principal focus of nonfederal funding is to match social service based budgets used to enhance mobility of the transportation dependent in nonurbanized areas. Two dollars of "special service" transportation money is spent at the state level for every one dollar of "general service" public transportation in nonurbanized areas. The author recommends that an interagency group at the federal level involve simultaneously the input from HEW, DOT, DOL, and DOA to maximize local opportunities for developing transportation programs with use of federal funds. Currently the majority of the nonfederal dollars are being used to match social service budgets from HEW.

**NTIS NO:** PB 284-410/AS

**PRICE:** A06

TITLE: ESTABLISHING INNOVATIVE TAXICAB SERVICES:  
A GUIDEBOOK

AUTHOR: University of North Carolina  
(G. Gilbert, C.A. Garber, and J.F. Foerster)

DATE: August 1977

PROJECT NO.: NC-11-0005

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KEYWORDS:

- |                        |                |
|------------------------|----------------|
| 1. Guides and Guidance | 5. Paratransit |
| 2. Demand-Responsive   | 6. Taxis       |
| 3. Dial-A-Ride         |                |
| 4. Planning            |                |
- 

Similar to the dilemma facing transit operators, taxi operators face rising costs and disappearing profits. The Wells' (1977) survey report, noted herein, shows that half of the operators did not generate enough revenues in 1975 to cover operating and capital costs, and about one-fourth of the operators did not even cover operating costs. This document is intended to serve as a guidebook for local planners and public officials who wish to integrate taxi services into the mix of local transit services.

Rather than just reporting the results of the research project, this report attempts to outline how to establish innovative taxi operated paratransit services. It focuses on the problems which face local transportation/public officials rather than taxi operators; it recognizes the critical position of local officials in integrating transit and paratransit services. Both conventional and innovative taxicab services in the United States are examined. Based upon this examination, guidelines are developed for establishing similar innovative services elsewhere.

This report is organized around four topics: Background information of the taxi industry (focus is on the economics of taxi operations); Description of taxi service innovations; Practical details of implementing innovative taxi services (focus is on contracts between public agencies and private operators); and Evaluation of innovative paratransit services.

NTIS ORDER NO.: PB 278-647/AS

PRICE: A04

TITLE: RAM: A NORMATIVE TOOL FOR TRANSIT ROUTE PLANNING

AUTHOR: Polytechnic Institute of New York  
(L. Goldstein, W. McShane, Advisor)

DATE: September 1977

PROJECT NO.: NY-11-0009

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KEYWORDS:

1. Bus, Fixed-Route
  2. Planning, Tools
  3. Models
  4. Routes and Routing
  5. Urban Development and Planning
- 

This work deals with the development of a Route Allocation Model (RAM), a practical methodology to assist the transit planner in the development of transit needs. RAM is a computerized transit route design tool which will sequentially allocate bus (or other) routes to an area under study. The model is multi-purpose in that it may be utilized for standard transit route planning or for transit route planning under a scenario of special interest. These scenarios may include such items as limited auto-environment planning, school bus planning, standard Transportation Systems Management Element applications, and the updating of currently outdated transit routes to reflect present day transportation needs.

Chapters of this report discuss: the nature of the general transit routing problem; a disutility function; a definition of the network and the RAM approach. There are charts that illustrate the differences between the conventional approach of route planning and the RAM approach towards transit route planning. The scope of this project includes a case study application of the RAM methodology in Queens County, New York City. Results obtained for this case study are presented as well as recommendations for further research. The RAM methodology is developed within this text and complemented by the appendices of computer outputs which illustrate components of the methodology. The appendix material is not included herein, but it is available on request from the Transportation Research and Training Center, Polytechnic Institute of New York.

The RAM methodology should provide the transportation planner with an innovative, sketch planning approach to deal with the complex transit routing problem. Currently the Urban Transportation Planning System does not include a transit route design tool within the suite of programs. The authors encourage the possibility of including the RAM for the transit route planning function.

NTIS ORDER NO.: PB 275-213/AS

PRICE: A09

**TITLE:** THE LOCATION AND SIZING OF URBAN FREIGHT TERMINALS  
WITH MULTIPLE PLANNING PERIODS: THE URBAN  
TERMINAL INVESTMENT MODEL (UTIM)

**AUTHOR:** The Ohio State University  
(G.M. Clark and W. Bradford Ashton)

**DATE:** December 1977

**PROJECT NO.:** OH-11-0001

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**KEYWORDS:**

- |                     |                         |
|---------------------|-------------------------|
| 1. Center City      | 5. Small-Shipment       |
| 2. Freight Movement | 6. Terminals            |
| 3. Models           | 7. Trucks and Trucking  |
| 4. Planning, Tools  | 8. Urban Goods Movement |
- 

High direct cost for small-shipment handling in urban areas and increasing costs of congestion, pollution, and energy consumption generated by vehicle movement have sparked interest in the current urban goods movement problem of small-shipment distribution. This document contains an investigation of the economic advantages of consolidation terminals for the distribution of small-shipment freight in large metropolitan areas.

The purpose of this research was to develop and test an Urban Terminal Investment Model (UTIM) for use in the design decisions required to locate, construct, and operate a network of terminal facilities. Several overall criteria are presented as guidelines to produce a model and a solution procedure which permits terminal planning on a routine basis. This research has led to a design methodology which is currently operational for use by transportation planners. The methodology is implemented with computer programs collectively called UTIM.

Planning models for two different system operating rules which assign freight flows to terminals are developed in this report. The models are designed to identify least cost terminal system configurations which are valuable in assessing the economic attractiveness of freight consolidation relative to other goods movement methods. The UTIM models are nonlinear integer programs which are solved with new partial enumeration methods developed in the research.

The research results included realistic evidence for potential economic superiority of multiple terminal networks over a single facility, namely, for cities whose metropolitan areas are characterized by spread out commercial zones and concentrated truck carrier locations. Application of the UTIM model was tested using data for the Columbus, Ohio, area. For this analysis, the least cost configuration was a single consolidation facility which was estimated to permit significant cost savings over the current goods movement system.

**NTIS ORDER NO.:** PB 286-490/AS

**PRICE:** A11

**TITLE:** A METHODOLOGY FOR DETERMINING CHARACTERISTICS  
OF SMALL SHIPMENTS

**AUTHOR:** The Ohio State University  
(Gordon M. Clark and David C. Murman)

**DATE:** July 1976

**PROJECT NO.:** OH-11-0001

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**KEYWORDS:**

- |                                 |                              |
|---------------------------------|------------------------------|
| 1. Freight Movement             | 5. Urban Goods Movement      |
| 2. Methodology, Data Collection | 6. Surveys, Shipper-Receiver |
| 3. Planning, Tools              |                              |
| 4. Terminals                    |                              |
- 

A new data collection methodology, the shipper-receiver method, for determining characteristics of small freight shipments in urban areas is presented in this report. These characteristics are used to determine the feasibility of urban goods consolidation terminals for small shipments to and from the Central Business District (CBD). The objective of this report is to present and evaluate an experimental design and operational procedure that will collect less than truckload (LTL) freight movement data directly from the shippers and the receivers of goods.

This data collection methodology is specifically designed to support the Urban Terminal Investment Model (UTIM) which determines preferred terminal locations and operating policies. It is intended for use by planners in designing and evaluating a system of urban goods consolidation terminals for small shipments. The overall methodology includes the use of survey of shippers and receivers of small shipment, a ratio-delay study of randomly selected truck loading areas, and a manual simulation of vehicle routes and schedules.

Conclusions and recommendations regarding the feasibility and effectiveness of the shipper-receiver survey, ratio-delay study, and simulation methods are presented in this report. The main conclusion drawn from the research is that this methodology will provide the necessary information at less cost than other currently available methods.

NTIS ORDER NO.: PB 279-649/AS

PRICE: A07

**TITLE:** METHODOLOGY FOR DETERMINING URBAN GOODS CONSOLIDATION TERMINAL INVESTMENT AND LOCATION DECISIONS: EXECUTIVE SUMMARY

**AUTHOR:** The Ohio State University/Systems Research Group  
(Gordon M. Clark and W. Bradford Ashton)

**DATE:** December 1977

**PROJECT NO.:** OH-11-0001

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**KEYWORDS:**

- |                        |                         |
|------------------------|-------------------------|
| 1. Center City         | 4. Terminals            |
| 2. Freight Movement    | 5. Trucks and Trucking  |
| 3. Models and Modeling | 6. Urban Goods Movement |
- 

This report constitutes one of the final reports for a study to develop an Urban Terminal Investment Model (UTIM) for use by planners in designing and evaluating a system of urban goods consolidation terminals for small shipments to reduce the cost of picking up and delivering these shipments in the Central Business District (CBD). It is a summary of two related reports: A Methodology for Determining Characteristics of Small Shipments (PB 279-649) and The Location and Sizing of Urban Freight Terminals with Multiple Planning Periods: The Urban Terminal Investment Model (UTIM) (PB 286-490). The study describes a planning methodology for designing the system which is applied in two phases: the data collection phase which involves interviews with shippers and receivers; a simulation to estimate truck travel times; and a sampling study to estimate vehicle loading and queuing times, and the investment phase which involves the application of a UTIM to determine least-cost terminal investment, location, and operation decisions. The report also addresses previous studies that have been conducted to evaluate consolidation terminals.

To illustrate UTIM capabilities, the Columbus, Ohio CBD was analyzed with forecasts for a 12-year period from 1974 to 1985. The forecasts were based upon the 1973 estimates of zonal volumes for consolidatable shipments less than 1000 pounds. The results from the application of the UTIM in Columbus are presented. These results indicate that significant savings in pickup and delivery costs could be realized through the use of a consolidation terminal. In addition, analyses of the spatial characteristics of urban areas indicate that multiple terminals in some areas may be more efficient than a single terminal.

NTIS ORDER NO.: PB 288-760/AS

PRICE: A03

**TITLE:** URBAN FREIGHT CONSOLIDATION:  
LEGAL, ATTITUDINAL, AND OPERATIONAL CONSIDERATIONS  
ASSOCIATED WITH IMPLEMENTATION

**AUTHOR:** The Ohio State University  
(James F. Robeson)

**DATE:** May 1978

**PROJECT NO.:** OH-11-0001

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**KEYWORDS:**

- |                           |                         |
|---------------------------|-------------------------|
| 1. Freight Movement       | 5. Trucks               |
| 2. Center City            | 6. Urban Goods Movement |
| 3. Inner City             |                         |
| 4. Stations and Terminals |                         |
- 

Of the several alternatives proposed to solve the urban congestion/small shipment problem, the most commonly mentioned are the temporal or spatial separation of freight and passenger movement, the revision of building codes and zoning ordinances, improvements in traffic engineering and street design, and the consolidation of pick-up and delivery service through a centralized terminal. This report points out that the freight consolidation concept has been recognized as having the greatest merit.

This study examines the issues associated with implementing the concept of urban freight consolidation. It includes an analysis of the legal implications of alternative forms of ownership and the impact which ownership might have on operating rights. In addition, it reports the findings of a national survey conducted to determine the attitudes toward urban freight consolidation held by consignees, consignors, transport agents, public warehousemen, and planning agents. It also examines the concerns expressed by each of the preceding publics relative to implementing and operating a consolidation terminal or series of terminals. The primary focus of this research has been to investigate the economic and social impact which an urban small shipment consolidation terminal might have on a typical metropolitan area such as Columbus, Ohio.

This report concludes that: urban goods consolidation is economically feasible and socially desirable; there are no apparent legal restrictions that cannot be overcome; and the attitudes toward consolidation by the publics are favorable. A set of conclusions stating how urban terminal consolidation might best proceed is also included.

Appendix A herein describes three phases of this research, namely, the economic and social desirability of an urban consolidation terminal, the economic costs of constructing and operating such a terminal, and modeling the site selection decision. Appendix B contains the attitude survey questionnaire.

NTIS ORDER NO.: PB 286-547/AS

PRICE: A06

**TITLE:** THE SIGNIFICANCE OF TELECOMMUNICATIONS AS A PARTIAL  
SUBSTITUTE FOR TRANSPORTATION  
Final Report

**AUTHOR:** Carnegie-Mellon University/Transportation Research Institute  
(Marty Wells and John E. Tolle)

**DATE:** September 1976

**PROJECT NO.:** PA-11-0013

---

**KEYWORDS:**

1. Communications
  2. Computers
  3. Time Costs
  4. Trip Generation
- 

The major objective of this research is to determine the feasibility of using existing communications technology to prevent the need for many of the Central Business District (CBD), inter-office business trips currently made in the Pittsburgh, Pennsylvania area. The effect these technologies may exercise on future urban form and travel patterns is also examined, as various types of communication systems, their use, cost-effectiveness, advantages/disadvantages, and short and long-term forecasting as to present and future changes are discussed.

The work trip offers the greatest potential for relieving congestion and associated costs, and since two out of five trips within the urban area (world-wide) are home to work and work to home, the possibilities of reducing peak hour congestion, delays, accidents, and pollution are immense. There are indications that in the future offices may provide suburban branches for the convenience of employees who can work together effectively with picture phones and time-sharing computers. However, although work trips may decrease, the additional time and ability to travel may result in dramatic increases in transportation for pleasure.

A study methodology is contained herein which represents the ideal procedure for determining how physical transportation and telecommunications are interrelated and how, together, they affect urban structure. However, several reasons are presented as to why these procedures are unlikely to be achieved at this time. The report addresses the Contact Record Surveys which were developed to present existing trip-making based on a sample of Pittsburgh CBD centers. Results of the questionnaires are analyzed and implications for substitution are formulated. The results of the Contact Record Survey tend to support an underlying hypothesis of this thesis that sophisticated telecommunications could substitute for many inter-office business trips originating in Central Business Districts. The results, based on limited data and therefore preliminary in nature, point toward a broad marker for substitution and underscore the need for further research in this area. A listing of References is included in this study.

NTIS ORDER NO.: PB 284-718/AS

PRICE: A07



TITLE: EMPLOYER VANPOOL PROGRAMS:  
FACTORS IN THEIR SUCCESS OR FAILURE

AUTHOR: University of Washington  
(James Oscar Jacobson)

DATE: June 1977

PROJECT NO.: WA-11-0005

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KEYWORDS:

1. Group Ridership
  2. Shared-Rides
  3. Survey
  4. Vanpools
  5. Carpools
- 

The energy crisis of 1973-1974 convinced many Americans that changes in their commuting habits would soon be necessary. Through vanpooling commuters can not only reduce energy consumption, but also save money. This study focuses only upon the employer operated vanpool programs, and the intent is to identify those conditions under which vanpooling operates best.

This study aims to identify factors that have made for the success or failure of some employer vanpool programs. Information was obtained from **lengthy questionnaires sent to managers of 58 different employer programs**; the results of the 58 returns are documented herein.

Results show that vanpooling occurs predominantly in outlying regions of the metropolitan areas, among professional and office workers, and not necessarily in organizations with many employees. Management interest played a key role in their existence, and usually no previous carpool program existed. Successful programs were motivated by factors which had some rewards to management. Failures occurred with user, more so than management, apathy.

This document contains a Bibliography. The Appendices contain a copy of the six-page employer survey/questionnaire and a list of agency/firm contacts.

NTIS ORDER NO.: PB 276-955/AS

PRICE: A05

TITLE: AN INTERACTIVE SPATIAL ANALYSIS AND DISPLAY SYSTEM

AUTHOR: University of Washington  
(James W. Clark)

DATE: July 1977

PROJECT NO.: WA-11-0005

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KEYWORDS:

- |                        |                                      |
|------------------------|--------------------------------------|
| 1. Computers, Graphics | 5. Maps and Mapping                  |
| 2. Information Aids    | 6. Management, Planning and Analysis |
| 3. Interfaces          | 7. Research, Operations              |
| 4. Planning, Tools     |                                      |
- 

A major contention of this paper is that a significant opportunity exists to apply computer tools to problems in the field of urban analysis and planning, mainly by expanding perceptions of the types of information processing and problem-solving for which computers can be used.

This paper presents a philosophical discussion of analysis needs when data bases with spatial components are available. The tool called the Interactive Spatial Analysis and Display System (ISADS) has been constructed to aid these needs, and example applications are presented herein to illustrate the use of this tool. ISADS is a computer system designed to aid the experimental, interactive analysis of spatial data. "Experimental, interactive analysis" involves data base browsing, heuristics, and hypothesis formulation and testing conducted in a real time mode using a graphic display terminal. The use of graphic displays as a powerful device for discovering spatial relationships has been fully exploited in ISADS.

ISADS is a general-purpose system that can be used with a variety of data base types. At the most primitive level, it is suitable for analysis of data which lacks spatial identification. Its utility becomes particularly evident if the data base is geocoded, permitting the creation of spatial displays and the exploration of spatial relationships. Finally, if a cartographic data base is available, then a variety of types of map overlays is possible, further enhancing the spatial analysis capability. User communication with ISADS is by means of an easily learned, English-language type command structure. The system takes advantage of a commercially available Data Base Management System (DBMS) to simplify the creation, updating, and maintenance of the data base. In addition, the DBMS supports a general purpose programming language interface which permits ready development of new applications within ISADS.

NTIS ORDER NO.: PB 280-693/AS

PRICE: A02

**TITLE:** POTENTIAL FOR BETTERMENT DISTRICT FINANCING AND JOINT DEVELOPMENT APPLICATIONS TO SURFACE TRANSIT

**AUTHOR:** University of Washington at Seattle/Urban Transportation Program (Robert G. Shawcroft, Edgar M. Horwood, and Martha S. Lester)

**DATE:** July 1977

**PROJECT NO.:** WA-11-0005

---

**KEYWORDS:**

1. Betterment District Financing
  2. Joint Development
  3. Transit Financing
  4. Transit Planning
- 

This report was written as the result of a general interest by U.S. Department of Transportation officials as to the feasibility of Betterment Development Financing and Joint Development. The intent is that the report will capture the interest of transit planners, as well as those interested in betterment and joint development. It proposes a general methodology for evaluating land use and investment activity with respect to land in the vicinity of surface transit facilities. Although development and benefit district financing has been considered relative to heavy rail urban transportation systems, little attention has been paid to their application to buses.

The three major objectives of the research were: (1) to determine if there are incremental benefits accruing to land near bus, trolley, and by inference light rail facilities; (2) to examine equity issues in potential tax benefit districts serving such facilities; and (3) to examine the potential of joint development with respect to surface transit. An underlying objective was the presentation of an interactive spatial analysis system suited to the small-scale study of transit system impacts and relationship to their environment.

A variety of criteria were used to identify desirable benefit district and joint development study areas, such as: (1) diversity in population and housing characteristics; (2) diversity in land uses; and (3) service by a variety of transit routes. Two basic data files were selected -- a building investment data and block-level population and housing data. Two types of building investment -- commercial and multi-family new construction -- were chosen as the best available indicators of benefit or development potential. Primary focus was directed to exploring locations in the vicinity of multiple routes where levels of commercial and multi-family new investment might be particularly high.

The study concludes that the use of special benefit districts would be difficult to operationalize and that joint development opportunities are encouraging.

TITLE: TRANSIT PERFORMANCE MEASURES:  
THEIR SIGNIFICANCE IN LOCAL FUNDING ALLOCATION

AUTHOR: University of Washington  
(Herbert A. Drosdat)

DATE: June 1977

PROJECT NO.: WA-11-0005

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KEYWORDS:

1. Measuring and Measurements
2. Government, Federal
3. Government, State
4. Planning, Tools
5. Transportation Systems Management

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Transit performance measures (TPM's) are the values of variables associated with transit performance, with respect to the vehicle itself, the service, use of the service, the costs of the service, and the social, economic and environmental impacts of the various elements of the physical system. Urban transportation issues of interest in this study are mainly those that relate to the subvention of tax monies, whether state or federally collected. The main problem addressed is the development of meaningful TPM's for funding allocation. Other issues deal with the multimodal nature of urban trips; the insensitivity of the state-of-the-art TPM's to paratransit services; and the use and application of TPM's, once they are attained. This report should be of particular interest to policy-makers dealing with the subvention of funds to local transit properties.

The objective of this research is to develop a basis for critical evaluation of TPM's as allocation mechanisms--what they do or do not measure and why, common expectations of use, and inconsistencies in the approaches reviewed. A matrix framework was developed to test the aggregate signifance, ease of definability, data obtainability, and inter-transit system consistency of state-of-the-art measures. A case study (CalTrans) is presented that provides a pragmatic feedback to the TPM evaluation presented earlier, and 11 CalTrans TPM's are discussed. Six generic TPM's were uncovered in the deductive screening process that are deemed to have potential utility to the allocation of transit support funds: 1) Energy efficiency; 2) Fiscal operating efficiency; 3) Vehicle use efficiency (system-wide revenue hours per vehicle); 4) Vehicle use efficiency (system-wide revenue miles per vehicle mile); 5) Transit service consumption efficiency; and 6) Labor efficiency. Examples of the difficulties in developing TPM's for use in the evaluation of transit properties are discussed in three studies: CalTrans, Fielding and Glauthier, and the Auditor General's report. This report concludes that the utility of TPM's has been overestimated, particularly with regard to their use in allocating funds to individual transit properties.

NTIS ORDER NO.: PB 276-141/AS

PRICE: A09

TITLE: TRANSIT'S ROLE IN THE CREATION OF THE  
POLYCENTRIC CITY: AN INITIAL ASSESSMENT

AUTHOR: University of Washington  
(Jerry B. Schneider and Tomoki Nogushi)

DATE: August 1977

PROJECT NO.: WA-11-0005

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KEYWORDS:

- |                           |                                   |
|---------------------------|-----------------------------------|
| 1. Joint Development      | 5. Research Activities            |
| 2. Land, Use              | 6. Outer City                     |
| 3. Planning               | 7. Surveys                        |
| 4. Polycentric Urban Form | 8. Urban Development and Planning |
- 

The concept of major activity centers as a key growth shaping element of any regional development plan has been widely accepted by the planning profession but few serious studies designed to make the concept operational have been undertaken to date. The purpose of this report is to review the activity centers concept and to examine its relationship to the public transit part of the regional development plan.

This report investigates the role of transit in aiding the implementation of land use plans that call for the creation of major diversified centers in the outer city. The polycentric city concept is defined and illustrated by reference to regional planning work in the Twin Cities of Minnesota. Arguments for and against the concept are outlined and the results of a survey relating to the present status of the concept are presented. An evaluation framework is developed and applied in visits to ten American and two Canadian urban regions. The most interesting work on this topic was found in Vancouver, B.C., and Toronto, Ontario. Other interesting work has been done in the Twin Cities and San Diego. The results of the field work are summarized and seven specific examples of noteworthy progress toward the development of outer city centers of significant scale are described. A brief discussion of the national potential for outer city centers is developed from several perspectives. Current UMTA policy with respect to outer city centers is reviewed as are several related studies recently completed or in process. Some policy options regarding UMTA's potential role in aiding the creation of outer city centers are defined. A do-nothing option is discussed as is a three-stage do-something option that is incremental in nature.

This document marks the half-way point of a two-year research project. Its main purpose is to foster discussion of the issues raised so as to aid the further assessment of the utility of the polycentric concept to the evolution of more viable areawide transit systems.

NTIS ORDER NO.: PB 275-043/AS

PRICE: A12

TITLE: UTILIZING GEOGRAPHIC BASEFILES FOR TRANSPORTATION ANALYSES:  
A NETWORK BASEFILE SYSTEM

AUTHOR: University of Washington  
(Claus D. Gehner)

DATE: June 1977

PROJECT NO.: WA-11-0005

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KEYWORDS:

1. Computers, Graphics
  2. Information Aids
  3. Network Models
  4. Planning, Tools
- 

The existence of Geographic Base Files (GBF) for most large urban areas offers a significant resource for the network models required for many transportation studies. The thrust of the Network Basefile System (NETBASIS) development, underway at the University of Washington since 1974, is to explicitly build upon the existing GBF data resource (which has been operational for the City of Seattle for many years) and to provide a general purpose transportation network data base together with the required data manipulation and display software. The purpose of this paper is to present a status report on the NETBASIS development as of June 1977.

The system presented herein is implemented in an interactive graphic computer environment. Aside from the standard data base input, editing, and retrieval capabilities given by the host Data Base Management System, software has been implemented to allow the user to extract geographic or functional subsets of the network. This extracted network can then be "abstracted" to remove non-intersection nodes, thus producing a network model which can be used within most existing transportation planning tools, such as the UMTA Transportation Planning System. An interactive graphic network editor is also provided which allows the user to modify his extracted/abstracted network to reflect planning options to be analyzed.

This report contains: 1) an overview description of NETBASIS in terms of its current functional specifications and the design philosophies used to implement these functions; 2) a description of the content and structure of the files making up the network data base together with the sources of the data; 3) sample application of each of the NETBASIS functions implemented to date; and 4) some general conclusions and indications as to future direction in the implementation, testing, and operationalization of NETBASIS. During the 1977-78 academic year, the University of Washington will conduct a detailed analysis of an on-board origin-destination survey recently completed by METRO. This project will emphasize those analyses for which an interactive, graphic, spatial analysis and display capability seem most suitable.

NTIS ORDER NO.: PB 275-586/AS

PRICE: A03

TITLE: VANPOOLS FOR URBAN TRANSPORTATION  
THEIR LEGISLATIVE BASE, PROMOTION AND POTENTIAL

AUTHOR: University of Washington  
(Richard Hillyard Ford)

DATE: June 1977

PROJECT NO: WA-11-0005

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KEYWORDS:

1. Commuter Transportation
  2. Paratransit, Ridesharing
  3. Vanpooling, State Role
  4. Vanpooling, State Legislative Action
  5. Vanpooling, Employer-Sponsored
- 

This research report reflects the view that vanpooling has emerged as a viable and new form of commuter transportation that can help meet public goals of reduced fuel consumption, air pollution, and congestion while affording benefits to individuals and employers; it is worthy of state attention. The intent of this report is to serve as a general assessment of current legislative interest and state promotional development in vanpooling. Information herein should be useful to the following: federal and state regulatory and legislative bodies; federal, state, and local transportation related agencies; university research groups; and employer organizations with or without ridesharing programs for employees.

The primary objectives of this report are as follows: to draw attention to state vanpool development and legislative action; to catalogue how the fifty states approach their regulation of vanpool operations; to present a compendium of state legislative interest, promotion, and development in vanpooling in a scenario format for use by other states; to present a case study documentation of Minnesota's response to promoting and developing vanpooling as a viable commuter mode of transportation; and to offer a package list of employer, legislative, and regulatory actions which can and should be taken to promote and encourage the development of shared-ride services like vanpooling.

This report contains a comprehensive bibliography on vanpooling to date. Appendix A contains a glossary of terms; Appendix B is a compendium of state legislative interest, promotion, and development of vanpooling activity; and Appendix C contains the letters sent to State Transportation Committee Chairpersons (50 states), DOT Staff, and Regulatory Body Personnel.

NTIS ORDER NO.: PB 279-590/AS

PRICE: A12

**TITLE:** LABOR RELATIONS IN URBAN TRANSIT  
Final Report

**AUTHOR:** University of Wisconsin at Madison/Industrial Relations Research Institute  
(James L. Stern, et al.)

**DATE:** August 1977

**PROJECT NO.:** WI-11-0004

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**KEYWORDS:**

1. Collective Bargaining Arbitration
  2. Financing Mass Transportation, Requirements
  3. Industrial Relations
  4. Labor Relations
  5. Surveys
- 

This study focuses on labor-management relations in the urban mass transit industry from 1960-1975, a period during which most of the major transit systems changed from private to public ownership and began receiving substantial funding from government. A major objective of this study was to evaluate how collective bargaining outcomes--transit wages, labor cost, and work rules--changed with the advent of public ownership and public subsidies.

Two chapters of this study are devoted to an examination of the development of Amalgamated Transit Union (ATU) policies and how they affect practices in the urban transit industry. The political, legal, and economic factors shaping the collective bargaining relationship are explored. Special attention is directed toward such factors as: 1) the labor protection clause, Section 13 (c), of the Urban Mass Transportation Act, and 2) the reliance on "interest" arbitration for the settlement of the terms of new contracts during the past seventy years. Data on wage and selected fringe benefit changes in the 1960-75 period are reviewed. The impact of the change from private to public ownership and the increasing reliance on governmental subsidies are studied. Because this is an exploratory study which relies in part on secondary data, conclusions are tentative.

The findings herein are based on several data collection and analysis techniques. Chapter X is based on data primarily from APTA's TRANSIT OPERATING REPORTS for various years; Chapters V and VI reflect information obtained from ATU publications and interviews with the national leadership of that union. The primary data sources for the other chapters were personal interviews with union and management spokesmen at 25 individual transit systems scattered across the U.S.

Some of the findings contained in this report indicate that: 1) labor and management officials at the 25 sample properties visited expressed satisfaction with the procedures now in force for meeting Section 13 (c) requirements; and 2) transit's unique brand of private sector collective bargaining has been carried on within a governmental context almost unchanged in structure or process.

NTIS ORDER NO.: PB 274-059/AS

PRICE: A15



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Issue 5

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