TCRP

REPORT 140

TRANSIT
COOPERATIVE
RESEARCH
PROGRAM

Sponsored by
the Federal
Transit Administration

A Guide for Planning and Operating Flexible Public Transportation Services

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

TCRP OVERSIGHT AND PROJECT SELECTION COMMITTEE*

CHAIR
Ann August
Santee Wateree Regional Transportation Authority

MEMBERS
John Bartosiewicz
McDonald Transit Associates
Michael Blaylock
Jacksonville Transportation Authority
Linda J. Bohlinger
HNTB Corp.
Raul Bravo
Raul V. Bravo & Associates
Gregory Cook
Veolia Transportation
Terry Garcia Crews
StarTran
Angela Iannuzziello
ENTRA Consultants
John Inglish
Utah Transit Authority
Sherry Little
Spartan Solutions, LLC
Jonathan H. McDonald
HNTB Corporation
Gary W. McNeil
GO Transit
Michael P. Melaniphy
Motor Coach Industries
Bradford Miller
Des Moines Area Regional Transit Authority
Frank Otero
PACO Technologies
Keith Parker
VIA Metropolitan Transit
Peter Rogoff
FTA
Jeffrey Rosenberg
Amalgamated Transit Union
Richard Sarles
Washington Metropolitan Area Transit Authority
Michael Scanlon
San Mateo County Transit District
Marilyn Shazor
Southwest Ohio Regional Transit Authority
James Stem
United Transportation Union
Gary Thomas
Dallas Area Rapid Transit
Frank Tobey
First Transit
Matthew O. Tucker
North County Transit District
Pam Ward
Ottumwa Transit Authority
Alice Wiggins-Tolbert
Parsons Brinckerhoff

EX OFFICIO MEMBERS
William W. Millar
APTA
Robert E. Skinner, Jr.
TRB
John C. Horsley
AASHTO
Victor Mendez
FHWA

TDC EXECUTIVE DIRECTOR
Louis Sanders
APTA

SECRETARY
Christopher W. Jenks
TRB

*Membership as of June 2010.

TRANSPORTATION RESEARCH BOARD 2010 EXECUTIVE COMMITTEE*

OFFICERS
CHAIR: **Michael R. Morris,** *Director of Transportation, North Central Texas Council of Governments, Arlington*
VICE CHAIR: **Neil J. Pedersen,** *Administrator, Maryland State Highway Administration, Baltimore*
EXECUTIVE DIRECTOR: **Robert E. Skinner, Jr.,** *Transportation Research Board*

MEMBERS
J. Barry Barker, *Executive Director, Transit Authority of River City, Louisville, KY*
Allen D. Biehler, *Secretary, Pennsylvania DOT, Harrisburg*
Larry L. Brown, Sr., *Executive Director, Mississippi DOT, Jackson*
Deborah H. Butler, *Executive Vice President, Planning, and CIO, Norfolk Southern Corporation, Norfolk, VA*
William A.V. Clark, *Professor, Department of Geography, University of California, Los Angeles*
Eugene A. Conti, Jr., *Secretary of Transportation, North Carolina DOT, Raleigh*
Nicholas J. Garber, *Henry L. Kinnier Professor, Department of Civil Engineering, and Director, Center for Transportation Studies, University of Virginia, Charlottesville*
Jeffrey W. Hamiel, *Executive Director, Metropolitan Airports Commission, Minneapolis, MN*
Paula J. Hammond, *Secretary, Washington State DOT, Olympia*
Edward A. (Ned) Helme, *President, Center for Clean Air Policy, Washington, DC*
Adib K. Kanafani, *Cahill Professor of Civil Engineering, University of California, Berkeley*
Susan Martinovich, *Director, Nevada DOT, Carson City*
Debra L. Miller, *Secretary, Kansas DOT, Topeka*
Sandra Rosenbloom, *Professor of Planning, University of Arizona, Tucson*
Tracy L. Rosser, *Vice President, Corporate Traffic, Wal-Mart Stores, Inc., Mandeville, LA*
Steven T. Scalzo, *Chief Operating Officer, Marine Resources Group, Seattle, WA*
Henry G. (Gerry) Schwartz, Jr., *Chairman (retired), Jacobs/Sverdrup Civil, Inc., St. Louis, MO*
Beverly A. Scott, *General Manager and Chief Executive Officer, Metropolitan Atlanta Rapid Transit Authority, Atlanta, GA*
David Seltzer, *Principal, Mercator Advisors LLC, Philadelphia, PA*
Daniel Sperling, *Professor of Civil Engineering and Environmental Science and Policy; Director, Institute of Transportation Studies; and Interim Director, Energy Efficiency Center, University of California, Davis*
Kirk T. Steudle, *Director, Michigan DOT, Lansing*
Douglas W. Stotlar, *President and CEO, Con-Way, Inc., Ann Arbor, MI*
C. Michael Walton, *Ernest H. Cockrell Centennial Chair in Engineering, University of Texas, Austin*

EX OFFICIO MEMBERS
Thad Allen (Adm., U.S. Coast Guard), *Commandant, U.S. Coast Guard, U.S. Department of Homeland Security, Washington, DC*
Peter H. Appel, *Administrator, Research and Innovative Technology Administration, U.S.DOT*
J. Randolph Babbitt, *Administrator, Federal Aviation Administration, U.S.DOT*
Rebecca M. Brewster, *President and COO, American Transportation Research Institute, Smyrna, GA*
George Bugliarello, *President Emeritus and University Professor, Polytechnic Institute of New York University, Brooklyn; Foreign Secretary, National Academy of Engineering, Washington, DC*
Anne S. Ferro, *Administrator, Federal Motor Carrier Safety Administration, U.S.DOT*
LeRoy Gishi, *Chief, Division of Transportation, Bureau of Indian Affairs, U.S. Department of the Interior, Washington, DC*
Edward R. Hamberger, *President and CEO, Association of American Railroads, Washington, DC*
John C. Horsley, *Executive Director, American Association of State Highway and Transportation Officials, Washington, DC*
David T. Matsuda, *Deputy Administrator, Maritime Administration, U.S.DOT*
Victor M. Mendez, *Administrator, Federal Highway Administration, U.S.DOT*
William W. Millar, *President, American Public Transportation Association, Washington, DC*
Cynthia L. Quarterman, *Administrator, Pipeline and Hazardous Materials Safety Administration, U.S.DOT*
Peter M. Rogoff, *Administrator, Federal Transit Administration, U.S.DOT*
David L. Strickland, *Administrator, National Highway Traffic Safety Administration, U.S.DOT*
Joseph C. Szabo, *Administrator, Federal Railroad Administration, U.S.DOT*
Polly Trottenberg, *Assistant Secretary for Transportation Policy, U.S.DOT*
Robert L. Van Antwerp (Lt. Gen., U.S. Army), *Chief of Engineers and Commanding General, U.S. Army Corps of Engineers, Washington, DC*

*Membership as of June 2010.

TRANSIT COOPERATIVE RESEARCH PROGRAM

TCRP REPORT 140

A Guide for Planning and Operating Flexible Public Transportation Services

John F. Potts
Maxine A. Marshall
THE DMP GROUP, INC.
New Orleans, LA

Emmett C. Crockett
Jackson, MS

Joel Washington
Silver Spring, MD

Subscriber Categories
Public Transportation • Planning and Forecasting

Research sponsored by the Federal Transit Administration in cooperation with the Transit Development Corporation

TRANSPORTATION RESEARCH BOARD

WASHINGTON, D.C.
2010
www.TRB.org

TRANSIT COOPERATIVE RESEARCH PROGRAM

The nation's growth and the need to meet mobility, environmental, and energy objectives place demands on public transit systems. Current systems, some of which are old and in need of upgrading, must expand service area, increase service frequency, and improve efficiency to serve these demands. Research is necessary to solve operating problems, to adapt appropriate new technologies from other industries, and to introduce innovations into the transit industry. The Transit Cooperative Research Program (TCRP) serves as one of the principal means by which the transit industry can develop innovative near-term solutions to meet demands placed on it.

The need for TCRP was originally identified in *TRB Special Report 213—Research for Public Transit: New Directions,* published in 1987 and based on a study sponsored by the Urban Mass Transportation Administration—now the Federal Transit Administration (FTA). A report by the American Public Transportation Association (APTA), Transportation 2000, also recognized the need for local, problem-solving research. TCRP, modeled after the longstanding and successful National Cooperative Highway Research Program, undertakes research and other technical activities in response to the needs of transit service providers. The scope of TCRP includes a variety of transit research fields including planning, service configuration, equipment, facilities, operations, human resources, maintenance, policy, and administrative practices.

TCRP was established under FTA sponsorship in July 1992. Proposed by the U.S. Department of Transportation, TCRP was authorized as part of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA). On May 13, 1992, a memorandum agreement outlining TCRP operating procedures was executed by the three cooperating organizations: FTA, the National Academies, acting through the Transportation Research Board (TRB); and the Transit Development Corporation, Inc. (TDC), a nonprofit educational and research organization established by APTA. TDC is responsible for forming the independent governing board, designated as the TCRP Oversight and Project Selection (TOPS) Committee.

Research problem statements for TCRP are solicited periodically but may be submitted to TRB by anyone at any time. It is the responsibility of the TOPS Committee to formulate the research program by identifying the highest priority projects. As part of the evaluation, the TOPS Committee defines funding levels and expected products.

Once selected, each project is assigned to an expert panel, appointed by the Transportation Research Board. The panels prepare project statements (requests for proposals), select contractors, and provide technical guidance and counsel throughout the life of the project. The process for developing research problem statements and selecting research agencies has been used by TRB in managing cooperative research programs since 1962. As in other TRB activities, TCRP project panels serve voluntarily without compensation.

Because research cannot have the desired impact if products fail to reach the intended audience, special emphasis is placed on disseminating TCRP results to the intended end users of the research: transit agencies, service providers, and suppliers. TRB provides a series of research reports, syntheses of transit practice, and other supporting material developed by TCRP research. APTA will arrange for workshops, training aids, field visits, and other activities to ensure that results are implemented by urban and rural transit industry practitioners.

The TCRP provides a forum where transit agencies can cooperatively address common operational problems. The TCRP results support and complement other ongoing transit research and training programs.

TCRP REPORT 140

Project B-35
ISSN 1073-4872
ISBN 978-0-309-15480-2
Library of Congress Control Number 2010929874

© 2010 National Academy of Sciences. All rights reserved.

COPYRIGHT INFORMATION

Authors herein are responsible for the authenticity of their materials and for obtaining written permissions from publishers or persons who own the copyright to any previously published or copyrighted material used herein.

Cooperative Research Programs (CRP) grants permission to reproduce material in this publication for classroom and not-for-profit purposes. Permission is given with the understanding that none of the material will be used to imply TRB, AASHTO, FAA, FHWA, FMCSA, FTA, or Transit Development Corporation endorsement of a particular product, method, or practice. It is expected that those reproducing the material in this document for educational and not-for-profit uses will give appropriate acknowledgment of the source of any reprinted or reproduced material. For other uses of the material, request permission from CRP.

NOTICE

The project that is the subject of this report was a part of the Transit Cooperative Research Program, conducted by the Transportation Research Board with the approval of the Governing Board of the National Research Council.

The members of the technical panel selected to monitor this project and to review this report were chosen for their special competencies and with regard for appropriate balance. The report was reviewed by the technical panel and accepted for publication according to procedures established and overseen by the Transportation Research Board and approved by the Governing Board of the National Research Council.

The opinions and conclusions expressed or implied in this report are those of the researchers who performed the research and are not necessarily those of the Transportation Research Board, the National Research Council, or the program sponsors.

The Transportation Research Board of the National Academies, the National Research Council, and the sponsors of the Transit Cooperative Research Program do not endorse products or manufacturers. Trade or manufacturers' names appear herein solely because they are considered essential to the object of the report.

Published reports of the

TRANSIT COOPERATIVE RESEARCH PROGRAM

are available from:

Transportation Research Board
Business Office
500 Fifth Street, NW
Washington, DC 20001

and can be ordered through the Internet at

http://www.national-academies.org/trb/bookstore

Printed in the United States of America

THE NATIONAL ACADEMIES

Advisers to the Nation on Science, Engineering, and Medicine

The **National Academy of Sciences** is a private, nonprofit, self-perpetuating society of distinguished scholars engaged in scientific and engineering research, dedicated to the furtherance of science and technology and to their use for the general welfare. On the authority of the charter granted to it by the Congress in 1863, the Academy has a mandate that requires it to advise the federal government on scientific and technical matters. Dr. Ralph J. Cicerone is president of the National Academy of Sciences.

The **National Academy of Engineering** was established in 1964, under the charter of the National Academy of Sciences, as a parallel organization of outstanding engineers. It is autonomous in its administration and in the selection of its members, sharing with the National Academy of Sciences the responsibility for advising the federal government. The National Academy of Engineering also sponsors engineering programs aimed at meeting national needs, encourages education and research, and recognizes the superior achievements of engineers. Dr. Charles M. Vest is president of the National Academy of Engineering.

The **Institute of Medicine** was established in 1970 by the National Academy of Sciences to secure the services of eminent members of appropriate professions in the examination of policy matters pertaining to the health of the public. The Institute acts under the responsibility given to the National Academy of Sciences by its congressional charter to be an adviser to the federal government and, on its own initiative, to identify issues of medical care, research, and education. Dr. Harvey V. Fineberg is president of the Institute of Medicine.

The **National Research Council** was organized by the National Academy of Sciences in 1916 to associate the broad community of science and technology with the Academy's purposes of furthering knowledge and advising the federal government. Functioning in accordance with general policies determined by the Academy, the Council has become the principal operating agency of both the National Academy of Sciences and the National Academy of Engineering in providing services to the government, the public, and the scientific and engineering communities. The Council is administered jointly by both the Academies and the Institute of Medicine. Dr. Ralph J. Cicerone and Dr. Charles M. Vest are chair and vice chair, respectively, of the National Research Council.

The **Transportation Research Board** is one of six major divisions of the National Research Council. The mission of the Transportation Research Board is to provide leadership in transportation innovation and progress through research and information exchange, conducted within a setting that is objective, interdisciplinary, and multimodal. The Board's varied activities annually engage about 7,000 engineers, scientists, and other transportation researchers and practitioners from the public and private sectors and academia, all of whom contribute their expertise in the public interest. The program is supported by state transportation departments, federal agencies including the component administrations of the U.S. Department of Transportation, and other organizations and individuals interested in the development of transportation. **www.TRB.org**

www.national-academies.org

COOPERATIVE RESEARCH PROGRAMS

CRP STAFF FOR TCRP REPORT 140

Christopher W. Jenks, *Director, Cooperative Research Programs*
Crawford F. Jencks, *Deputy Director, Cooperative Research Programs*
Gwen Chisholm Smith, *Senior Program Officer*
Tom Van Boven, *Senior Program Assistant*
Eileen P. Delaney, *Director of Publications*
Ellen M. Chafee, *Editor*

TCRP PROJECT B-35 PANEL

Field of Service Configuration

Ann August, *Santee Wateree Regional Transportation Authority, Sumter, SC* (Chair)
Timothy Collins, *Veolia Transportation, North Las Vegas, NV*
Ronald Downing, *Golden Gate Bridge, Highway, and Transportation District, San Rafael, CA*
Vince Jackson, *Hampton Roads Transit, Norfolk, VA*
Del A. Peterson, *North Dakota State University, Fargo, ND*
Will Scott, *Will Scott & Co., LLC, Cincinnati, OH*
Carol Wise, *New Jersey Transit Authority, Newark, NJ*
Doug Birnie, *FTA Liaison*
Robert Carlson, *Community Transportation Association of America, Washington, DC*
Peter Shaw, *TRB Liaison*

FOREWORD

By Gwen Chisholm Smith
Staff Officer
Transportation Research Board

TCRP Report 140: A Guide for Planning and Operating Flexible Public Transportation Services describes the types of flexible transportation service strategies appropriate for small, medium, and large urban and rural transit agencies. This guide includes discussions on financial and political realities, operational issues, and institutional mechanisms appropriate for implementing and sustaining flexible transportation services. This guide will be helpful to public transportation providers, decision-makers, policymakers, planners, and others interested in considering flexible services.

Public transportation agencies face increasing demands to serve ever more diverse markets that may require cost-effective, unconventional solutions. Flexible transportation services show great promise in meeting the mobility needs of many individuals nationwide. Flexible transportation service may be especially valuable to those communities that are trying to address ADA requirements and those classified as suburban, small urban, and rural, where mobility markets are often defined by low or irregular demand. In addition to new flexible services, existing traditional fixed-route and paratransit transit services may be converted into flexible services. In order to answer the questions of whether, and in what circumstances, the introduction of flexible service may be feasible, a broad, comprehensive look at planning and operating flexible transportation services as part of an array of options was needed.

To develop the guide, the research team conducted a comprehensive review of flexible service types operated in the United States and Canada over the last 10 years that included identifying flexible services that have been successfully implemented or are close to implementation. Services that were successfully implemented but not sustained were also reviewed. In this review, the research team gathered key information from a cross section of public transportation providers on (1) the characteristics of the provider's flexible service, (2) the provider's reasons for considering flexible service, (3) the way that the flexible service was implemented, (4) the benefits of implementing flexible service, (5) the political environment, and (6) the operational considerations. Also, the researchers made a series of on-site visits to transit agencies that operate flexible public transportation service to gather information on lessons learned. Finally, the guide identifies a range of best practices for implementing flexible public transportation services and includes "decision guides" to assist agencies in rural, small urban, and large urban areas in determining whether and how to provide flexible transportation services.

CONTENTS

1 Summary

4 **Chapter 1** Basic Concepts of Flexible Public Transportation Service

4 1.1 History and Definitions
5 1.2 Current Status of Flexible Public Transportation Services

19 **Chapter 2** Framework/Decision Matrix for Considering Flexible Public Transportation Service

19 2.1 Rural Flexible Public Transportation Service
24 2.2 Small Urban Flexible Public Transportation Service
27 2.3 Large Urban Flexible Public Transportation Service

31 **Chapter 3** Implementing New Flexible Public Transportation Services

31 3.1 Analyzing Existing Conditions—What Data Should I Review?
34 3.2 Obtaining Community and Policymaker Input
35 3.3 Planning and Scheduling Flexible Public Transportation Service
36 3.4 Understanding the Costs
37 3.5 Capital Needs—Vehicles and Technology
40 3.6 Marketing Flexible Public Transportation Service

42 **Chapter 4** Best Practices of Successful Flexible Public Transportation Services

44 4.1 Mason County Transportation Authority
48 4.2 St. Joseph Transit
51 4.3 Potomac and Rappahannock Transportation Commission
56 4.4 Pierce County Public Transportation Benefit Area Corporation
59 4.5 Regional Transportation District
67 4.6 Jacksonville Transportation Authority
73 4.7 Charleston Area Regional Transportation Authority
76 4.8 Mountain Rides Transportation Authority
78 4.9 South Central Adult Services Council, Inc.
82 4.10 Omnitrans

88 References

89 Unpublished Material

SUMMARY

A Guide for Planning and Operating Flexible Public Transportation Services

Flexible public transportation services include a range of services that are not fully demand responsive or fixed route. While these types of services have been around for over 40 years, it was believed that flexible public transportation services were operated by a relatively small percentage of public transit agencies. In a survey for this study of nearly 1,100 public transportation operators, it was revealed that 39 percent of the 500 respondents (ranging from small rural to large urban operators) provided some type of flexible public transportation service.

Many agencies that have implemented flexible public transportation services have realized real benefits while others have attempted this approach and abandoned the effort after several months or years. Often, in rural and small urban areas, flexible public transportation services can serve senior citizens and persons with disabilities at a lower cost than demand-responsive service. Also, in suburban communities, a flexible public transportation service with small buses may encourage first-time public transit users to leave their cars at home and use the service to connect with regional transit services to reach nearby destinations.

For the purposes of this study, the concept of flexible public transportation services includes the following:

- **Route Deviation**—vehicles operating on a regular schedule along a well-defined path, with or without marked bus stops, that deviate to serve demand-responsive requests within a zone around the path. The width or extent of the zone may be precisely established or flexible.
- **Point Deviation**—vehicles serving demand-responsive requests within a zone and also serving a limited number of stops within the zone without any regular path between the stops.
- **Demand-Responsive Connector**—vehicles operating in demand-responsive mode within a zone, with one or more scheduled transfer points that connect with a fixed-route network. A high percentage of ridership consists of trips to or from the transfer points.
- **Request Stops**—vehicles operating in conventional fixed-route, fixed-schedule mode and also serving a limited number of undefined stops along the route in response to passenger requests.
- **Flexible-Route Segments**—vehicles operating in conventional fixed-route, fixed-schedule mode, but switching to demand-responsive operation for a limited portion of the route.
- **Zone Route**—vehicles operating in demand-responsive mode along a corridor with established departure and arrival times at one or more end points in the zone.

This guide will identify best practices and barriers to effective implementation of flexible public transportation services and will also move the research into practice by suggesting specific actions that public transit providers can take to more effectively consider and successfully implement flexible public transportation service alternatives.

The research revealed that flexible public transportation is structured differently and serves very different needs depending on the area served. For this reason, this guide offers a

decision-making framework for agencies considering flexible public transportation services in three different operating environments:

- Rural Areas (Under 50,000 in population)
- Small Urban Areas (50,000 to 200,000 in population)
- Large Urban Areas (more than 200,000 in population)

Chapter 1: Basic Concepts of Flexible Public Transportation Service provides an overview of the current state of flexible public transportation services in the United States. This is accomplished by sharing the results of a comprehensive survey of 95 agencies that offer one or more types of flexible public transportation service. The list of respondents and the survey instrument are presented in Appendices A and B. (Appendices A through C available by searching for "TCRP Report 140" on www.trb.org.)

Chapter 2: Framework/Decision Matrix for Considering Flexible Public Transportation Service uses previous research studies, the results of the survey for this study, and lessons learned during on-site visits to numerous flexible public transportation service operations to assist agencies in making a decision on the applicability of flexible public transportation services in their locality. The framework takes into consideration the key factors that affect the effectiveness of flexible public transportation services, including population and employment densities, trip purpose, and clientele served. Decision guide flowcharts are presented to help agencies determine whether flexible public transportation services should be considered.

Chapter 3: Implementing New Flexible Public Transportation Services guides local agencies through the process of implementing flexible public transportation services if implementation has been determined to be feasible. This chapter identifies key steps for local decision makers to follow such as analyzing existing conditions, obtaining community input, planning and scheduling the service, determining capital needs, and marketing the services.

Chapter 4: Best Practices of Successful Flexible Public Transportation Services presents detailed information on nine agencies that operate a range of flexible public transportation services and one agency that operated flexible public transportation service and then discontinued the service. The agencies and contact persons are identified, and service area characteristics are described for the overall service area and specifically for the flexible public transportation service area. The flexible public transportation services are described in detail, productivity standards and measures are noted, and other issues faced by the agencies are described. Some of the agencies have accumulated considerable data on their flexible public transportation services and noted trends; this information will be very useful to similar agencies that may be considering implementing flexible public transportation services. Finally, Appendix C—available on the TRB website (www.trb.org) by searching on *TCRP Report 140*—provides a collection of marketing materials from the websites of over 20 different operators of flexible public transportation service. This material can be very useful to any agency wishing to gain more information on similar services operated in small and large communities throughout the United States.

In summary, the primary objective of this research effort is the development of a practical guide that public transportation providers can use to consider the merits of flexible public transportation services. Agencies should learn that the costs per trip for flexible public transportation are higher than the costs per trip for fixed-route public transportation. Additionally, flexible public transportation services require communications and scheduling technology that exceeds the communications and scheduling technology needs of fixed-route public transportation. Finally, customers who use public transportation for time-sensitive trips, including work and school trips, may resist a change to flexible public transportation services.

Nonetheless, for an agency that has areas and/or services that are conducive to flexible public transportation, this service type can serve many needs, including the following:

- Reducing the costs of full demand-response services in rural areas where passengers frequent common destinations such as medical centers, senior citizen centers, or shopping centers.
- Eliminating the need to operate ADA-complementary paratransit in a specific geographic area or systemwide, if an agency chooses to eliminate fixed-route services in those areas.
- Providing an introduction to public transportation for suburban residents not served by regular fixed-route service by offering convenient connections to frequent fixed-route buses or fixed-guideway systems.

CHAPTER 1

Basic Concepts of Flexible Public Transportation Service

The primary objective of this research effort is the development of a practical guide that public transportation providers can use to consider the merits of flexible public transportation services. Prior to this research, flexible public transportation services were believed to be operated by a relatively small percentage of public transit agencies. Many agencies that have implemented flexible public transportation services have realized real benefits while others have attempted this approach and abandoned the effort after several months or years. Often, in small urban areas, flexible public transportation services can serve persons with disabilities at a lower cost than demand-responsive service. Also, in suburban communities, a flexible public transportation service with small buses may encourage first-time public transit users to leave their cars at home and use the service to connect with regional transit services to reach nearby destinations.

This guide will identify best practices and barriers to effective implementation of flexible public transportation services. This guide will also move the research into practice by suggesting specific actions that public transit providers can take to more effectively consider and successfully implement flexible public transportation service alternatives.

1.1 History and Definitions

Public transportation services have historically operated as fixed-route systems that operate along a well-defined corridor making predetermined stops to collect passengers at scheduled times. These systems are most efficient in areas where there are high concentrations of residences and common destinations, such as a strong downtown or central business district (CBD). More recently, public transportation services have come to include those services that operate as demand responsive, meaning that no fixed route is involved and the vehicle collects passengers at their origins and takes them to their destinations. These demand-responsive systems usually serve specific clientele (e.g., persons with disabilities) and/or areas of low densities. Clearly, fixed-route services are more productive and less costly than demand-responsive systems.

Flexible public transportation services encompass a wide range of hybrid service types that are not fully demand responsive or fixed route. According to *TCRP Synthesis 53: Operational Experiences with Flexible Transit Services* (Koffman, 2004), flexible public transportation services have been in existence for over 40 years:

> At least since the 1960s, practitioners have proposed services that combine features of conventional service and purely demand-responsive service (Cole 1968; Arrillaga and Mouchahoir 1974). One of the earliest documented experiments is the Merrill-Go-Round in Merrill, Wisconsin (Flusberg 1976; Mergel 1976), which used a 'point deviation' mode of operation, as defined later in this report, and that is still operating. More recent research continues to propose flexible transit services as part of the toolkit to help transit operators address suburbanization and dispersed travel patterns (Cervero and Beutler 1999; Urbitran 1999) (p. 3).

For purposes of this study, the definition of flexible public transportation services includes the following:

- **Route Deviation—**vehicles operating on a regular schedule along a well-defined path, with or without marked bus stops, that deviate to serve demand-responsive requests within a zone around the path. The width or extent of the zone may be precisely established or flexible.
- **Point Deviation—**vehicles serving demand-responsive requests within a zone and also serving a limited number of stops within the zone without any regular path between the stops.
- **Demand-Responsive Connector—**vehicles operating in demand-responsive mode within a zone, with one or more scheduled transfer points that connect with a fixed-route network. A high percentage of ridership consists of trips to or from the transfer points.
- **Request Stops—**vehicles operating in conventional fixed-route, fixed-schedule mode and also serving a limited number of undefined stops along the route in response to passenger requests.
- **Flexible-Route Segments—**vehicles operating in conventional fixed-route, fixed-schedule mode, but switching to demand-responsive operation for a limited portion of the route.
- **Zone Route—**vehicles operating in demand-responsive mode along a corridor with established departure and arrival times at one or more end points.

1.2 Current Status of Flexible Public Transportation Services

This research effort involved a comprehensive review and outreach effort to identify flexible public transportation services that have been successfully implemented or are close to being implemented in the United States and Canada. Over 1,100 transit managers, representing public transit systems of different sizes and types and in different areas of the country, were asked to participate in a web-based initial survey to help the researchers gain a better understanding of the types of agencies that operate flexible public transportation services and those that don't. The initial survey contained the following questions:

- Please provide the contact information on your agency and a contact person that we can reach for follow-up questions.
- What modes of public transportation does your agency operate?
- If you checked "Flexible Public Transportation" on the previous question, please tell us which type(s) of flexible public transportation your agency operates.
- If your agency currently operates or has plans to operate any type of "flexible public transportation," please briefly describe your service.
- On what date did you begin operation of flexible public transportation OR if the service has not yet started, what date do you plan to begin operation?
- If your agency ever operated "flexible" public transportation and discontinued the service, please briefly describe the type of flexible service operated and the reason for discontinuing the service.

The final response rate for the initial survey was approximately 45 percent, with 194 agencies (39 percent) indicating that they operated flexible public transportation service. This is a much higher number than was expected. As shown in Table 1, the profile of the agencies operating flexible public transportation service is very similar to the profile of all respondents, including those that do not operate flexible public transportation service.

The initial outreach survey also identified the types of flexible public transportation services operated by the agencies. Table 2 shows that route deviation is by far the most common form of flexible public transportation service (63.9 percent), followed by request stops (30.9 percent) and demand-responsive connector (24.2 percent).

Table 1. Operating characteristics of survey respondents.

Modes of Transit Operated	All 501 Respondents (%)	194 Respondents Operating Flexible Transit (%)
Fixed Route	58.1	57.3
ADA Paratransit	53.4	48.4
General Public Demand Response	55.2	67.2
Client Demand Response	29.6	33.
Light Rail	2.7	2.6
Heavy Rail	1.4	0
Bus Rapid Transit	2.5	2.1

Table 2. Types of flexible public transportation services operated.

Type of Flexible Public Transportation Service	% of Respondents
Route Deviation	63.9
Request Stops	30.9
Demand-Responsive Connector	24.2
Point Deviation	16.0
Flexible Route Segments	14.4
Zone Routes	11.9

The initial survey also revealed that the implementation of flexible public transportation services is on the rise. As shown in Figure 1, a large number of respondents implemented flexible public transportation service after 1991, and the number of new service implementations has been higher still in the past 8 years. The last column on this figure shows those respondents who indicated that they plan to implement flexible public transportation services in the next 5 years.

Finally, the initial outreach effort asked respondents if their agencies had ever operated flexible public transportation services and discontinued the service. If discontinuation of flexible public transportation services had occurred, respondents were asked to please briefly describe the type of flexible public transportation service operated and to share the reason for discontinuing the service. Over 30 respondents shared comments regarding the discontinuation of flexible public transportation services. Some of the reasons given for discontinuing flexible public transportation service were the following:

- "Problems with scheduling—can't make time points when demand for flexible trips is high or have too much extra time when demand for flexible is low."

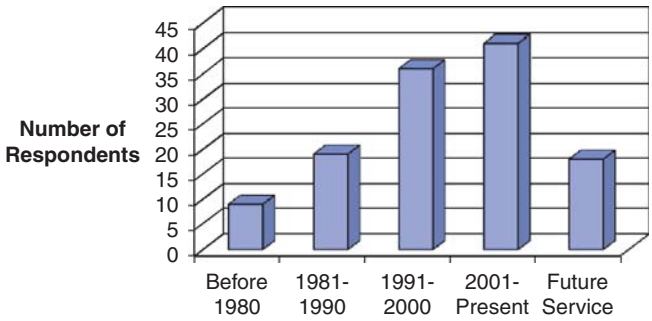


Figure 1. Number of respondents by date of flexible transportation service implementation.

- "Decided not to implement flexible transportation after pilot program in an area of town that had lost a fixed route several years earlier failed to generate sufficient ridership."
- "Replaced flexible service with door-to-door service; ridership increased from two passengers per hour to three and one-half passengers per hour."
- "Flexible transportation service scaled back due to fuel expenses."
- "Low ridership, equipment and resources needed in other areas."
- "Implemented flexible transportation services to salvage Saturday service on two local fixed routes. Discontinued service due to low ridership, communication problems, and confusion about how the service operated."
- "Discontinued flexible service when ridership increased to justify fixed-route service."

In summary, the initial outreach effort revealed the following about flexible public transportation service:

- Nearly 40 percent of respondents indicated that they operate some form of flexible public transportation service.
- While respondents were geographically dispersed across the United States, the largest numbers of respondents were located in the Southeast and Midwest.
- Agencies that operate flexible public transportation service also operate other modes of public transit service at a similar proportion as all respondents.
- The largest majority of agencies that operate flexible public transportation service operate route-deviation service, followed by request stops, and demand-responsive connector service.
- Implementation of flexible public transportation service has increased significantly in the past 20 years and is still on the increase.
- The major reason for discontinuing flexible public transportation services was low ridership.

Using the results of the initial outreach effort, a distribution list of public transit service operators was developed to solicit for gathering key information. The second phase of data solicitation was targeted at the 194 agencies that indicated that they operated flexible public transportation service.

Survey Respondents

Ninety-five agencies (see Appendix A for listing of agencies) responded to the second request for more detailed data on their flexible public transportation services. Of the 95 respondents, 85.3 percent completed the survey, and most answered all of the questions (see Appendix B for survey and summary of responses). As shown in Figure 2, there was a good distribution of agency types among the respondents. Over 30 percent were transit authorities or districts, while 28 percent

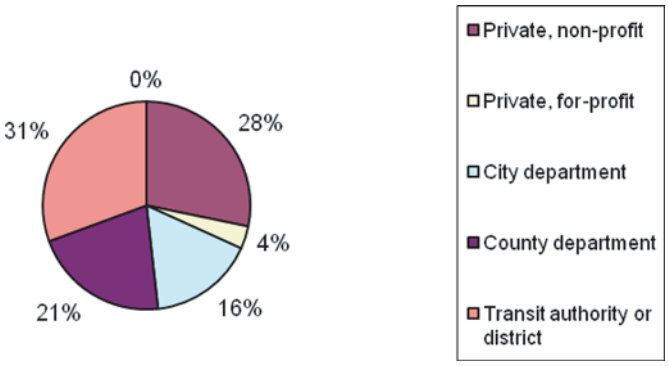


Figure 2. Distribution of agency types among respondents to second phase of data solicitation.

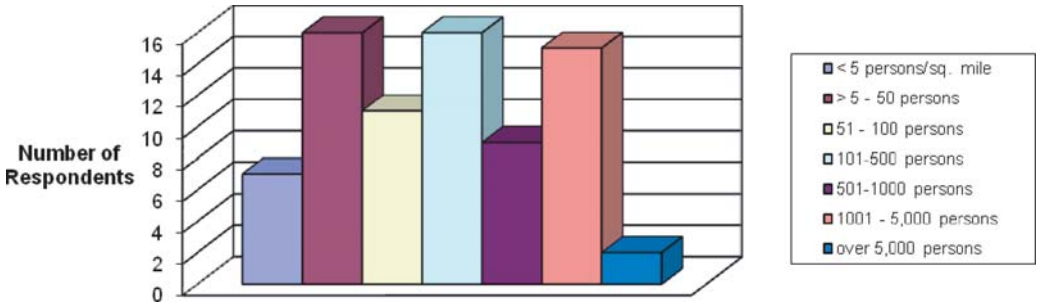


Figure 3. Service area population density.

were private, non-profit. The remaining agencies were primarily city or county departments, with a small number (4 percent) responding that their agency was private, for profit.

The respondents served a wide range of service areas and service area populations. The smallest agency served a rural area of 2,000 in population, while the largest agency served a population of over two million people. The square mileage of the service areas also varied significantly, from 20 square miles to nearly 17,000 square miles. Previous research showed that areas of low density (persons/square mile) were often good candidates for flexible public transportation service. Clearly, service areas can include a mix of medium-/high-density and low-density areas, but for purposes of this data collection phase, total service area densities were calculated. The results, as shown in Figure 3, were that 34, or nearly 45 percent, of the respondents that provided population statistics served areas of relatively low density (less than 100 persons/square mile). Conversely, only 16 respondents (20 percent) served areas of medium-/high-density (over 1,000 persons per square mile).

When asked about basic service statistics for all modes of public transit service, 95 percent of respondents provided data on ridership, vehicle revenue hours, peak vehicles operated, and operating budgets. Figure 4 shows annual ridership while Figure 5 shows peak vehicles for all modes. As shown, the respondents were predominately small agencies.

Types of Flexible Public Transportation Service

Fewer respondents, 56 percent, provided similar basic service statistics for flexible public transportation service only. Six respondents indicated that 100 percent of their service was flexible, so the service statistics reported were reported for all modes. Figure 6 compares annual ridership on

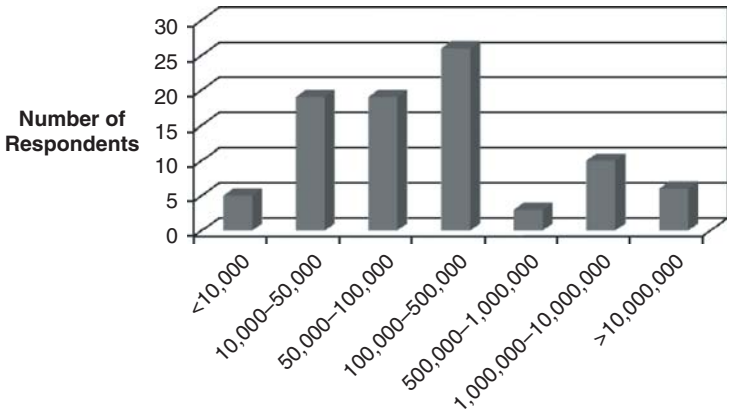


Figure 4. Annual ridership—all modes.

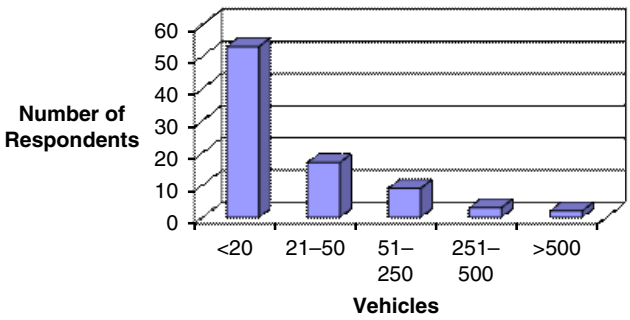


Figure 5. Peak vehicles—all modes.

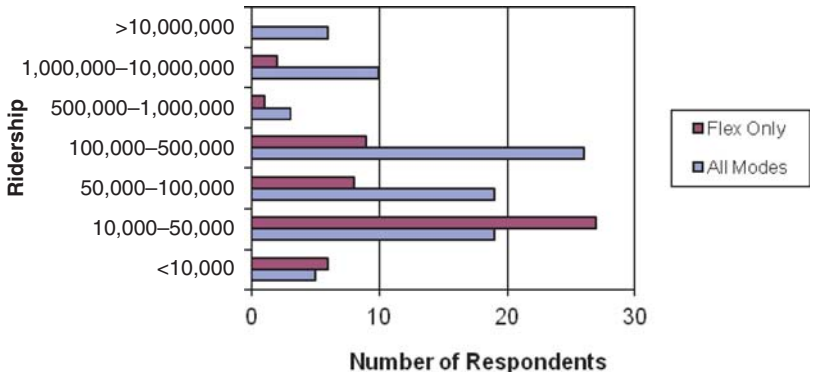


Figure 6. Annual ridership on all modes and on flexible public transportation service only.

all modes to ridership reported for flexible public transportation service alone. As shown, where ridership was low (less than 50,000 annual trips), flexible public transportation service was predominant. None of the respondents reported flexible ridership exceeding 10,000,001.

Figure 7 shows the percentage of total passenger trips that used the flexible public transportation service feature.

When asked to describe their flexible public transportation service, 56 percent of respondents reported that the service included route deviation for the general public while 45 percent indicated that the service was route deviation for persons with disabilities. The other responses are presented in Table 3.

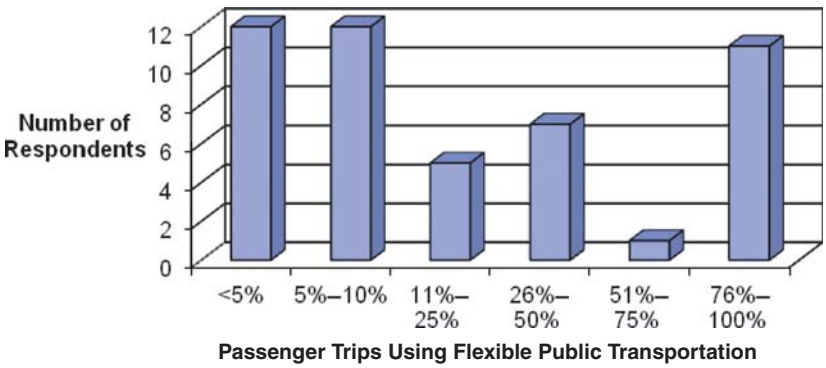


Figure 7. Percent of passenger trips using the flexible transportation feature.

Table 3. Types of flexible transportation services operated.

Type of Flexible Public Transportation Service	% of Respondents
Route Deviation for General Public	56.1
Route Deviation for Persons with Disabilities	45.1
Point Deviation	19.5
Demand-Responsive Connector	30.5
Request Stops	30.9
Flexible Route Segments	19.5
Zone Routes	32.9

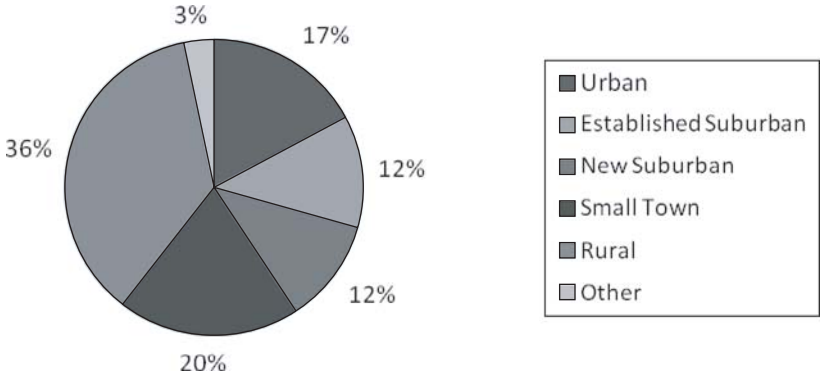


Figure 8. Flexible service area types.

A large majority of respondents (84.7 percent) indicated that the flexible public transportation service was operated at all times of the day, while only 4.2 percent indicated that the service was only operated at night and 6.9 percent indicated the service was only operated on weekends.

It appears that flexible public transportation service is operated in a variety of area types. As shown in Figure 8, most of the respondents indicated that flexible public transportation service was provided in rural areas (36 percent) and small towns (20 percent). However, over 40 percent of respondents indicated that the service was operated in urban and suburban areas also.

Flexible Public Transportation Service Users and Productivity of the Service

A large majority of respondents indicated that senior citizens (29 percent) and persons with disabilities (27 percent) were the principal users of flexible public transportation service, as shown in Figure 9.

When asked about productivity standards for flexible public transportation service, nearly 80 percent of the respondents indicated that they did *not* have standards. Productivity standards for flexible transportation services, for those respondents that did have them, included the following:

- "4 passengers/hour"
- "Growth rate in Unit Costs (trip/vehicle mile/change to revenue vehicle hour/etc.)"
- "2.3 passengers per revenue hour per contract with the provider"
- "Rural route deviated—goal 10 passengers/hour, minimum 5 passengers/hour"
- "Ridership comparison, cost per passenger"
- "Like to stay over 5.0 passengers/hour"
- "Boardings per hour and cost per passenger"

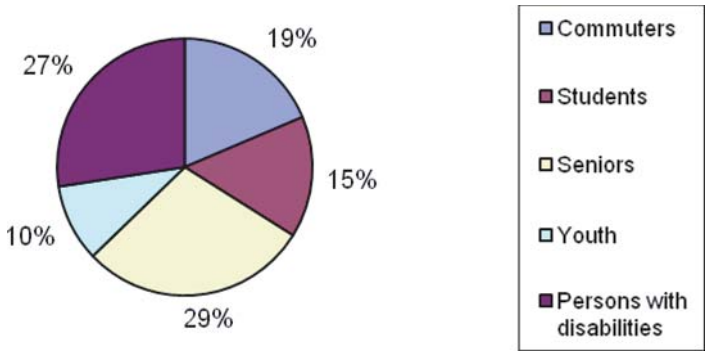


Figure 9. Users of flexible transportation service.

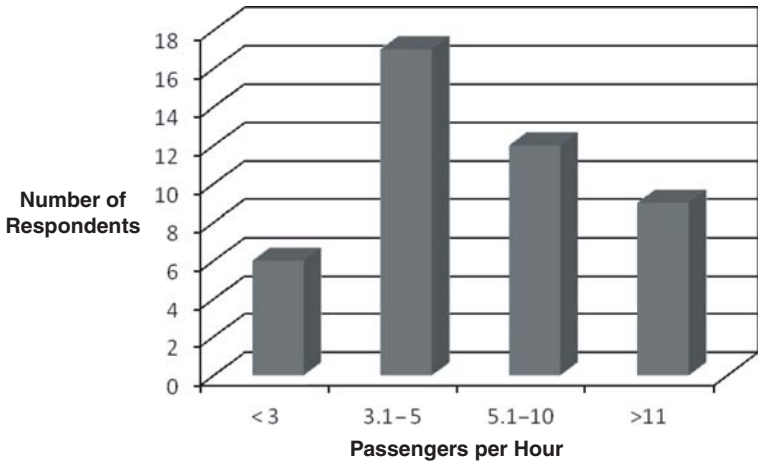


Figure 10. Flexible transportation service passengers per hour.

- "At least 20 passengers a day"
- "15% farebox ratio, minimum 4.0 passengers/revenue hour"
- "3–5 passengers/hour"
- "Cost per trip, mile, hour must meet contracted amount and standards for fixed routes"
- "Miles per passenger"
- "4.00 passengers/vehicle hour and 0.193 passengers/vehicle mile"
- "Safe on-time standard"
- "3 to 5 boarding per hour minimum"
- "Not separately recorded, included with regular passenger count"

As the list of productivity standards suggests, most respondents used passengers per hour as their standard, and most agencies reported standards ranging from 3 to 5 passengers per hour. Figure 10 shows the actual passengers per hour productivity measures for the respondents that provided measures.

Operation of Flexible Public Transportation Service

With respect to how flexible public transportation service is operated, the following questions were asked:

- For route deviation service, how far are the vehicles allowed to deviate?
- What is the fare for flexible service? Is it different from the fare charged for fixed-route or demand-responsive service?

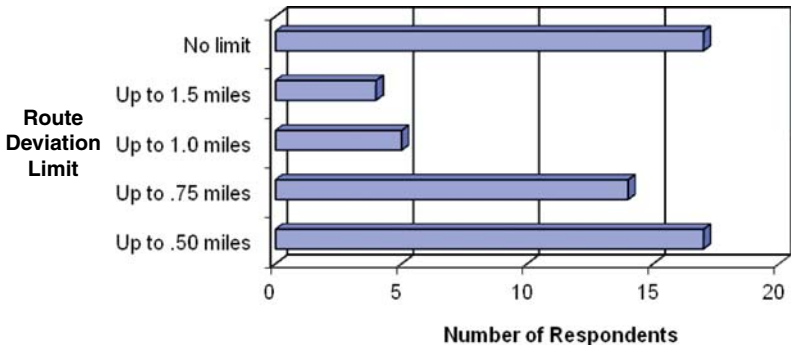


Figure 11. Maximum deviation from route.

- How is the flexible transportation service scheduled?
- How are drivers assigned to flexible transportation service?
- What types of vehicles are used to operate flexible transportation service?

Distance That Vehicles Are Allowed to Deviate in Route Deviation Service

An equal number of respondents, 17 (27 percent), stated that the maximum deviation from the route was up to one-half mile *and* that there was no limit for deviation within the agencies' service area. Fourteen respondents (22 percent) allowed deviation up to three-quarters of a mile from the route, the distance required by the ADA to provide complementary paratransit service. Figure 11 displays these results.

Fares for Flexible, Fixed-Route, and Demand-Responsive Services

Seventy percent of respondents indicated that the fare charged for flexible public transportation service was the same as the fare charged for fixed-route or demand-responsive service. Of the respondents that charge a different fare for flexible public transportation service, 61 percent said that the fare for flexible public transportation service was higher.

Scheduling of Flexible Transportation Service

Respondents who operated route deviation were asked to complete a statement about route deviation ("For route deviation service, a complete route is scheduled . . .") with one of three phrases. The completing phrases and the percentage that chose each one are the following:

- With a limited number of short deviations to known locations—44%
- With time for deviations to unspecified locations, but only within short portions of the route—17%
- With time for deviations throughout the route to unspecified locations—35%

Respondents who operated point deviation, zone routes, or demand-responsive connector service were also asked how they scheduled their service. The top responses and the percentage that chose them were the following:

- A few time points are scheduled with most of the time available for deviations—64%
- With time for deviations to unspecified locations, but only within short portions of the route—28%

Assignment of Drivers to Flexible Transportation Service

Following is some information on drivers who operate flexible public transportation service—including type of employee, process by which drivers are selected for flexible routes, and any special training provided—and the percentage of respondents that selected the characteristic to describe their drivers.

The types of drivers and the percentage of respondents using each type for flexible transportation services were the following:

- Full time—88.3%
- Part time—79.2%
- Volunteer—9.1%
- Union member—27.3%
- Contract employee—22.1%

The processes by which drivers were selected for flexible routes and the percentage of respondents using each selection process for flexible transportation services were the following:

- Assigned to flexible service by agency—52.1%
- Bid process, based on seniority—35.2%
- Bid process, with special training requirement—9.9%
- Driver volunteers for flexible assignments—9.9%

Types of special training provided for drivers, if any, and the percentage of respondents providing different types of special training for drivers (or no special training) were the following:

- No special training—19.7%
- Map reading skills training—31.8%
- Familiarization with area served—83.3%
- Technology training (e.g., to use mobile data terminals)—24.2%

Types of Vehicles Used to Operate Flexible Transportation Service

Nearly half of respondents (46 percent) used small body-on-chassis buses, while 28 percent used vans to operate flexible public transportation service. The mix of vehicles most used is shown in Figure 12.

Communication Strategies Used for Flexible Public Transportation Service

Communication is a key element of flexible public transportation services. Passengers are usually required to make advance reservations or place requests for pick-ups and drop-offs. Major issues include the following:

- Who do passengers call and how far in advance must they place the request?
- If requests are made to a dispatcher, how is the driver notified?
- Does the agency negotiate with passengers for convenient pick-up or drop-off locations?
- Do agencies coordinate flexible transportation services with other transportation services, if applicable?

Figure 12. Types of vehicles used to operate flexible public transportation services.

Table 4. Requirement for prior arrangements.

Can Passengers Use Flexible Public Transportation Service Without Making Prior Arrangements?	Flexible Pick-Up (%)	Flexible Drop-Off (%)
No	39.5	27.8
Yes, at any established stop along a route	50.0	65.3
Yes, at a fixed-route transfer location	22.4	18.1
Yes, at a limited number of stops	14.5	26.4

Requesting Flexible Public Transportation Service

Exactly 50 percent of respondents said that passengers using flexible public transportation service could be picked up without a called-in request or prior reservation at any established stop along a route. Nearly 40 percent said that the passenger must make prior arrangements. Over 60 percent of respondents said that passengers using flexible public transportation service could be dropped off without a called-in request or prior reservation at any established stop along a route. Nearly 30 percent said that passengers must make prior arrangements, and approximately the same percentage of respondents stated that passengers could be dropped off at a limited number of designated locations without making prior arrangements. Table 4 shows these results.

Most respondents, 55.2 percent, require previous day advance notice for flexible pick-ups, while a total of 37 percent of respondents allow passengers to call within 2 hours or less to request a flexible pick-up. Passengers appear to be offered multiple ways to request a flexible pick-up, as shown in Figure 13. A large majority of respondents, 68.4 percent, have passengers call the dispatcher or reservation agent, while a limited number of respondents, 14 percent, allow passengers to call the driver directly.

Notifying Drivers of Flexible Public Transportation Service Requests

As shown above, most of the respondents require passengers to contact a dispatcher or reservation agent to make the request for a flexible public transportation service pick-up. Since many agencies allow for the request to be made within 2 hours of the desired pick-up, it is critical that the agency be able to communicate with the driver. As shown in Figure 14, a large majority of respondents rely on radio communications with drivers, while others use cell phones, and a small number use mobile data terminals (MDTs).

Negotiation with Passengers for Convenient Pick-Up or Drop-Off Locations

Respondents were very evenly split on whether they negotiated with passengers for convenient pick-up or drop-off locations that are off the main route but not at the actual origin

Figure 13. Distribution among respondents of methods for requesting a flexible pick-up.

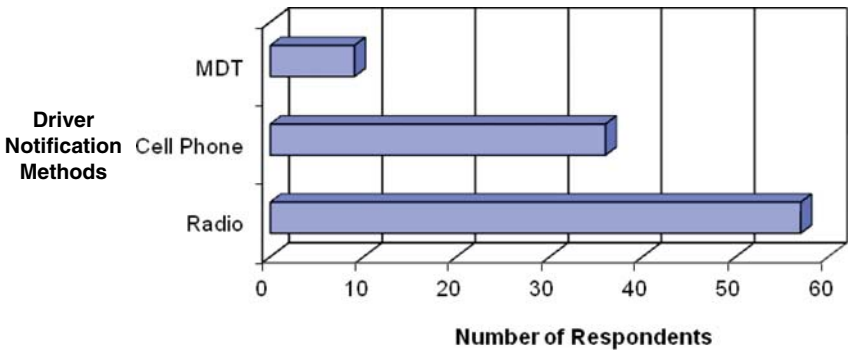


Figure 14. Distribution among respondents of methods by which a dispatcher notifies a driver of flexible requests.

or destination of the passenger. Finally, with respect to communication, a large majority of respondents, 89 percent, who operated both flexible public transportation service and fixed-route or demand-responsive transportation services reported that they coordinated the services.

Coordinating Flexible Transportation Services with Other Transportation Services

When asked to describe how they coordinated flexible public transportation and other services, respondents indicated that the flexible public transportation services made it easier for passengers to transfer to other routes and coordinate with other transit operators in surrounding areas, including intercity bus and rail service. Several respondents indicated that they served senior centers or nursing homes, reducing the demand on complementary ADA paratransit service. In many locations, the purpose of flexible public transportation was to coordinate with other services. In these areas, the respondents indicated that rather than serve specific destinations, their flexible public transportation services acted as feeder service into major fixed-route services, including light or heavy rail lines.

Other Considerations for Flexible Public Transportation Service

Many other factors affect the successful operation of flexible public transportation service. To gain added insight, respondents were asked the following:

- What technologies are used for flexible public transportation service?
- What reasons motivated you to operate flexible public transportation service?
- What is the best way to promote flexible public transportation to the public?
- What advice would you offer other agencies that are considering implementing flexible public transportation services?

Technologies Used for Flexible Public Transportation Service

Most respondents reported more than one type of technology used for flexible public transportation services. Over 55 percent of respondents identified voice radio as the most frequently used technology for flexible public transportation services (see Figure 15). Many respondents provided more than one response to this question. In addition to voice radio, 50 percent indicated that they used computerized scheduling, while 38 percent stated that they used cellular phones. A much smaller number, 18 percent, used automated vehicle locators (AVL) or global positioning systems (GPS), and only 8 percent indicated that they utilized the Internet (web) for their flexible public transportation services.

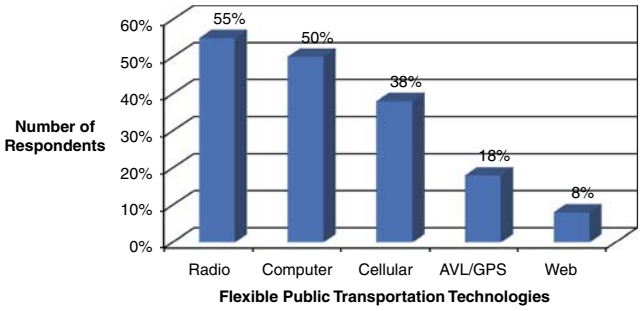


Figure 15. Technologies used for flexible public transportation service.

Table 5. Reasons for operating flexible public transportation services.

What Motivated Your Agency to Operate Flexible Services?	Respondents (%)
Respond to community preferences and geography	71.1
Provide coverage to a large, low-density area	60.5
Balance customer access and routing efficiency	42.1
Reduce/eliminate the expense of separate ADA complementary paratransit	32.9
Lay the groundwork for future fixed-route transit	19.7
Serve low demand times	17.1

Reasons to Operate Flexible Public Transportation Service

When asked what motivated the agency to operate flexible public transportation service, over 70 percent stated that they were responding to community preferences and geography. Other responses are shown in Table 5.

Promoting Flexible Public Transportation to the Public

Survey respondents used a combination of methods to promote flexible public transportation service to the public as shown in Figure 16.

Advice for Agencies Considering Implementing Flexible Public Transportation Services

Respondents were very generous when asked to share advice with other agencies that were considering implementing flexible public transportation service. Some respondents suggested that agencies should understand the community to be served and set expectations and service design to match. Others suggested that agencies should start slowly, advertise heavily, and be

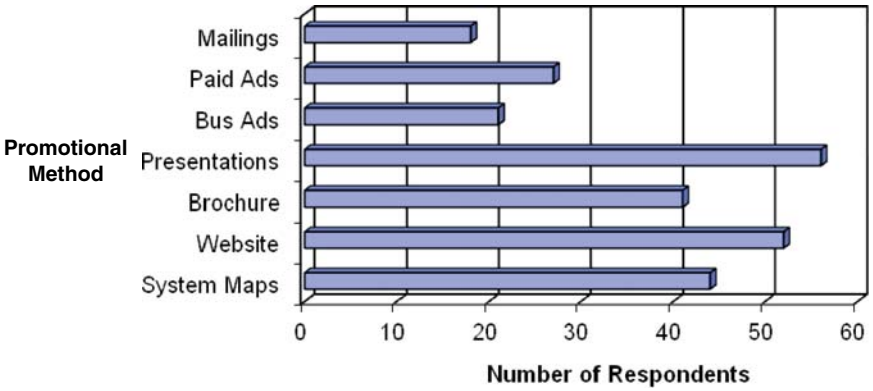


Figure 16. Methods for promoting flexible public transportation.

realistic. Some respondents recommended making sure that agency staff, especially drivers, understand the service, are trained properly, and are willing to be patient and listen to passengers. Other respondents focused on understanding the costs associated with operating flexible public transportation services. Respondent comments ranged from topics such as the potential cost savings of flexible public transportation service in comparison to complementary ADA paratransit service, to the fact that flexible public transportation service costs more than traditional fixed-route bus service.

In summary, the survey revealed the following key findings about flexible public transportation service:

- Most respondents were public agencies, but nearly one-third were private, non-profit entities.
- Most agencies were small and served areas of low density.
- In agencies that operated other modes of service, flexible public transportation service represented a small proportion of total trips.
- Route deviation is the most common type of flexible public transportation service.
- Most agencies operate flexible public transportation service in rural areas, small towns, and suburban areas.
- Senior citizens and persons with disabilities are the most frequent rider types.
- Productivity as measured by passengers per hour averaged 4 passengers per hour.
- Most agencies limit the distance that buses can deviate from the route for flexible public transportation trips; however, nearly 40 percent have no limits or informal limits.
- Most agencies do not charge a premium fare for flexible public transportation.
- Flexible public transportation drivers do not receive additional skills training.
- Most agencies use small body-on-chassis buses for flexible public transportation service.
- Most agencies require previous-day, advance notice to arrange flexible public transportation service pick-ups.
- Passengers most frequently call a reservation agent or dispatcher to make a request.
- Voice radios are the most common method of contacting drivers.
- Most agencies coordinate flexible public transportation service with other services, if applicable.
- The use of technology to implement flexible public transportation services is limited.
- Most agencies implemented flexible public transportation service in response to community needs.
- Agencies often promote flexible public transportation service through a variety of means, including community presentations and on agency websites.

Using the results of the initial survey of public transit agencies, the following factors were considered important in identifying current flexible public transportation service agencies for further study:

- Geography—agencies selected from all regions of the United States.
- Agency Type and Size—studied both public and non-profit agencies.
- Density—selected agencies that serve both high- and low-density areas.
- Area Served by Flexible Service—agencies that served urban, rural, or suburban areas.
- Type of Flexible Public Transportation Service Operated.
- Participation in *TCRP Synthesis 53: Operational Experiences with Flexible Transit Services.*

The results of the detailed case studies presented in Chapter 4, along with the survey results, formed the basis for the framework and decision matrix described in Chapter 2. Table 6 shows the agencies studied, primary types of flexible public transportation service provided, areas served by the flexible public transportation services, and population densities of the areas served by flexible public transportation services.

Table 6. TCRP Project B-35 participating agencies.

Agency Name	State	Primary Type(s) of Flexible Public Transportation Service	Area Served	Population Densities (For Flexible Services)
South Central Adult Services Council, Inc. (South Central Adult Services)	ND	Route Deviation, Zone Routes, Demand-Responsive Connector	Rural	5 per square mile
Mountain Rides Transportation Authority (Mountain Rides)*	ID	Request Stops	Rural	7 per square mile
Mason County Transportation Authority	WA	Route Deviation, Zone Routes, Request Stops	Rural	51 per square mile
Charleston Area Regional Transportation Authority (CARTA)	SC	Zone Routes	Urban	997 per square mile
Jacksonville Transportation Authority (JTA)	FL	Route Deviation, Demand-Responsive Connector	Urban and Suburban	1,000 per square mile
Potomac and Rappahannock Transportation Commission (PRTC)/Omniride	VA	Route Deviation	Suburban	1,180 per square mile
City of St. Joseph	MO	Route Deviation, Request Stops	Small Urban	1,688 per square mile
Omnitrans	CA	Zone Routes, Demand-Responsive Connector	Suburban	1,600–1,796 per square mile
Pierce Transit	WA	Route Deviation, Request Stops	Suburban	1,800 per square mile
Denver Regional Transportation District (RTD)	CO	Point Deviation, Demand-Responsive Connector	Suburban	1,800 per square mile

* Route deviation service discontinued October, 2008. Information provided for purposes of describing barriers of providing flexible transportation services in a rural community.

CHAPTER 2

Framework/Decision Matrix for Considering Flexible Public Transportation Service

TCRP Synthesis 53: Operational Experiences with Flexible Transit Services (Koffman, 2004) suggested that there were few places that operated flexible public transportation services. As previously described, results of the survey undertaken as part of TCRP Project B-35, reported herein, suggest that flexible public transportation services are much more prevalent in the United States than initially thought. Almost 39 percent of the respondents to the initial survey for this study stated that they operated some form of flexible public transportation.

The overwhelming majority of flexible public transportation services were found in rural areas that could be described as the following:

- Very large rural areas (up to 6,000 square miles) with very low-density populations (5 to 100 persons per square mile)
- Large jurisdictions (e.g., counties) with low-density populations (100 to 500 persons per square mile)
- Small rural communities (e.g., towns) with low-density populations (100 to 500 persons per square mile).

There are some flexible public transportation services operated in **small urban areas** where population densities can range from low/medium (500 to 1,000 persons per square mile) to medium/high (1,000 to 2,000 persons per square mile). These services typically occur in communities where the public transportation agency does not provide many work trips and flexible public transportation services obviate the need for complementary ADA paratransit.

In **larger urban areas,** limited flexible public transportation services are operated under specific circumstances, e.g., to fill a need for nighttime service, to serve low-density areas, to act as a feeder or connector to fixed-route, rail, or major traffic generators such as employment centers and shopping malls. Flexible public transportation service can also serve to introduce choice riders to fixed-route services in some limited circumstances.

2.1 Rural Flexible Public Transportation Service

The use of flexible public transportation in rural areas is well documented. In *TCRP Report 6: Users' Manual for Assessing Service-Delivery Systems for Rural Passenger Transportation* (Burkhardt et al., 1995), route deviation and point deviation are discussed as "variable route, fixed schedule services" (*33*). The report states that (*33*)

Route deviation services work well where:

- the deviations are a relatively small part of the overall demand and the overall running time of the route,
- the majority of the riders are not highly time-sensitive,

- door-to-door service is important to some but not all passengers,
- there are other positive reasons for providing services that are more like fixed route than demand-responsive options.

TCRP Report 6 also states the following (Burkhardt et al., 1995, 33):

Route deviation services do not typically work well where:

- most of the trips are time sensitive, and
- some sort of basic route structure is not desirable for this community.

On the subject of point deviation, *TCRP Report 6* states:

> While **point deviation services** share many of the same advantages and disadvantages of route deviation services, point deviation services are more like demand-responsive operations. Route deviation service would be preferred where passengers would be waiting along the route to be picked up without advance notice to the system, and point deviation would be preferred when a service needed to be more highly responsive to changing or variable demands. Point deviation services may be preferable to route deviation services in rural areas because the routes between checkpoints can be flexible, allowing the driver more routing options for maintaining the schedule, and requests for service can be negotiated or deferred so that the schedule is maintained. (Burkhardt et al., 1995, *33–34*)

Table 7 in this report contains statistics on rural transportation service benchmarks for high performance systems that were included as Table 3.1 in the *TCRP Report 6.*

The use of flexible public transportation services is also discussed in *TCRP Report 101: Toolkit for Rural Community Coordinated Transportation Services* (Burkhardt et al., 2004). In that report, flexible public transportation is a part of the section entitled "Service Development, Delivery, and Pricing Options":

> Specific service delivery options could include traditional fixed route; door-to-door (also known as paratransit or demand responsive); flexible routing; paid or volunteer drivers; shared riding; and voucher or user-side subsidies, among others. In most rural communities, the delivery of service in areas where customers are far apart is a significant challenge particularly because the length of travel to reach destinations is long. Consequently, travel ties up vehicle capacity for a long period of time, and the cost per passenger can be very high. A flexible coordinated travel service could mitigate those high costs. (*60*)

Flexible public transportation service is also discussed in a report entitled *Best Practices in Transit Service Planning* (Mistretta et al., 2009). The report classified public transit system service types into four basic groups (*6*):

- function of the number of stops or service frequency
- function of the population served
- function of route design
- function of time of day

Table 7. Rural transportation service benchmarks: high performance systems.

Service Factors	Ranges
Population Served:	6,000–62,000
Area Served (Sq. Miles)	5–3,000
Vehicles:	1–34
Square Miles/Vehicle:	1–650
Persons Served/Vehicle:	650–7,200
Miles/Vehicle/Year:	11,500–29,000
Trips/Year:	8,200–210,000
Trips/Person/Year:	0.85–9
Trips/Vehicle/Year:	4,200–13,500

Source: Burkhardt et al., 1995, Table 3.1

The report defines flexible public transportation service as follows:

> **Flexible service** or **route deviation** allows for deviations from the general route path to provide direct transportation access to passengers who live in the vicinity of the basic route path. On request, and perhaps for an additional charge, the vehicle will deviate a few blocks from the route to pick up or deliver a passenger. This service is most often provided with smaller vehicles and provides service in a designated area (typically lower density). (Mistretta et al., 2009, *6*)

The report provides a useful definition for flexible public transportation service in rural areas:

> **Extremely low density service** also referred to as **life-line or peripheral service** provides some level of minimal service in areas with low population density or low transit use. This type of service typically operates on secondary streets. Extremely low density services usually operate with one-hour headways or higher and may not operate a full day or every day. They are operated primarily to provide accessibility to transit-dependent populations that have no other alternative. While productivity is low, this type of service is often less expensive to run as compared to demand response services. It also can serve as a vital connection to more frequent service. (Mistretta et al., 2009, *7*)

In considering when flexible public transportation service works best in rural areas, there should be some discussion of population demographics and trip purposes. In low-density areas, the demand for public transportation services usually comes from the traditionally transit-dependent populations of elderly persons, persons with disabilities, and low-income persons. Given the relative inconvenience of flexible public transportation service (e.g., trips are often longer than trips using fixed-route service), if population demographics are correlated to trip purposes (e.g., work, school, or medical), then targeted trip demand for flexible public transportation service can be determined. Where transit-dependent populations are making trips that are not time sensitive, flexible public transportation service is viable. When populations are less transit-dependent or trip purposes are more time sensitive, the viability of flexible public transportation service diminishes. Table 8 ranks trip purposes by demographics for flexible public transportation service viability. A combination of demographic group and trip purpose that is ranked "high" best fits flexible public transportation service options. For rural areas, the trip demands that best fit flexible public transportation service primarily come from the traditionally transit-dependent populations of elderly persons, persons with disabilities, and low-income persons, although there are youth activities that could be considered viable for flexible public transportation service.

Table 8. Viability of flexible public transportation service by passenger demographics and trip purpose.

<table>
<tr><th>Demographics/Trip Purpose</th><th>Youth < 18</th><th>Adult 18–64</th><th>Elderly 65 and over</th><th>Persons with Disabilities</th><th>Low-Income Persons</th></tr>
<tr><td>Work</td><td colspan="5" rowspan="2">Low Potential for Flexible Public Transportation</td></tr>
<tr><td>School</td></tr>
<tr><td>Non-Emergency Medical</td><td rowspan="2">High</td><td>Medium Potential</td><td colspan="3" rowspan="4">High Potential for Flexible Public Transportation</td></tr>
<tr><td>Shopping/Groceries</td><td colspan="2">Low</td></tr>
<tr><td>Shopping/ Other</td><td rowspan="2">High</td><td rowspan="2">Low</td></tr>
<tr><td>Social</td></tr>
</table>

The actual demand for flexible public transportation service in rural areas depends on the number of transit-dependent populations and their densities. Where there are rural population densities that approach the high end of low-density (500 persons per square mile) and the transit-dependent population demographics (i.e., elderly persons, persons with disabilities, and low-income persons) are higher than average, the demand for flexible public transportation service is higher. Ridership data suggest that flexible public transportation service can be more productive than general demand-responsive service since trip types can be scheduled and operated together as the travel demand requires. If substantial demand exists, then services can be provided more frequently, e.g., every day. Should actual demand be lower, services can be provided less frequently, e.g., every Tuesday and Thursday.

In considering flexible public transportation service design, trip origin and destination options by trip purpose were examined and ranked for applicability to flexible public transportation service. A trip origin is viable for flexible public transportation service when it is close to transit-dependent populations or is a convenient public gathering place and the trip purpose is not time sensitive. A trip origin becomes less viable for flexible public transportation service the further it is away from transit-dependent populations or convenient public gathering places and as trip purposes become more time sensitive. Table 9 shows the rankings of trip origins.

With respect to trip destination options, where the destination provides the trip purpose that transit-dependent populations need, e.g., non-emergency medical services, and the trip purpose is not time sensitive, that trip location is viable as a destination for flexible public transportation service. When the trip destination is for trip purposes that are more time sensitive, its ranking as a destination for flexible public transportation service diminishes. Table 10 shows that destinations such as hospitals or clinics, for non-emergency medical trip purposes, have a high potential for flexible public transportation service.

The key to designing flexible public transportation service is gearing the service to transit-dependent populations and using origins, routes, and destinations that have trip purposes that are not time sensitive.

Flexible public transportation service has been shown to be more productive than basic demand-responsive systems because it introduces a "time" or "schedule" component to service delivery. In *TCRP Report 124: Guidebook for Measuring, Assessing, and Improving Performance of Demand-*

Table 9. Viability of flexible public transportation service by trip origin and purpose.

<table>
<tr><th>Trip Origin/
Trip Purpose</th><th>Activity Center</th><th>Landmark</th><th>Elderly Housing</th><th>Subsidized Housing</th><th>Single Family Home</th></tr>
<tr><td>Work</td><td colspan="5" rowspan="2">Low Potential for Flexible Public Transportation</td></tr>
<tr><td>School</td></tr>
<tr><td>Non-Emergency Medical</td><td colspan="2">Medium Potential</td><td colspan="2">High</td><td rowspan="4">Low</td></tr>
<tr><td>Shopping/Grocery</td><td colspan="4" rowspan="3">High Potential for Flexible Public Transportation</td></tr>
<tr><td>Shopping/Other</td></tr>
<tr><td>Social</td></tr>
</table>

Table 10. Viability of flexible public transportation service by trip destination and trip purpose.

<table>
<tr><th>Trip Destination/ Trip Purpose</th><th>Major Shopping Center</th><th>Small City Center</th><th>Hospital/Clinic</th><th>Employment Center</th><th>School</th></tr>
<tr><td>Work</td><td colspan="5">Low Potential for Flexible Public Transportation</td></tr>
<tr><td>School</td><td colspan="2" rowspan="2">Not Applicable</td><td colspan="2">Not Applicable</td><td>Low</td></tr>
<tr><td>Non-Emergency Medical</td><td>High Potential</td><td colspan="2">Not Applicable</td></tr>
<tr><td>Shopping/Grocery</td><td rowspan="3">High Potential</td><td>Low</td><td colspan="3" rowspan="3">Not Applicable</td></tr>
<tr><td>Shopping/Other</td><td rowspan="2">High</td></tr>
<tr><td>Social</td></tr>
</table>

Response Transportation (KFH Group, Inc., et al., 2008), in a section of Table 6a-4/Figure 6-6 called "Characteristics of Systems Affecting Performance," there was the following observation:

> In addition to ADA paratransit service, the system provides 'shopper' routes, essentially service routes with same-day service for ADA riders; these flexible routes, which serve specific areas and target senior and other housing complexes, achieve group loads and help increase productivity. (*71*)

In Table 6A-7/Figure 6-10 of *TCRP Report 124* (KFH Group, Inc., et al., 2008), there was another observation:

> Starting in 2004, the DRT system 'zoned' much of the service, requiring riders to use the closest facility for their trips. This change affected roughly 25% of riders, and allowed the system to reduce its peak fleet by 12%. (*74*)

South Central Adult Services Council, Inc. (South Central Adult Services) in North Dakota (see description in Chapter 4), successfully operates this type of flexible public transportation in an area that has population densities ranging from two to eight persons per square mile.

The types of flexible public transportation service best suited for very rural areas are the following:

- **Demand-responsive connector.** This service works best when there are no viable trip origins but there are public transportation connections to viable trip destinations within a defined area.
- **Request stops.** This service works best when passengers are given the opportunity to use the fixed-route system (even a deviated fixed route) along the corridor.
- **Flexible route segments.** This service works best when there is an area where no viable trip origins exist, but a transit-dependent trip demand is prevalent.
- **Zone routes.** This service works best when no corridor exists, but viable trip origins and/or trip destinations exist within a defined zone.

Transportation agencies that serve rural areas that are smaller in geographic size, such as Mason County Transit (see description in Chapter 4), can also operate the other types of flexible public transportation services:

- **Route deviation.** This service works best where there are defined origins and destinations along a corridor that have high viability for flexible public transportation service. Given the low-density nature of the area, service can deviate off the route as the occasion arises.

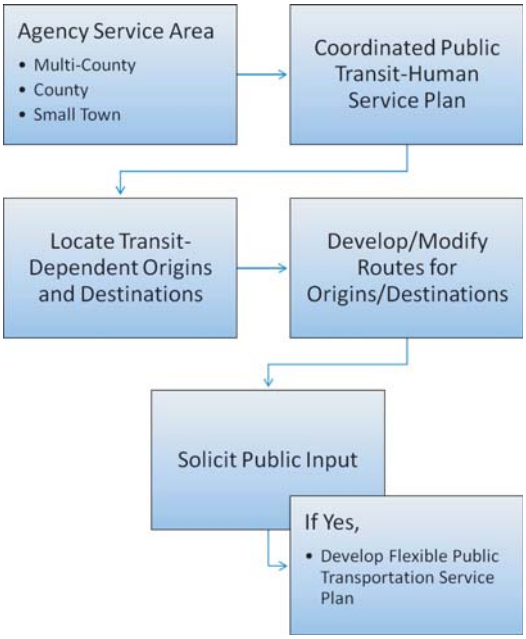


Figure 17. Decision guide for rural areas (less than 50,000 population).

- **Point deviation.** This service works best when there are no viable trip origins, but there are viable trip destinations within a defined area or when there are no viable trip destinations, but there are viable trip origins.

Agencies offering public transportation in rural areas should follow the decision guide presented as Figure 17 in considering whether its service area is a good candidate for flexible public transportation services.

2.2 Small Urban Flexible Public Transportation Service

In the United States, almost all of the small urban areas (50,000 to 200,000 population) operate some form of public transportation service. These small urban areas are usually recipients of FTA Section 5307 funding on a formula basis and use the funding to obtain vehicles, other equipment, and facilities to operate public transportation service, primarily fixed-route service. A considerable number of small urban public transportation systems operate fixed-route service with one major focal point, normally the city center or downtown, which often has a transit center. Service is provided using "clockface" headways, with buses meeting at the transit center every 30, 45, or 60 minutes to facilitate transfer. Many systems utilize buses that are 30 feet or smaller in length, and passenger loads generally range from 5 to 15 passengers per hour. Many of the small urban areas have population densities that range from low/medium (500 to 1,000 persons per square mile) to medium/high (1,000 to 2,000 persons per square mile).

Small urban fixed-route public transportation systems that have ridership productivity rates that approach 5 to 16 passengers per hour are strong candidates for flexible public transportation service options. Ridership data suggest that flexible public transportation service in small urban areas has its benchmark productivity levels at between 5 and 11 passengers per hour. St. Joseph Transit in Missouri (see Chapter 4) provides a flexible public transportation service that operates route deviation and request stops. For the last 3 years, St. Joseph Transit has

reported that its passenger per hour rates were 5.9, 5.8, and 7.2 passengers per hour. However, Transfort, a small urban transit system in Fort Collins, Colorado, reports average ridership of 27.6 passengers per hour. This system would not be a good candidate for flexible public transportation service. Fort Collins is home to Colorado State University and carries a large number of students and faculty who frequently make time-sensitive trips.

In the development of a flexible public transportation service model, the logistics should evolve from a demand-responsive service approach to public transportation and not a fixed-route service approach. Conceptually, flexible public transportation service is more like demand-responsive service than fixed-route service. In planning the logistics of fixed-route service, the concept is to develop and operate defined routes, stops, and timeframes (service) to which the riding public responds. The operator focuses internally on the reliability of the public transportation network and accepts passengers as they board and alight. Adjustments are made to the "fixed" nature of the public transportation network to improve productivity. Fixed-route systems can be very productive, and the boardings per hour can range from 10 to 500. Communications are necessary, but they focus mostly on internal matters. Advanced communications (e.g., AVL) become more important as the productivity and complexity of the fixed-route system increases. A wide variety of vehicles are used, ranging from a 25-foot, body-on-chassis bus to a 65-foot, articulated bus. Fares can be more than nominal in nature and, in some instances, assist in controlling demand.

In planning the logistics of demand-responsive service, the concept is to develop and operate service based on an interaction with the passenger before the routes, stops, and timeframes (service) are provided. The operator develops service based on a predetermined demand. The operator makes adjustments to the "tours" created by the demand for the service to improve productivity. Demand-responsive systems are far less productive than fixed-route systems, with boardings per hour ranging from 1.28 to 4.70, as shown in Table 11. *TCRP Report 124: Guidebook for Measuring, Assessing, and Improving Performance of Demand-Response Transportation* (KFH Group, Inc., et al., 2008) provides a range of passenger trips per revenue hour for the following demand-responsive systems.

Small urban fixed-route public transportation systems that have ridership productivity rates that approach 5 to 16 passengers per hour are strong candidates for flexible public transportation service options that would obviate the need for complementary ADA paratransit service. Under the Americans with Disabilities Act of 1990 (ADA), agencies that operate fixed-route service must provide complementary ADA paratransit service for persons who, because of their disability, are unable to use the fixed-route system. According to the APTA *2009 Public Transportation Fact Book* (Neff and Dickens, 2009), the capital and operating expenses associated with complementary ADA paratransit service are substantial. Table 12 summarizes the

Table 11. Range of performance data from representative demand-responsive transportation systems.

Representative Demand-Responsive Systems by Category		Passenger Trips/Revenue Hour
Small Urban Systems	ADA Only	1.77–3.84
	Limited Eligibility	1.76–4.04
	General Public	2.92–4.70
Large Urban Systems	ADA Only	1.83–2.68
	Other	1.70–3.55
Largest Urban Systems	ADA Only	1.28–2.34
	Other	1.49–4.35

Table 12. 2007 capital expense by mode (millions of dollars).

Expense Category	Paratransit Capital Expenses ($ Million)	All Modes Capital Expenses ($ Million)
Facilities	170.6	8,842.5
Rolling Stock	500.2	3,927.0
Other	76.9	1,758.8
Total	747.7	14,528.3
% of Total	**5.2%**	**100%**

Table 13. 2007 operating expense by mode (millions of dollars).

Expense Category	Paratransit Operating Expenses ($ Million)	Total Operating Expenses ($ Million)
Vehicle Operations	1,429.0	15,560.0
Vehicle Maintenance	290.9	5,981.7
Non-Vehicle Maintenance	58.0	3,154.0
General Administration	388.1	4,779.1
Purchased Transportation	2,254.7	4,402.4
Total	4,420.7	33,877.2
% of Total	**13.0%**	**100%**

annual total public transportation capital and operating expenses for Fiscal Year (FY) 2007 for paratransit (which is predominately complementary ADA paratransit) and for all modes. Paratransit capital expenses were $747.7 million and represented 5.2 percent of the total capital expenses.

Paratransit operating expenses, as shown in Table 13, were $4,420.8 million and represented 13.0 percent of the total expenses in that category.

When totaled together, as shown in Table 14, paratransit expenses represented 10.7 percent of all capital and operating public transportation expenses.

In many small urban areas, paratransit operating expenses can be an even higher percentage of total operating expenses. Table 15 summarizes the FY 2008 public transit operating expenses for the small urban city (population of 137,000) of Fort Collins, Colorado. For FY 2008, paratransit expenses represented 22 percent of the system's operating expenses.

The type of flexible public transportation service that is being implemented most frequently in small urban areas is route deviation. As previously described, the operation of complementary ADA paratransit service is expensive, and most agencies need to reduce costs in order to serve the growing public demand for public transit service. Now that most public transit systems operate fully accessible transit fleets and as communities complete the task of making sidewalks and bus stops accessible, persons with disabilities are more able to use the same services offered to the general public. Many small urban areas have substituted fixed-route service with route deviation service to eliminate the ADA requirement to provide for ADA complementary para-

Table 14. 2007 total expense by mode (millions of dollars).

Expense Category	Paratransit Expenses ($ Million)	Total Operating Expenses ($ Million)
Operating Expenditures	4,420.8	33,877.3
Capital Expenditures	747.8	14,528.3
Total Expenditures	5,168.6	48,405.6
% of Total	**10.7%**	**100%**

Table 15. City of Fort Collins, Colorado—2008 public transit operating expenses.

Service Type	Total Expenses ($ Thousands)	% of Total
Fixed Route (27.6 pph*)	$6,051.7	78
Paratransit (2.6 pph)	$1,743.0	22
Total	**$7.794.7**	**100**

* pph = passengers per hour.

transit service to fixed-route service. While this service design can be a very viable alternative, there are two mistakes small urban transit systems must avoid:

- The service should not be publicized as only for persons with disabilities.
- The service should not be designed as fixed route with deviations added as an afterthought.

FTA has determined that flexible public transportation services, including route deviation, are not fixed-route services; therefore, ADA complementary paratransit service is not required where flexible public transportation is operated. However, the service must be flexible and deviate for the general public. An agency cannot require persons requesting a deviation to prequalify as elderly or a person with disabilities in order to schedule a pick-up or request a deviated destination.

The other mistake that some small systems make is not properly planning for the demand-responsive service features of route deviation as a flexible public transportation service. Sometimes small systems have approached the provision of route deviation service from a fixed-route service perspective instead of a demand-responsive service perspective. This not only causes disappointment when policymakers realize that the costs per passenger of providing flexible public transportation is higher than fixed-route service, it causes discontent among passengers who do not have the benefit of a more comprehensive and interactive call-taking and dispatching system, as is required of demand-responsive services. Communication is more complex, given the need for both external and internal interactions. Advanced communication capability does become more important as the productivity and complexity of the demand-responsive system increases. The passenger communications systems and the driver skills needed for complementary ADA paratransit service can be modified to work on flexible public transportation service. Smaller vehicles are almost always used in providing demand-responsive services since productivity is limited. Fares are almost always nominal in nature.

Transit operators in small urban areas should follow the decision guide presented as Figure 18 in considering whether its service area is a good candidate for flexible public transportation services.

2.3 Large Urban Flexible Public Transportation Service

Large urban areas present some new opportunities for the provision of flexible public transportation service. While there is limited opportunity for comprehensive implementation of flexible public transportation service because of the overall higher population densities, there are some areas where population densities are conducive to flexible public transportation service. For many years, urban populations have been moving to the suburbs, creating communities that are more automobile oriented and less dense than communities in the city center. In some instances, the movement to the suburbs has created pockets of less densely populated communities in the urban core. In some circumstances, a major event, such as Hurricane Katrina in New Orleans, Louisiana, has created an urban location that has a lower density rate more conducive to flexible public transportation services. Research has shown that low-density urban areas in which major transportation activity centers—such as rail stations, transit hubs, shopping centers, medical centers, employment parks, and schools—are located are conducive to flexible public transportation. The most informative research results on this subject are contained in a report on Denver, Colorado's, RTD call-n-Ride Service (Transportation Management & Design, 2008). Other opportunities for flexible public transportation service include service in low/medium (500 to 1,000 persons per square

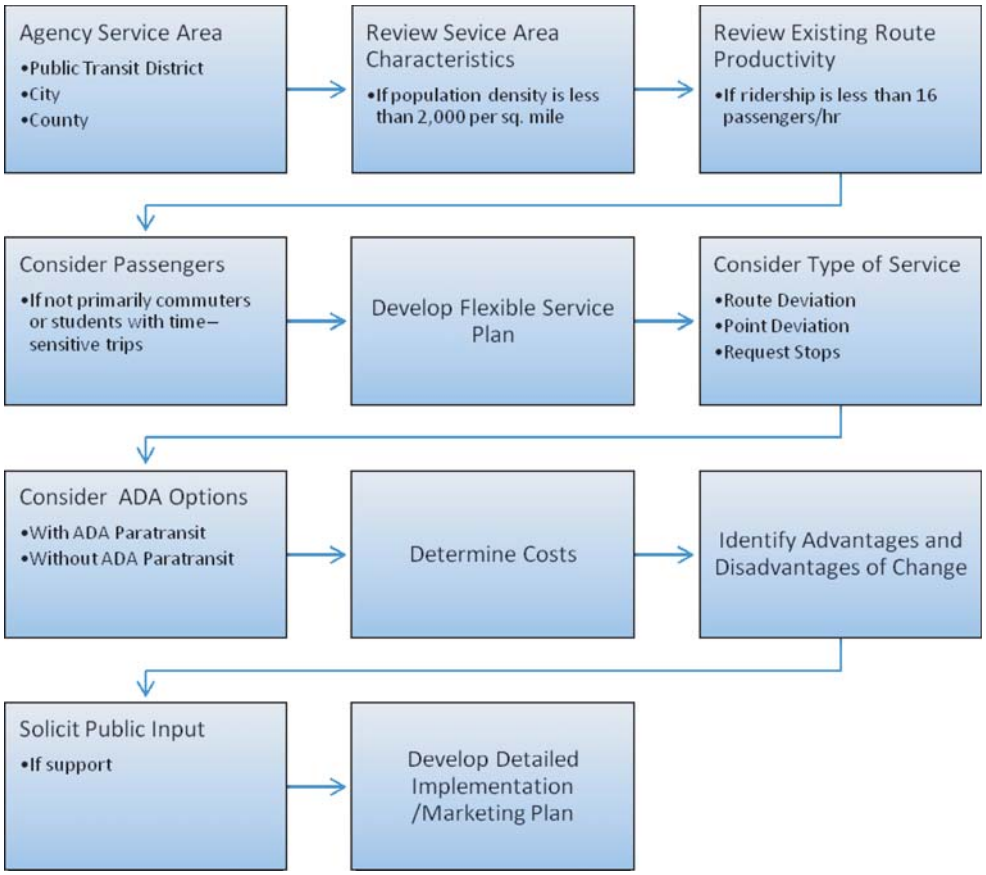


Figure 18. Decision guide for small urban areas (50,000–200,000 population).

mile) density service areas during lower than normal demand periods, e.g., nighttimes and/or weekends.

Best Practices in Transit Service Planning (Mistretta et al., 2009) lists several service area characteristics that should be measured when planning for public transportation services. These measures include population density, employment density, age, income, and vehicle availability (*10*):

- Population Density
  - Persons per square mile
  - Dwelling units per acre
  - Minimum number of households
- Employment Density
  - Employees per square mile
  - Employees per acre
  - Employees per employer (threshold)
- Age
  - Population age 18 and younger
  - Population age 60 and older
- Income
  - Number of households with incomes less than $10,000
  - Per capita income

- Vehicle Availability
  - Zero car households
  - One-car households

A report on flexible public transportation in Denver (Transportation Management & Design, 2008) identified five of these variables as having the highest overall correlation to the performance of flexible public transportation services (*4*):

- Population density
- Employment density
- Senior density
- Youth density
- Median income

Large urban fixed-route public transportation systems that have routes or areas that have ridership productivity rates that approach 5 to 16 passengers per hour are strong candidates for flexible public transportation service options. Pierce Transit in Washington State (see Chapter 4) provides a flexible public transportation service that operates route deviation and request stops. The Pierce Transit productivity standard for its flexible public transportation service is 5 passengers per hour. The Regional Transportation District (RTD) in Denver, Colorado (see Chapter 4), provides a flexible public transportation service called call-n-Ride that operates point deviation, demand-responsive connector, and route deviation. RTD's call-n-Ride service standards analysis for FY 2007 show that the number of passengers per hour ranges effectively from 1.7 to 14.6, with an average of 4.9. Call-n-Ride productivity for FY 2008 ranges from 2.7 passengers per hour to 9.7 passengers per hour. One call-n-Ride route, Gateway, had a productivity rate of 19.1 passengers per hour in FY 2008, but this rate appears to be outside of the norms.

In the *RTD Call-N-Ride Performance Review* (Transportation Management & Design, Inc., 2008) was the following "key finding" (*10*):

- *Routes with scheduled stops are the most productive call-n-Ride services.*

  The call-n-Ride services offering point deviation and scheduled checkpoints perform significantly better than those that do not. These particular services seem to work well for regular commuters who routinely ride the call-n-Ride services. The consistency of service helps to increase its attractiveness to riders who require the same service on a repeated basis. Although the implementation of point deviation is partially brought about by high ridership demand, designing other call-n-Ride service areas to provide checkpoint service, if applicable, may help to increase the performance, as it helps to create a base market with consistent ridership. Utilizing scheduled stop service eliminates the need for customers to call ahead to plan trips, allowing for more spontaneous ridership.

The productivity rates for Omnilink, a flexible public transportation service provided by the Potomac and Rappahannock Transportation Commission (PRTC) in Virginia (see Chapter 4), were 15.4, 15.8, and 16.1 passengers per hour, respectively, for the past 3 years.

In large urban areas, the flexible public transportation service area must be defined to facilitate optimal service operations. The optimal physical size of an area for flexible public transportation service is dependent on several factors, including population demographics, population density, topography, and the presence of a major transportation activity center; however, consideration must also be given to optimal vehicle operating times. For zone routes, for example, the service area must be small enough for the vehicle to reach end points at defined intervals, e.g., every 30, 45, or 60 minutes.

Transit operators in large urban areas should follow the decision guide presented as Figure 19 in considering whether certain parts of its service area are good candidates for flexible public transportation services.

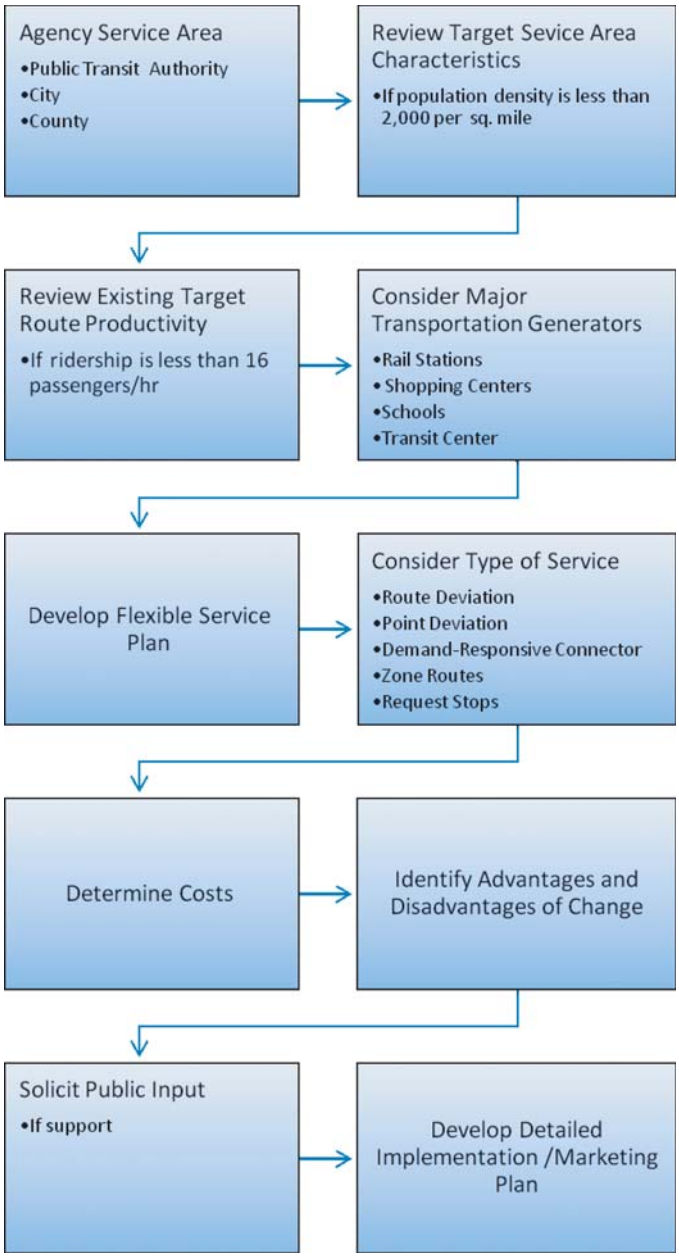


Figure 19. Decision guide for large urban areas (over 200,000 population).

CHAPTER 3

Implementing New Flexible Public Transportation Services

The intent of this chapter is to guide local agencies through the process of implementing new flexible public transportation services. There are numerous reasons why a community or agency chooses to operate flexible public transportation services. Based on this research effort, three operating environments were identified as good candidates for flexible public transportation services. They are all rural areas, small urban cities, and selected applications in urban and suburban areas.

While communities operate different types of services for different reasons, there are some generally shared circumstances and related operational responses. Often, fiscal constraints, geographic challenges, and ridership behavior patterns influence the public transportation mix in any locale. Some reasons for considering flexible public transportation services are the following:

- Improving productivity for general public demand-responsive systems
- Serving special needs populations (ranging from senior citizens to students)
- Replacing all or some fixed routes with flexible public transportation service to reduce or eliminate the need for complementary ADA paratransit service
- Providing limited employment transportation such as Job Access and Reverse Commute (JARC)
- Providing connections to other public transportation services in the area
- Providing basic mobility and travel options when demand is low
- Introducing public transportation to new areas and/or new users

Prior to undertaking the implementation of new flexible public transportation services, it is necessary to take the following key steps, which will be described in this chapter:

- Analyze existing conditions
- Obtain input from policymakers and the community
- Plan and schedule flexible public transportation services
- Determine capital needs—vehicles and technology
- Understand the costs
- Market the new service

3.1 Analyzing Existing Conditions—What Data Should I Review?

Implementing flexible public transportation services in an existing public transportation operation requires an understanding of the agency's existing conditions. These issues vary according to the type of service currently provided by the agency and the area to be served by the flexible public transportation service. In all cases, drivers and supervisors should be involved with planners and management in analyzing existing conditions and considering options. These employees are

closest to the customers and the operating environment and can offer valuable advice. Further, drivers and supervisors need to buy-in to the change since they will be ultimately responsible for delivering the new service.

Rural Areas

Agencies that serve rural areas of extremely low density (up to 500 persons per square mile) should review and understand the following data when considering flexible public transportation:

- Population density
- Senior citizen density
- Youth density
- Low-income and/or subsidized housing
- Senior citizen housing
- Trip destination locations (e.g., discount stores, hospitals, senior citizen centers, and activity centers for persons with disabilities)
- Trip purpose

Public transportation in rural areas usually serves the most transit-dependent populations. When the service is general public demand-responsive service, the agency operates service based on demand and groups trips together on a daily basis; there is little need to understand the demographics of the service area. Since flexible public transportation service must contain some type of schedule and time, the agency must take steps to understand as much as possible about the locations of potential riders. Since senior citizens, persons with disabilities, and youth have the highest potential to be users of flexible public transportation service, transportation providers need to know where members of these groups live and where they want to travel. By plotting population densities, e.g., concentrations of people in a given area, it is easy to predict where most trips will originate. Many rural areas can look to their regional planning organizations to provide these data. These regional planning organizations often help to facilitate locally coordinated transportation plans that are used to prioritize federal funding for transportation. Population density data are most useful when socioeconomic characteristics such as age and income are considered.

An agency that is already operating demand-responsive service should examine trip patterns during a 6-month period to identify common destinations. If riders frequent a transportation generator—such as Walmart, a hospital (for non-emergency trips), or a senior citizen nutrition program—it may be more cost-effective to create a flexible public transportation service route to serve the hospital twice each week, instead of making that trip every day for fewer passengers. A possible guideline is to consider any destination that generates over five individual trips per week as a candidate for a flexible public transportation service route. The next step would be to determine whether the origination point is conducive to grouping the trips in a scheduled flexible public transportation service zone route. The operation and routing of service by South Central Adult Services (described in Chapter 4) in North Dakota is a good example of this type of service.

Other agencies operate one or two fixed routes in rural areas in relatively close proximity to a CBD where many services and shops are located. These agencies are therefore required to operate complementary ADA paratransit. When considering more cost-effective options, these agencies should determine the trip purposes of their current riders. If the trips are time sensitive, such as work or school commutes, flexible public transportation services may result in a loss of riders. Work and school commuters tend to want to minimize their travel time since they make the trip so frequently. However, if the trips are for shopping or non-emergency medical purposes, current riders will be less inconvenienced by flexible public transportation service. Mason County Transit Authority (described in Chapter 4) is an example of a rural area in Washington

State that evolved from general public demand-responsive service to **route deviation** flexible public transportation service.

Small Urban Areas

Small urban areas (50,000 to 200,000 in population) are usually the best candidates for the route deviation or point deviation forms of flexible public transportation service. In these areas, the following factors should be considered when assessing whether flexible public transportation services are viable:

- Current route productivity
- Population density
- Senior citizen density
- Youth density
- Income levels
- Trip purpose

Agencies operating fixed-route service in small urban areas should first determine whether the transit system has productivity rates of fewer than 15 passengers per hour. If so, the entire transit system can be considered for flexible public transportation services. This research effort has shown that flexible public transportation services can achieve productivity rates of up to 15 passengers per hour. A second factor to consider is the trip purposes of the current riders. If passenger trips are largely work or school commutes, the agency is less likely to be in a position to successfully operate route deviation throughout the day. In these cases, the agency could consider operating flexible services during off-peak periods, limiting the need to provide complementary ADA paratransit service to those peak periods when fixed-route service is operated.

Population densities are also an important consideration because concentrations of transit-dependent persons, including senior citizens, youth, and low-income persons, may impact the number of deviations and the scheduled trip time.

Large Urban Areas and Suburban Areas

Many large urban (population over 200,000) transit systems have service standards for different types of service. These standards allow management to measure the efficiency and effectiveness of the service. When routes do not meet the standards, management will consider alternatives ranging from reducing service frequency to eliminating the service completely. Further, standards can be used to determine whether conditions exist for implementing new service. One alternative, especially in areas outside of the core area, is substituting the regular route service standard for less frequent, but more targeted, flexible public transportation service.

Flexible public transportation services in medium and large urban areas have been proven successful in limited applications. Due to higher ridership and the high use of public transportation for work and school commutes in these areas, a systemwide approach to flexible public transportation service is usually not advised. The most frequently reported applications for flexible public transportation service in urban areas are the following:

- Suburban residential and mixed use as feeder to other transit connections
- Office campuses
- Replacement of an unsuccessful bus route
- Urban night owl service
- Residential community constrained by geographic barriers such as lakes, mountains, etc.
- Suburban residential as circulators for senior citizens and youth

- New suburban residential
- Areas never served by transit

Key data to examine when considering flexible public transportation service in urban areas are the following:

- Population density
- Size of area to be served
- Travel time to connector or time point
- Employment density
- Household density
- Auto ownership
- Senior citizen density
- Youth density
- Median income
- Productivity of existing routes, if any

In large urban areas, both residential and employment population densities are key data factors to consider in understanding whether flexible public transportation service can be utilized effectively. Other factors to consider include the following:

- Are there routes outside of the core area where ridership productivity is below 15 passengers per hour?
- Are there areas with significant origins or destinations, near a transit connection such as bus rapid transit (BRT) or light-rail line that are not served by public transportation?
- Are there times of day when ridership is low, but public transportation is needed?
- Are there special needs groups, year round or seasonally, that could travel within a small area or zone?

3.2 Obtaining Community and Policymaker Input

Obtaining community input on decisions such as the type of transportation service to be implemented and the area to be served is vital to planners and local officials. The community should be engaged early on in the planning process and stay engaged through implementation and operations. In several communities studied for this research, community leaders initiated discussion with the transportation provider about implementing local, community-based transportation that resulted in flexible public transportation service, often in the form of **zone routes.** Ongoing community involvement builds support and creates advocacy for the new service. This research revealed a broad range of outreach techniques that are employed by flexible public transportation service providers, including town hall type meetings and information fairs. The most prevalent outreach methods reported by operators of flexible public transportation services were the following:

- Public meetings/hearings
- Targeted presentations to civic clubs, neighborhood associations, and church groups
- Website forums
- Citizen's advisory committees
- Surveys
- Mixed media, i.e., print and broadcast

Communities should use the public involvement technique that is most appropriate for the event purpose and audience. The surveys and case study interviews pointed out that involvement is critical, and marketing the services is a major challenge. To increase the likelihood of success,

agencies and communities should try a number of techniques and settle on those that are most appropriate for their communities.

3.3 Planning and Scheduling Flexible Public Transportation Service

As stated previously, the logistics of flexible public transportation services are more related to demand-responsive service than fixed-route service. Deviations consume time, and unscheduled activity is problematic for fixed-route service. Even without route deviations, fixed-route service can have its schedule disrupted by weather, accidents, passenger illnesses, traffic congestion, railroad trains, and lift deployments. Fixed-route schedules need recovery time to ensure that, no matter what unscheduled activity occurs, the next trip can begin at the scheduled time. Fixed-route schedules already build in up to 10 percent or more of the total scheduled time for recovery (3 minutes on a 30-minute trip and 6 minutes on a 60-minute trip). Each route deviation can take 3 to 10 minutes, therefore, adding the time for recovery and the deviation can make the ability to schedule times more difficult, especially if 50 percent or more of the time has an unknown factor to it.

Rural Areas

One advantage in providing flexible public transportation service in rural areas is introducing a time component to the service. In low-density areas, there is less likelihood of the unscheduled activities that occur in small urban and large urban areas. It is also probable that the passenger productivity potential is lower than the maximum threshold for utilizing fixed-route service. There also is probably not another scheduled trip for the bus to make after the main trip. As a result, the process for scheduling flexible public transportation service in rural areas is simpler and could entail the following steps:

- Developing a route that has stops at all the major origins and destinations of the purpose of the trip(s).
- Calculating the running time from Point A to Points B, C, and D along the way, using a speed under the posted speed limits.
- Adding 20 to 25 percent additional time for expected daily deviations on a daily basis.

Small Urban Areas

In planning and scheduling flexible public transportation service in small urban areas, it is important to understand the neighborhoods to be served, the street system, and the logical place(s) for service to "meet."

Since all small urbanized areas receive FTA Section 5307 funding for capital, operating, and preventative maintenance expenses, they currently operate some form of public transportation, most likely fixed-route service. Routes generally have trip times that allow the buses to meet every 30, 45, and/or 60 minutes at a designated point, often a transit center. Recovery time is already built into the fixed-route schedule. When planning and scheduling flexible public transportation service, the unscheduled time should be approximately 50 percent of the actual time to allow for flexibility and recovery.

Large Urban Areas

In planning and scheduling flexible public transportation service in large urban areas, it is important to understand the area to be served, the street system, the natural and man-made barriers, and the logical place(s) for service to target.

Flexible public transportation service areas should be small enough to allow buses to penetrate and return in logical times, e.g., 30, 45, and/or 60 minutes. As a result, the service area should be no larger than 4 to 10 square miles. Flexible public transportation service works well in areas with barriers such as mountains, water, and railroad tracks. The important time points are provided at the major transportation activity centers such as rail stations, shopping centers, and transit centers. Routes should be developed to allow the buses to serve the activity center every 30, 45, and/or 60 minutes such that passengers can know the service frequencies. When planning and scheduling for flexible public transportation service in these circumstances, the unscheduled time should be approximately 50 percent of the actual time to allow for flexibility and recovery.

3.4 Understanding the Costs

The cost of providing flexible public transportation service is measurable, and, while it may vary from region to region, there is enough cost history available to compare flexible public transportation service costs to fixed-route costs across the three operating environments identified for this study. Most agencies did not calculate the cost per trip for flexible public transportation services; therefore, for the purposes of this analysis, where flexible public transportation service costs are not available or where flexible public transportation service does not actually operate, its costs were presumed to be similar to those of demand-responsive service.

According to the 2007 National Transit Database (NTD), the national averages for directly operated demand-responsive service cost per trip was $26.95 and the directly operated fixed-route motorbus service cost per trip was $3.21. These rates are similar to the national averages for the combined directly operated and purchased transportation cost per trip of $28.52 for demand-responsive service and $3.19 for fixed-route motorbus service. To gain a better understanding of flexible public transportation service costs, the cost per trip for the three operating environments identified in the study are presented below.

Rural Areas

Most flexible public transportation services are operated in rural areas that include large areas with low-density populations, large counties with low-density populations, and small rural communities and towns with low-density populations. The cost per trip among rural service providers varied across regions, but the rates do show that flexible public transportation service costs in rural areas are less than the national averages. For example:

- South Central Adult Services in North Dakota (see Chapter 4 for more information) operates flexible public transportation services (route deviation and zone routes) and reported cost per trip rates of $10.37 for 2008.
- Western Maine Transportation Services, Incorporated (WMTS) in Auburn, Maine, a private, non-profit corporation that provides fixed-route and demand-responsive transportation services, reported cost per trip rates of $12.18 for demand-responsive service and $3.66 for fixed-route bus service in 2007.
- Santee Wateree Regional Transportation Authority (SWRTA) in South Carolina, a rural multi-county jurisdictional agency, reported a 2007 cost per trip rate of $35.27 for demand-responsive service and $8.01 for fixed-route bus service.

Small Urban Areas

Flexible public transportation services are operated in a number of small urban areas where population densities can range from low/medium (500 to 1,000 persons per square mile) to medium/high (1,000 to 2,000 persons per square mile). In a number of these small urban communities, the public transportation agency does not provide many work trips, and flexible public transportation services obviate the need for complementary ADA paratransit service. The cost

per trip rates among small urban service providers show that flexible public transportation service costs in small urban areas are less than the national averages. For example:

- City of St. Joseph, Missouri (see Chapter 4 for more information), operates flexible public transportation service (route deviation and request stops) on each of its eight routes and reports a cost per trip of $10.46.
- Decatur Public Transit System in Decatur, Illinois, reported a 2007 cost per trip of $9.98 for demand-responsive service and $3.63 for fixed-route bus service.
- Middletown Area Transit District (MAT) in Middletown, Connecticut, reported a cost per trip of $15.02 for demand-responsive service and $3.19 for fixed-route bus service.
- City of Fargo, North Dakota, reported a 2007 cost per trip of $7.17 for demand-responsive service and $6.45 for fixed-route bus service.

Large Urban Areas

Limited flexible public transportation services are generally operated in large urban areas, and they usually fulfill a specific need—nighttime service; service to low-density areas; or feeder or connector service to fixed route, rail, or major traffic generators such as employment centers and shopping malls. In addition, flexible public transportation service can also serve to introduce choice riders to public transit services in some limited circumstances. The cost per trip rates among large urban service providers show that flexible public transportation service costs in large urban areas are similar to the national averages. All of the agencies listed below operate flexible public transportation services that are further described in Chapter 4 of this report. The costs of flexible public transportation service for these agencies were reported as the following:

- Jacksonville Transportation Authority (JTA) in Jacksonville, Florida, reported a 2007 cost per trip of $46.77 for demand-responsive service and $6.00 for fixed-route bus service.
- Charleston Area Regional Transportation Authority (CARTA) in Charleston, South Carolina, reported a cost per trip of $36.27 for demand-responsive service, $23.83 for flexible public transportation service, and $4.14 for fixed-route bus service in 2007.
- Regional Transportation District (RTD) in Denver, Colorado, reported a 2007 cost per trip of $30.18 for demand-responsive service, $13.51 for flexible public transportation service, and $3.78 for fixed-route bus service.
- Potomac and Rappahannock Transportation Commission (PRTC) in Virginia reported a 2007 cost per trip of $5.38 for its OmniLink flexible public transportation service and $7.59 for fixed-route service.

Table 16 shows the cost per trip for different types of public transportation for selected agencies in each of the three operating environments identified in the study. The shaded areas in the table indicate services that are not operated by the agency.

As the table shows, the cost per trip of flexible public transportation service is generally lower than demand-responsive service, yet much higher than fixed-route service.

3.5 Capital Needs—Vehicles and Technology

Transportation agencies and other providers of flexible public transportation services use a variety of vehicles to transport riders, ranging from passenger vans to regular transit buses. A number of considerations are factored into the choice of vehicles, including the following:

- Passenger loads
- Ridership characteristics (ADA, senior citizens, etc.)
- Width of travel lanes
- Route or zone distances
- Capital funding
- Agency preferences

Table 16. Cost per trip for different types of public transportation.

Agency Name	Area Served	Cost Per Trip for Fixed Route ($)	Cost Per Trip for DRT* ($)	Cost Per Trip for FPTS** ($)
South Central Adult Services Council, Inc. (ND)	Rural			10.37
WMTS (ME)	Rural	3.66	12.18	
Santee Wateree (SC)	Rural	8.01	35.27	
Decatur Public Transit System (IL)	Small Urban	3.63	9.98	
City of St. Joseph (MO)	Small Urban			10.46
City of Fargo (ND)	Small Urban	6.45	7.17	
MAT (CT)	Small Urban	3.19	15.02	
JTA (FL)	Large Urban	6.00	46.77	Not available
CARTA (SC)	Large Urban	4.14	36.27	23.83
RTD (CO)	Large Urban	3.78	30.18	13.51

*DRT =Demand-Responsive Transportation
**FPTS = Flexible Public Transportation Services

A large majority of the survey respondents indicated that they used small, body-on -chassis buses to operate flexible public transportation services. This is not too surprising since most respondents were small agencies and private, non-profit organizations that generally served areas of low density in rural and small urban areas. Small buses and body-on-chassis vehicles are best suited for flexible public transportation service in all areas. Table 17 shows the different types of vehicles recommended for each service area and the type of flexible public transportation service operated.

Vehicle Selection Issues

A number of variables should be considered when determining the type of vehicle to operate for flexible public transportation service. Ultimately, the vehicle selected should closely fit the type

Table 17. Vehicle types and service areas.

Type of Service Area	Type of Flexible Public Transportation Service	Recommended Vehicle Types
Rural	Request Stops Zone Routes Route Deviation	Passenger Vans (5–16 seats) Body-on-Chassis Vehicle (12–30 seats) Small Buses (18–35 seats)
Small Urban	Route Deviation Point Deviation Request Stops	Body-on-Chassis Vehicles (12–30 seats) Small Buses (18–35 seats)
Large Urban	Point Deviation Demand-Responsive Connector Flexible Route Segments Zone Routes	Body-on-Chassis Vehicles (12–30 seats) Small Buses (18–35 seats)

of service to be used and the operating and physical environment in which it will be operated. A Pennsylvania Department of Transportation Report titled *Handbook for Purchasing a Small Transit Vehicle* (Bureau of Public Transportation, 1988) cited a number of factors to be considered in the selection of a vehicle type and size. These include the following:

- Service considerations
- Costs
- Maintenance and storage capabilities
- Operating environment
- Other factors (i.e., government regulations, community acceptance, etc.)

A community or agency should evaluate the above factors and make the vehicle selection based on what they determine to be the best fit for their service needs.

Technology to Facilitate Flexible Public Transportation

The use of technology by agencies operating public transportation is now commonplace in the United States. Agencies typically employ technology to achieve a higher level of passenger service, increase capacity and quality of service, improve customer service, reduce system operating costs, manage fleets, and improve service reliability. The same holds true for providers of flexible public transportation services. These providers use technology predominantly for communications and scheduling. The vast majority of survey respondents identified voice radio as the most frequently used technology for flexible public transportation service. Voice radio was followed by cell phones and computerized scheduling systems. Very few respondents indicated use of AVL systems, GPS, or MDTs. Table 18 shows the different types of technology used by flexible public transportation service providers.

The deployment of advanced communication and scheduling technologies holds considerable promise for improving the effectiveness and efficiency of flexible public transportation services. More sophisticated technologies have been identified and tested with the potential for improving the delivery of flexible public transportation services, including the following:

- Interactive voice response technologies for handling customer requests
- Accurate automatic vehicle location of buses
- Powerful mathematical algorithms for calculating shortest path assignments
- Fast processors to make the calculations feasible
- Reliable communications systems with on-board MDTs

Table 18. Technology used to operate flexible public transportation services.

Type of Service Area	Type of Technology Deployed
Rural	Cell Phones Voice Radio
Small Urban	Voice Radio Cell Phones AVL Computerized Scheduling and Dispatching Systems
Large Urban	Voice Radio AVL GPS MDTs Computerized Scheduling and Dispatching Systems

There is no doubt that the use of technology can greatly affect the timeliness and quality of flexible public transportation service; however, costs, staffing, and training of drivers and dispatch personnel are issues that must be considered.

Most agencies in rural and small urban areas deploy the same technologies and strategies used for demand-responsive service, including ADA complementary paratransit service, for their flexible public transportation services. A dispatcher and/or reservationist can accept requests for a flexible pick-up and radio the same to the driver or, if received a day in advance of the trip, can add the pick-up to the driver's daily manifest.

Larger agencies that operate service in a variety of areas or that carry more than 10 passengers per hour should invest in more sophisticated computerized scheduling systems designed for flexible public transportation services. This can involve direct communication with the driver, via cell phone or an on-board computer that accepts on-line reservations and inserts them into the next available slot. The driver then checks the schedule before each trip leaves the time point. The most advanced systems identified during this research were found at RTD's call-N-Ride service and at the PRTC OmniLink service in suburban Washington, DC. Both of these services are further described in Chapter 4.

3.6 Marketing Flexible Public Transportation Service

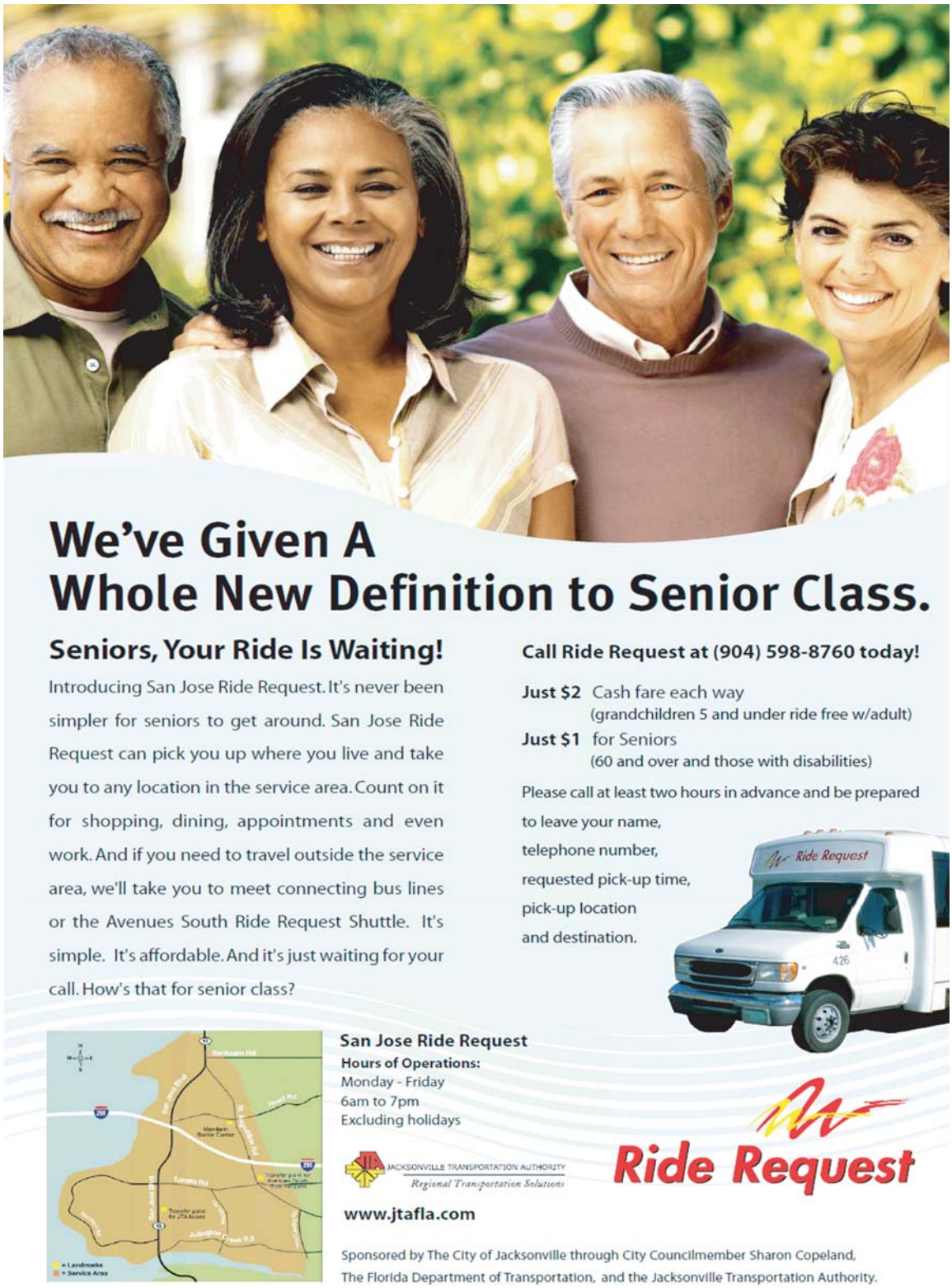
It is very important to promote and advertise any type of new product or service. This is no less true for flexible public transportation service than it is for a new flavor of diet soda. The type of marketing that most providers of flexible public transportation service found useful is direct presentations to community groups. Since flexible public transportation service usually serves a specific clientele, area, or community, the public transportation provider should meet with members of the public at regular community gatherings to solicit input and feedback and promote the service. The transportation provider can speak at the following:

- Senior citizen centers
- Neighborhood associations
- Local business groups such as a chamber of commerce
- Community fairs
- Events at colleges or local schools

The next most frequently used and probably least costly form of marketing was the agency's website. More than half of the agencies participating in this research indicated that their websites were an effective and efficient way to publicize and explain flexible public transportation services. Appendix C of the contractor's final report for TCRP Project B-35 (available by going to www.trb.org and searching for "TCRP Report 140") contains a large array of marketing materials found on websites regarding flexible public transportation services.

In addition to presentations and websites, agencies include information on their flexible public transportation services on system maps, individual route timetables, and/or brochures. Fewer agencies reported using paid advertising in print media or using direct mail as a method of promoting their service. One agency, JTA, used posters to promote flexible public transportation to different markets. An example of one poster is shown as Figure 20.

In summary, it is important for an agency to include information on flexible public transportation in its general marketing material. However, this type of service is usually community based, so marketing efforts should be focused on the target area. Making personal presentations and distributing materials in the affected area are considered to be the most effective ways to reach potential riders.



Source: JTA

Figure 20. Poster advertising flexible public transportation services.

CHAPTER 4

Best Practices of Successful Flexible Public Transportation Services

This chapter summarizes the results of the best practices of successful flexible public transportation services throughout the country. Using the results of the initial survey of public transportation agencies, candidate flexible public transportation service agencies were identified for a more detailed analysis. The agencies represented a broad cross section of transportation providers that have implemented some type of flexible public transportation service. The following factors were considered in identifying current flexible public transportation agencies for best practices:

- **Geography** (agencies selected from all regions of the United States)
- **Agency Type** (both public and non-profit agencies)
- **Density** (agencies serving both high- and low-density areas)
- **Number of Vehicles** (a standard measure of the size of an agency)
- **Area Served by Flexible Service** (urban, rural, or suburban areas)
- **Type of Flexible Public Transportation Operated** (each of the six major types of flexible public transportation service should be represented)
- **Participation in *TCRP Synthesis 53*** (Koffman, 2004) (further study of selected participants)

Twenty-six candidate agencies were initially identified and the following 10 agencies, shown in Table 19, agreed to participate in this research effort:

Nine of the agencies were public bodies and one was a private non-profit (South Central Adult Services). Three of the agencies (Mason County Transportation Authority, Pierce Transit, and PRTC/Omniride) had participated in the research reported in *TCRP Synthesis 53: Operational Experiences with Flexible Transit Services* (Koffman, 2004).

For each participating agency, the following detailed information was collected:

- Agency Name
  - Type of agency, e.g., city or county department, private not-for-profit
  - Type of flexible public transportation service(s) operated
- Overall Service Area Characteristics
  - Population (transit-related demographics such as youth, income, senior citizen)
  - Area (square miles, topography)
  - Population densities (residential, employment)
- Flexible Public Transportation Service(s) Area Characteristics
  - Population (transit-related demographics such as youth, income, senior citizen)
  - Area (square miles, topography)
  - Population densities (residential, employment)
- Transit System Description for All Modes
  - Modes operated
  - Fleet size and type
  - Ridership

Table 19. Study participants.

Agency Name	Primary Type(s) of Flexible Public Transportation	Area Served	Website
Mason County Transportation Authority (WA)	Route Deviation, Zone Routes, Request Stops	Rural	www.masontransit.org
City of St. Joseph (MO)	Route Deviation, Request Stops	Small Urban	www.stjoemo.info/transit/
PRTC/Omniride (VA)	Route Deviation	Suburban	www.PRTCTransit.org
Pierce Transit (WA)	Route Deviation, Request Stops	Suburban	www.piercetransit.org
Denver RTD (CO)	Point Deviation, Demand-Responsive Connector, Route Deviation	Suburban	www.rtd-denver.com
JTA (FL)	Route Deviation, Demand-Responsive Connector	Urban and Suburban	www.jtafla.com
CARTA (SC)	Zone Routes	Urban	www.ridecarta.com
Mountain Rides (ID)*	Request Stops	Rural	www.mountainrides.org
South Central Adult Services (ND)	Route Deviation, Zone Routes, Demand-Responsive Connector	Rural	www.southcentralseniors.org
Omnitrans (CA)	Zone Routes, Demand-Responsive Connector	Suburban	www.omnitrans.org

*Route deviation service discontinued October, 2008. Information provided for illustrative purposes of services provided in a rural, low-density community.

  - Fares
  - Span of service
  - Revenue, costs, subsidies, and funding
- Flexible Public Transportation Description for All Types Operated
  - Types operated and how
    - Distance allowed for route deviation
    - Percent of trips that deviate
    - Procedures and requirements for advanced flexible public transportation requests
    - Service coordination elements
    - Scheduling techniques
  - Fleet size and type
  - Ridership
  - Fares
  - Span of service
  - Revenue, costs, subsidies, and funding
  - Technologies employed
  - Employees/contractors/personnel
- Productivity Standards and Measures for Flexible Public Transportation Service(s)
- Policy objectives for Implementing Flexible Public Transportation Service(s)
- Marketing Strategies for Flexible Public Transportation Service(s)
- Other Issues
  - Operational challenges
  - Benefits and costs
  - Advantages/Disadvantages
  - Strengths/Weaknesses
  - Data needs
  - Factors that inhibit the use of flexible public transportation service

In addition to collecting detailed information, several agencies were visited in person:

- Mason County Transportation Authority (WA)
- Pierce Transit (WA)

- City of St. Joseph (MO)
- PRTC/Omniride (VA)
- Denver RTD (CO)
- JTA (FL)

These in-person site visits were conducted to observe firsthand the actual delivery of flexible public transportation service. The visits included observing the service planning and scheduling functions. It also included riding the service to ascertain the actual operations and operating environment. Interviews were conducted with agency staff and riders to better understand the perceived benefits and constraints of flexible public transportation service.

The results of the agency evaluations are presented in the remainder of this chapter.

4.1 Mason County Transportation Authority

Flexible Transportation Services: Systemwide Route Deviation, Zone Routes, and Request Stops

The Mason County Public Transportation Benefit Area is a special purpose district, authorized by the State of Washington in 1975. Mason County voters approved the district in late 1991 and the Mason County Transportation Authority began operating general public demand-responsive transit service throughout the County, with connections to adjacent counties, in December 1992.

The following Mason County Transportation Authority staff met with the researchers during an on-site visit to provide the information and background used for this case study:

- Dave O'Connell, General Manager
- Jay Rosapepe, Operations Manager

Overall Public Transportation Service Area Characteristics

The Mason County Transportation Authority service area covers 961 square miles of land and 90 square miles of water, with a 2008 estimated population of 57,846 persons. The density of the entire service area is approximately 51 persons per square mile. The racial makeup of the County was 90.8 percent white, 3.6 percent American Indian or Alaskan Native, 1.3 percent Black and 1.2 percent Asian. Hispanics or Latinos of any race were 6.2 percent of the population. The median household income in 2007 was $47,200 and 17.1 percent of the population was age 65 and older. The county seat is Shelton, the only incorporated city in the County. The topography ranges from sea level to 6,255 feet at the peak of Mount Washington. In 2006, the County received a near record 81 inches of precipitation. The largest employer in the County is the Squaxin Indian Tribe with 700 employees. Many of the area residents travel outside of the County to jobs in Seattle (via ferry), Brinnon, Olympia, and Bremerton, WA.

Flexible Public Transportation Service Area Characteristics

The flexible public transportation service area characteristics are the same as the overall service area characteristics, since the flexible services are operated countywide.

Transit System Description for All Modes

According to its *Transit Development Plan 2009–2014 and 2008 Annual Report* (2009), Transportation Authority made 377,706 passenger trips and operated 35,545 revenue vehicle hours on its route deviation services in 2008. Mason County Transportation Authority also provided 57,286 pas-

senger trips on its dial-a-ride service and 53,114 trips on vanpools in 2008. Mason County Transportation Authority operates nine deviated fixed routes on weekdays. One of these routes also operates on Saturday. Most routes operate from 7:00 a.m. until 8:30 p.m. Mason County Transportation Authority offers a number of regional transit connections at the following locations:

- Olympia Transit Center
- Bremerton Transportation Center
- Brinnon Store (with connections to ferries, Amtrak, and Greyhound)
- Kimilche Transit Center (connecting to Squaxin Island Transit)

Over 54,000 of the deviated fixed-route passenger trips (14 percent) are worker/driver trips, where a worker at the local naval shipyard drives the bus and his/her co-workers to the shipyard. Some riders connect to the Washington State Ferries, while others work in the shipyard. The vehicle stays at the shipyard for the return trip in the evening.

Transit service within Mason County is free of charge. Full cash fares to areas outside of the County are $1.00. Annual operating expenses for the entire system were $5.2 million. The primary source of revenue for the service is sales tax revenue. Farebox revenue accounts for less than 10 percent of operating costs ($435,577). The bus fleet includes 19 buses ranging in size from 40-foot, low-floor Gilligs to 30-foot high-floor Bluebirds. Twenty-one cut-away vehicles are used for both dial-a-ride and deviated fixed-route service. Thirty-three 12-passenger vans are used for vanpool service. As of December 31, 2008, Mason County Transportation Authority had 66 employees.

Flexible Public Transportation Service Description for All Types Operated

Route Deviation

Mason County Transportation Authority allows a deviation (up to 1 mile) off of the regular bus routes for those who experience difficulty getting to bus stops. Availability depends on road conditions and the number of requested deviations. The Mason County Transportation Authority may suggest alternate pick-up locations if the bus cannot get to the stop initially requested by the passenger. Passengers are required to call the Mason County Transportation Authority Customer Service Center a minimum of 2 hours in advance for this service. The dispatcher notifies the driver of same-day requests via two-way radio. The Mason County Transportation Authority does not collect information on the number or percentage of passengers that request a deviation. Figure 21 presents a graphic of the entire Mason County Transportation Authority service area, and Figure 22 shows an example of a deviated fixed route.

Zone Routes

In addition to general public dial-a-ride service, the Mason County Transportation Authority also operates service that is limited to a geographic area (zone) and is limited to a specific time of day or day of the week. Much of this service is known as After School Activity (ASA) service and operates on weekdays after 5:00 p.m. The Shelton and Pioneer School Districts operate four afternoon general public deviated routes under contract to the Mason County Transportation Authority. These routes have a scheduled start in downtown Shelton and transport the general public (including students involved in afterschool activities), taking passengers directly to their destinations within the zone or to a connecting route.

Request Stops

At any time of the day, Mason County Transportation Authority passengers may flag buses at any safe location on the same side of the road the bus is travelling. Two of Mason County Transportation Authority's deviated routes also have call/request stops located off of the fixed

Source: Mason County Transportation Authority

Figure 21. Mason County Transportation Authority service area.

route, where customers are required to call the Customer Service Center a minimum of 2 hours in advance to request a ride at the designated call/request location.

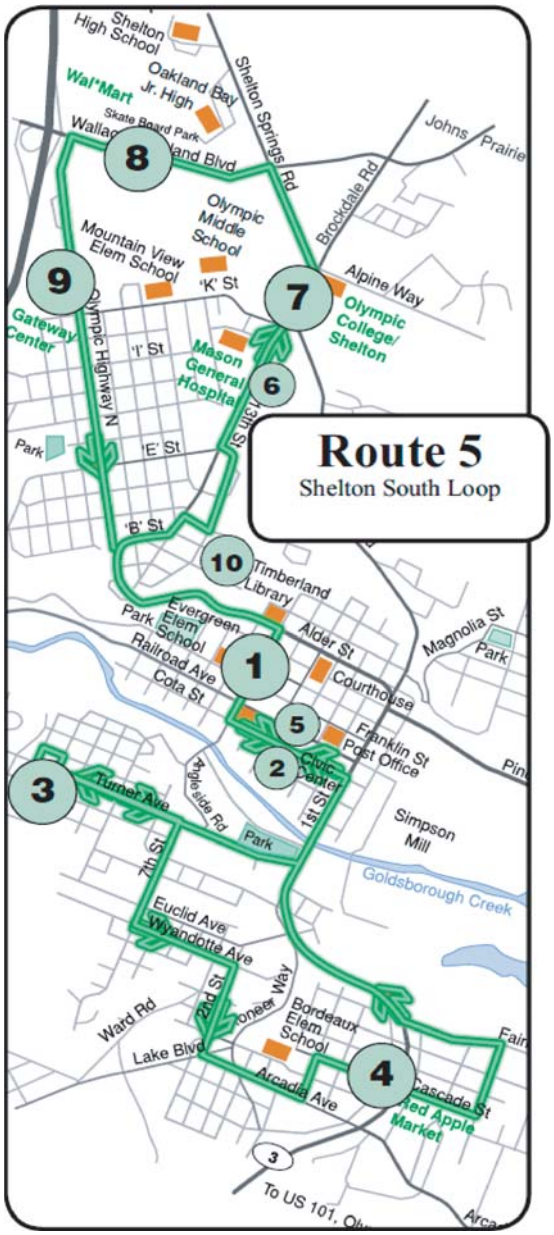
Productivity Standards and Measures for Flexible Public Transportation Service

The Mason County Transportation Authority does not have established service productivity standards for any of its transit services. In its *2009–2014 Transit Development Plan and 2008 Annual Report* (2009) the Mason County Transportation Authority noted the following productivity data for 2008:

- 10.6 passengers/hour for route-deviated service
- 2.3 passengers/hour for dial-a-ride service
- 1.9 passengers/hour for vanpooling

Policy Objectives for Implementing Flexible Public Transportation Service

The Mason County Transportation Authority began as a countywide general public dial-a-ride service. As transit ridership increased and as travel patterns became more distinct, the Mason County Transportation Authority made a decision to operate fixed routes, while allowing for the flexibility of the demand-responsive features of deviations off the fixed routes.



Source: Mason County Transportation Authority

Figure 22. Mason County Transportation Authority deviated fixed route.

The flexible services of the zone routes and request stops also allow the Mason County Transportation Authority to provide coverage to a large, low-density area and provide service in periods of low demand. The flexible public transportation services also enable the Mason County Transportation Authority to eliminate the expense of separate ADA complementary transit service by not operating fixed-route service.

Marketing Strategies

The Mason County Transportation Authority reports that the most effective ways to market the flexible public transportation features are the following:

- Inclusion of information in the system schedule or "bus book"
- Inclusion of information on its website

- Presentations to community groups
- Targeted mailings

Other Issues

The top area of concern for the Mason County Transportation Authority is the need for improved technology to allow for better dispatching and scheduling of flexible public transportation services. Current AVL technologies are ineffective given the differing geographic topography throughout the service area.

4.2 St. Joseph Transit

Flexible Transportation Services: Route Deviation and Request Stops

St. Joseph Transit is the name of the municipal bus company for the City of St. Joseph, Missouri. St. Joseph Transit is an operating unit in the City's Department of Public Works and Transportation. St. Joseph is the largest city in northwest Missouri and is the county seat of Buchanan County.

The following St. Joseph Transit staff met with the researchers to provide the information and background used for this case study:

- Andy Clements, Assistant Director for Public Works and Transportation
- Kurt Janicek, Resident Manager
- Michelle Schultz, Operations Manager

Overall Public Transportation Service Area Characteristics

The St. Joseph Transit service area covers 49.5 square miles with a 2008 population of 75,000 persons. St. Joseph Transit serves the downtown business district and city neighborhoods, as well as several employment centers. The City of St. Joseph is located along the Missouri River, 35 miles north of Kansas City. Interstate 29 runs through St. Joseph, providing a corridor from Canada to Mexico. According to the 2000 Census, there were 29,026 households and 18,460 families residing in the City. The population density was 1,688 people per square mile. There were 31,752 housing units at an average density of 724.2 per square mile. The racial makeup of the City was 91.88 percent White, 5.03 percent African American, 0.46 percent Native American, 0.47 percent Asian, 0.03 percent Pacific Islander, 0.69 percent from other races, and 1.44 percent from two or more races. Hispanic or Latinos of any race were 2.61 percent of the population. The median household income in 1999 was $32,663. St. Joseph Transit also serves Elwood, Kansas, a small city with a population of 1,145. Elwood, Kansas, is located just one mile from the city limits of St. Joseph.

Flexible Public Transportation Service Area Characteristics

Same as overall service area characteristics, since the flexible services are operated throughout the City.

Transit System Description for All Modes

St. Joseph Transit operates flexible public transportation service on each of its eight regular routes. The system is known as *The Ride* and provides a fixed-route system with route deviation and request stops.

According to its *Riders Guide* (2007), in 2007, St. Joseph Transit carried 417, 906 passengers along eight bus routes. The bus fleet includes 20 buses, with 16 in daily use and 4 in reserve as spares. There are three transfer centers, one intermodal transit center, and over 460 bus stops.

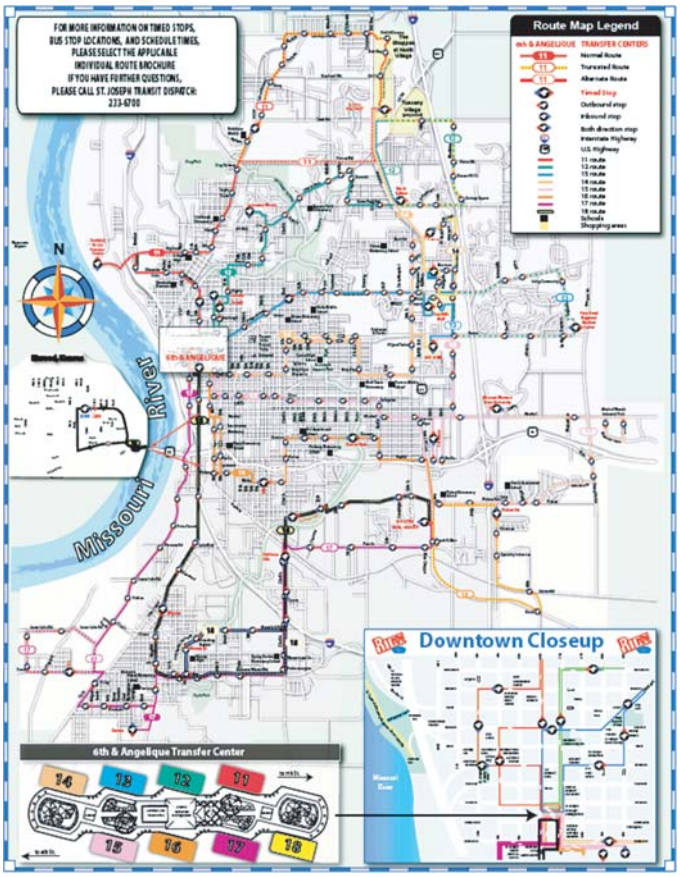
St. Joseph Transit also provides bus service to Elwood, Kansas. In addition to its eight local routes, St. Joseph Transit operates a limited night schedule on three routes. Route deviation is not offered on these three routes. This service is called *Nite Ride* and provides job access and reverse commute opportunities to St. Joseph citizens living in the U.S. Census designated low-income areas of the City. *Nite Ride* operates Monday through Saturday from 9:15 p.m. to 5:15 a.m.

St. Joseph Transit operates six days a week on its eight fixed routes, and five nights on its three *Nite Ride* routes. St. Joseph Transit's FY 2009 Operating Budget projected $246,000 of operating revenue to cover operating expenditures of $4 million. The base cash fare for all routes is $1.00, with a $.50 charge for route deviation. Discounted cash fares are available for seniors, youth, and individuals with disabilities.

Flexible Public Transportation Service Description for All Types Operated

Fixed-Route Deviation

Each of St. Joseph Transit's eight local routes operates as a deviated fixed route. St. Joseph Transit implemented this service in 1999 and calls its bus service *The Ride.* These routes are operated using a fleet of 30-foot, Gillig low-floor vehicles that have a seating capacity of 25 passengers. Prior to 1999, St. Joseph Transit operated a point-deviation system. The point-deviation system operated along with a separate ADA complementary paratransit service. The City surveyed its citizens and determined that a single-route deviation system would provide better service than the separate point-deviation and paratransit systems. Figure 23 displays the system map for *The Ride.*



Source: St. Joseph Transit

Figure 23. St. Joseph Transit system map for The Ride.

Table 20. St. Joseph Transit ridership.

Route Name	June FY 2007 Monthly Ridership	June FY 2008 Monthly Ridership	June FY 2009 Monthly Ridership
St. Joseph Avenue	2,998	2,563	2,617
Lovers Lane	3,051	2,431	2,134
Fredrick Avenue	6,923	6,127	5,736
Faraon/Jules	5,285	4,810	4,378
MO Western	4,524	4,588	4,388
Industrial Park	2,499	3,193	2,280
Stockyards	3,840	3,185	2,614
King Hill	1,940	1,915	1,516

Under the current route-deviation system, buses follow a fixed route and schedule but deviate into neighborhoods upon request, always returning to their regular routes. Riders have the option of being picked up at a regular bus stop or scheduling a pick-up at other pre-approved locations. The deviation can be up to ¾ mile from its designated fixed route, depending upon demand. A maximum of 10 deviations per trip are allowed. All of the buses are ADA compliant. St. Joseph Transit does not operate a separate complementary ADA paratransit service since its entire service is route deviation. St. Joseph Transit reports that of approximately 1,400 daily passengers, 300, or 25 percent of its passengers, actively use route deviation. St. Joseph Transit estimates that 4 percent of these passengers are ADA clients.

Monthly ridership data for the eight routes are provided in Table 20.

Customers requesting pick-up at an off-route designated bus stop are advised to call at least 1 day in advance of the requested trip. St. Joseph Transit will take same-day reservations for pick-ups, but passengers may have to wait at least 1 hour before a pick-up on weekdays and up to 2 hours on Saturday. Once on board a bus, riders can simply inform the driver of the location of the stop where they wish to be dropped off. The driver will honor an off-route stop if schedules allow and the street location is suitable for the vehicle. There is a $.50 surcharge for on-route or deviated services. *The Ride* operates on weekdays and Saturdays, with no service on Sundays.

Productivity Standards and Measures for Flexible Public Transportation Service

St. Joseph Transit did not identify specific productivity standards but provided performance indicators (presented in Table 21).

Table 21. Performance indicators.

All Routes	FY 2007	FY 2008	FY 2009
Passengers	417,906	408,696	382,039
Total Expenses	$3,820,636	$4,207,971	$3,059,678
Route Deviations	99,939	76,269	52,400
Revenue Hours	70,528	70,272	52,896
Revenue Per Passenger	$0.32	$0.35	$0.65
Expense Per Hour	$54.17	$57.84	$57.88
Total Expense per Passenger	$8.82	$9.75	$10.00

Policy Objectives for Implementing Flexible Public Transportation Service

- Provide coverage to a large, low-density area
- Reduce or eliminate the expense of providing an ADA-complementary paratransit service
- Respond to community preferences and geography

Marketing Strategies

- Specially designed brochures
- Television and radio advertisements
- Presentations to community groups
- Implementation of a Riders Advisory Committee (future)

Other Issues

- Financial constraints limit the number of routes, and the 1-hour headways mean that a round trip takes 2 hours of travel time for passengers and operators.
- There is no service on Sundays, which may leave disabled persons without any means of accessing emergency or social trips.
- The flexible public transportation service may be dependable, but it is not convenient for choice or captive riders.

4.3 Potomac and Rappahannock Transportation Commission

Flexible Transportation Services: Route Deviation

The Potomac and Rappahannock Transportation Commission (PRTC) is a multi-jurisdictional agency representing Prince William and Stafford Counties and the cities of Manassas, Manassas Park, and Fredericksburg. PRTC operates a number of transportation services to meet the needs of area residents. These services are known locally as

- OmniRide
- Metro Direct
- OmniLink
- Cross Country Connector
- OmniMatch
- Virginia Railway Express

PRTC provides commuter bus service along the busy I-95 and I-66 corridors to points north (OmniRide and Metro Direct) and bus services in Prince William County and the cities of Manassas and Manassas Park (OmniLink and Cross County Connector). PRTC also offers OmniMatch, a free ridesharing service. Operated by PRTC in partnership with the Northern Virginia Transportation Commission (NVTC), the Virginia Railway Express (VRE) provides commuter rail service along the Manassas and Fredericksburg lines, connecting to transit providers at stations in Virginia and the District of Columbia.

The following PRTC staff met with the researchers to provide the information and background used for this case study:

- Eric Marx, Director of Planning and Operations
- Joan Martin-Morris, Customer Service Supervisor

Overall Service Area Characteristics

The PRTC transit service area covers 360 square miles with a population of over 425,000 persons. PRTC is located in Northern Virginia, about 25 miles southwest of Washington, DC. The PRTC transit system serves two basic demographic groups—commuters into Washington, DC, and Arlington, VA, and transit-dependent local services in five jurisdictions that include two counties and three cities. The service area population density is 1,180 persons per square mile. OmniRide and Metro Direct bus riders tend to be choice riders, meaning that although they may have an automobile available to them, they choose to ride the bus to reduce trip times and costs. Conversely, OmniLink, the flexible bus service, tends to serve disadvantaged populations and those without access to an automobile, such as senior citizens, persons with disabilities, youth, and low-income workers.

Flexible Public Transportation Service Area Characteristics

PRTC operates OmniLink, a flexible public transportation service on six routes. OmniLink is a local demand-responsive bus service operating through the more heavily populated parts of PRTC's service area. It is a route-deviation system blended with fixed-route characteristics to provide transit services for all area residents without operating a separate ADA paratransit system. Prior to 1995, there was no local public transportation in the PRTC area, and OmniLink began as a flex route operation, i.e., there never was fixed-route service with complementary paratransit. PRTC estimates that it achieves a 25- to 50-percent savings by operating one service versus two separate services.

Transit System Description for All Modes

PRTC operates commuter bus service with its OmniRide and Metro Direct routes between the PRTC local service area and Metrorail stations, local bus service with its six OmniLink flexible routes and one Cross County Connector route.

OmniRide is a commuter bus service for residents of Prince William County, Manassas, and Manassas Park, VA, traveling to Washington, DC, Arlington, VA, and suburban Tysons Corner in Fairfax County, VA (service to Tyson's corner was added recently). OmniRide operates in both the I-95 and I-66 corridors on weekdays, with service inbound to Washington in the morning and outbound in the evening. Some routes have limited midday service. OmniRide service is provided using 57-seat over-the-road coaches.

Metro Direct is a commute and reverse-commute bus service with limited stops from Prince William County, Manassas, and Manassas Park to the West Falls Church and Franconia-Springfield Metrorail stations. Service on two routes operates throughout the day on weekdays with increased frequency during the normal commuting hours. The third route runs only in the peak direction during normal commuting times. Service is provided using 45-seat transit buses.

Cash and the regional SmarTrip card may be used to board OmniRide and Metro Direct buses. Reduced fares are available for senior citizens and persons with disabilities during off-peak hours. Local trips on OmniRide and Metro Direct can be paid for with cash, SmarTrip card, pre-paid token, or day pass. Commuter bus fares are $4.75 if paid using SmarTrip and $6.50 if paid in cash. Metro Direct fares are $2.40 and $3.00, respectively.

OmniLink is a local demand-responsive bus service within Prince William County, Manassas, and Manassas Park. PRTC operates six OmniLink routes from around 5:40 a.m. to 10:45 p.m. on

weekdays on most routes. Manassas area routes end around 8:00 p.m. Eastern area routes operate on 45-minute headways (30 minutes during peak periods), while Manassas area routes operate every 60 minutes throughout the day. Saturday service is provided from 7:30 a.m. to 10:30 p.m. only in the eastern part of the County with mostly 90-minute headways. The difference between eastern-area and Manassas-area service operating parameters is dictated by local government preference.

Passengers may pay OmniLink fare using cash, pre-paid tokens, a local bus day pass, or a regional SmarTrip card. Fares are $1.10 for cash, tokens, or SmarTrip, while the local bus day pass is $2.50 (cash only). Discounted cash fares are available for senior citizens, youth, and persons with disabilities at all times. There is a $1.00 surcharge for off-route deviations for able-bodied customers and those under the age of 60.

For all modes for 2009, PRTC's ridership was 3.1 million with annual vehicle revenue hours of 160,000. During this period, an average of 108 vehicles of varied sizes operated during peak periods. PRTC's operating budget was $26.8 million, and it had a total of 235 full- and part-time employees—45 were PRTC employees and 190 were contracted employees.

Flexible Public Transportation Description for All Types Operated

Route Deviation

The six OmniLink routes operate as local deviated fixed routes. These routes use a fleet of 30-foot Gillig vehicles, which seat 30 passengers each. Buses follow a fixed route and schedule but deviate off route upon request, always returning to the regular route. A deviated bus is not required to return to the route departure point but must serve all stops. In addition to the designated bus stops, riders have the option of being picked up or dropped off at an off-route location if they cannot get to an OmniLink stop or if their destination is not close to a bus stop. Deviation service is provided within a corridor of ¾ mile on both sides of each route. It is recommended that reservations be made 1 to 2 days in advance. Nonetheless, trips may be scheduled with as little as 2 hours advance notice. Riders can also make a standing order for recurring trips. All off-route trips are subject to availability, which is limited by the need to maintain acceptable on-time performance. Additionally, there are a number of designated off-route locations on each route called on-demand bus stops. Riders on board buses may be dropped at on-demand bus stops without prior reservation. Those waiting at on-demand bus stops call PRTC, and the next available bus is routed to pick them up.

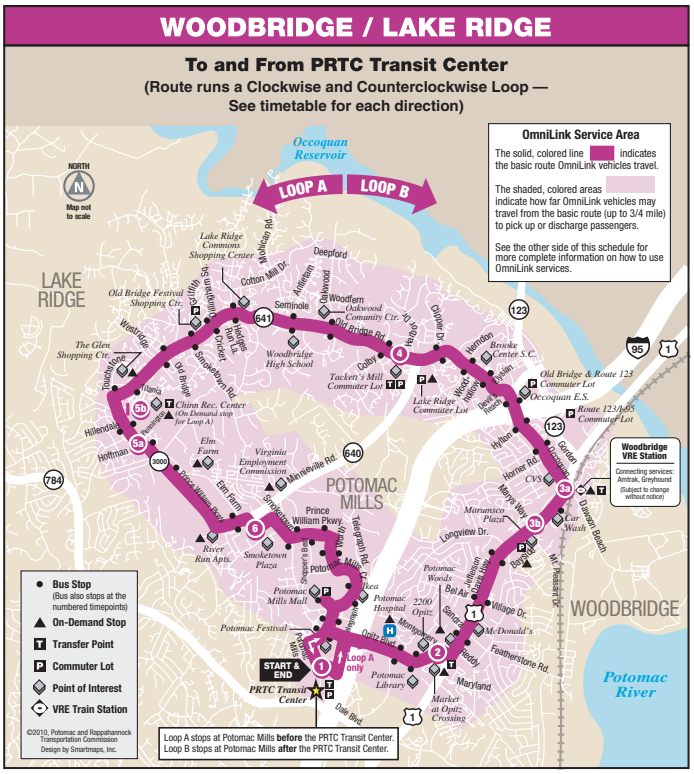
All of the OmniLink buses are ADA compliant, and PRTC does not operate a separate complementary ADA paratransit service. PRTC reports that annual OmniLink ridership is approximately 960,000, and its annual vehicle revenue hours are 61,000. In FY 2009, approximately 250 daily trips, or 7.4 percent of total OmniLink ridership, used the flexible public transportation feature, with subscriptions accounting for about 40 percent of off-route trips. Figure 24 and Figure 25 show two of OmniLink's routes.

OmniLink's annual budget in 2009 was $8.9 million. Average daily ridership for each of the six OmniLink bus routes is provided in Table 22.

OmniLink buses operate on weekdays and Saturdays, with no service on Sundays.

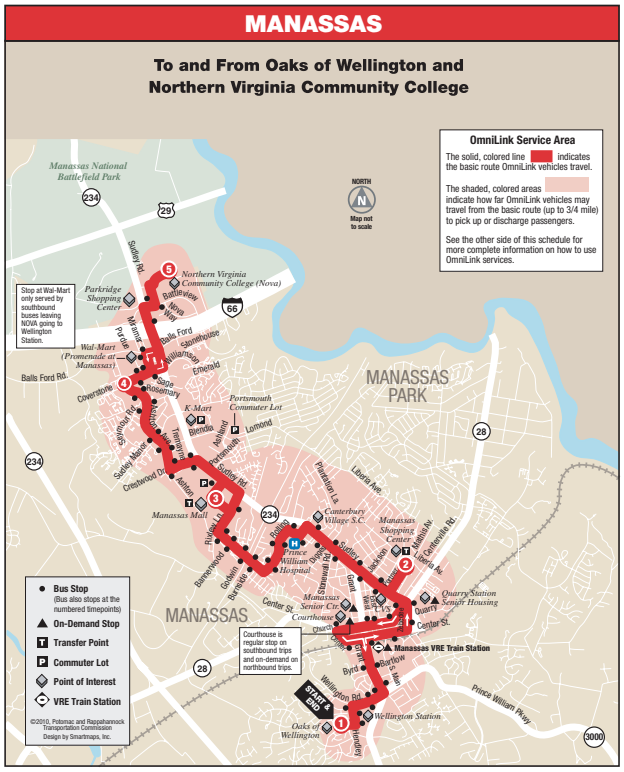
Productivity Standards and Measures for Flexible Public Transportation Service

Selected performance indicators for PRTC's OmniLink are presented in Table 23.



Source: PRTC

Figure 24. PRTC Woodbridge/Lake Ridge OmniLink route.



Source: PRTC

Figure 25. PRTC Manassas OmniLink route.

Table 22. PRTC OmniLink average daily ridership.

Route Name	FY 2007	FY 2008	FY 2009
Dale City	690	667	663
Dumfries	629	691	761
Manassas	331	369	356
Manassas Park	902	329	290
Woodbridge/Lake Ridge	1,193	1,307	1,287
Route 1	300	317	392

Table 23. Selected PRTC OmniLink performance indicators.

All Routes	FY 2007	FY 2008	FY 2009
Riders per Day	3,433	3,680	3,821
Trips per Revenue Hour	15.4	15.8	16.1
Operating Costs	$295,004	$315,600	$329,850
Revenue Hours	70,528	70,272	52,896
Gross Cost per Trip	$5.38	$5.42	$5.59
Net Cost per Trip	$4.67	$4.71	$4.83

Policy Objectives for Implementing Flexible Public Transportation Service

- Provide coverage to a large, low-density area
- Balance customer access and routing efficiency
- Provide one service for all riders on more routes, with more frequent service, and for a longer service span than would be possible if operating both fixed-route and ADA-complementary paratransit service
- Respond to community preferences and geography

Marketing Strategies

- Use specially designed brochures
- Include information on flexible public transportation services in system maps or "bus books"
- Provide information on website
- Use paid newspaper advertisements
- Use presentations to community groups
- Distribute targeted mailings
- Cross-promoting services through email

Other Issues

- PRTC has invested heavily in ITS technology for scheduling and dispatching as well as communicating with bus operators and dispatchers.
- PRTC had the first automated flex-route project in the United States.
- Annualized ITS investment cost of $165,000 is more than offset by capital savings alone and allows PRTC to provide more service.
- Real-time information allows for shorter advance notices, dispatcher knowing location of vehicles, and drivers knowing where they are and whether they are on schedule.
- Demand-response riders tend to be more tolerant of late trips than commuter riders.
- Current OmniLink policy is to be no more than 5 minutes late due to trip deviations
- There is no service on Sundays, which may leave transit-dependent persons without any means of accessing jobs or making other trips.
- The flexible service may be dependable, but it is not convenient for choice or captive riders.

4.4 Pierce County Public Transportation Benefit Area Corporation

Flexible Transportation Services: Route Deviation and Request Stops

The Pierce County Public Transportation Benefit Area Corporation (Pierce Transit) formed in 1979 and is a municipal corporation with taxing authority. Pierce Transit is the second largest transit agency in Washington State.

The following Pierce Transit staff met with the researchers to provide the information and background used for this case study:

- Kelly Hayden, Director of Planning
- Jean Archer, Senior Planner
- Jerri Kelly, Systems Analyst

Overall Service Area Characteristics

The Pierce Transit service area covers 414 square miles with a population of 767,000 persons. The transit system serves the cities and towns of Bonney Lake, Buckley, DuPont, Fife, Fort Lewis, Edgewood, Fircrest, Gig Harbor, Graham, Lakewood, McChord Air Force Base, Milton, Orting, Puyallup, Ruston, Spanaway, Steilacoom, Sumner, Tacoma, and University Place, along with some areas in unincorporated Pierce County. Pierce Transit operates on more than 900 miles of city streets, county roads, and state highways from Seattle through Tacoma and on to the state capital of Olympia. The most densely populated areas of the County have densities of over 6,000 persons per square mile and include Tacoma, Lakewood, and University Place. Large portions of Pierce County have population densities of fewer than 1,800 persons per square mile.

Flexible Public Transportation Service Area Characteristics

At the time of this study, Pierce Transit operated flexible public transportation on four routes. These routes were located in middle- to low-density areas known locally as Key Peninsula, Parkland/Spanaway, South Hill/Spanaway, and Mid-County. These areas were generally located on the outskirts of the service area. Pierce Transit planned to eliminate one of the routes, South Hill/Spanaway, in February 2010.

Transit System Description for All Modes

According to its website, in 2008, Pierce Transit carried nearly 19 million passengers along 63 bus routes, including 52 local routes and 11 regional routes, operated under contract to the regional bus operator, Sound Transit. The bus fleet includes 272 buses (77 owned by Sound Transit). Eleven transit centers and stations and over 3,300 bus stops, 626 bus shelters, and 28 park-and-ride lots are part of the overall system. Pierce Transit provides connections for residents of Pierce County to other transportation services in the region, including the following:

- Sound Transit (serving Snohomish, King, and Pierce counties)
- Intercity Transit (serving Pierce and Thurston counties)
- King County Metro (serving the Seattle metropolitan area and cities within King County)
- Pierce County ferries (in Steilacoom)
- Washington State ferries (at Point Defiance)

In addition to local and regional bus routes, Pierce Transit operates public vanpools serving 130 employers with over 13,000 customers in the regional ridematch database. Complementary paratransit service, known as SHUTTLE, serves 7,968 ADA-eligible, registered users. Pierce also operates three express routes—one to downtown Seattle, one to Sea-Tac Airport, and the third

to the University of Washington in Seattle—all under contract to Sound Transit. Pierce Transit operates 7 days a week, with many routes operating over 18 hours per day. Pierce Transit's FY 2009 operating budget projects $121 million of operating revenue to cover operating expenditures of $115 million. In 2008, Pierce Transit calculated its fully allocated costs for local transit service to be $103.88 per platform hour. Pierce Transit offers a wide range of transit passes and participates in a regional fare card system. The basic cash fare for local routes is $1.75. Express services are zone-based fares, ranging from $1.50 to $3.00. The cash fare for ADA-complementary paratransit service, the SHUTTLE, is $0.75. Discounted cash fares are available for seniors, youth, persons with disabilities, and Medicare cardholders.

Flexible Public Transportation Service Description for All Types Operated

Route Deviation

Of Pierce Transit's 52 local routes, 4 operated as deviated fixed routes at the time of this study. Pierce Transit calls this type of service Bus PLUS. These routes are operated using a fleet of 25-foot, Ford El Dorado vehicles, which seat 14 to 16 passengers. Buses follow a fixed route and schedule but deviate into neighborhoods upon request, always returning to their regular routes. Riders have the option of being picked up at a scheduled stop or scheduling a pick-up at other pre-approved locations. The deviation can be up to ¾ mile from its designated fixed route, depending upon demand. All Bus PLUS vans are ADA compliant. Pierce Transit does not operate its complementary ADA paratransit service (SHUTTLE) in areas served by Bus PLUS routes. Pierce Transit reports that approximately 300 passengers or 5 percent of Bus PLUS passengers actively use off-route stops. Twenty-two percent of these passengers are ADA clients and the rest are the general public. Ridership data for the four Bus PLUS routes are provided in Table 24.

Customers requesting pick-up at an off-route designated bus stop must call at least 2 hours in advance of the requested trip. Bus PLUS by request service is limited by space availability. Once on board Bus PLUS, riders can simply inform the driver of the stop where they wish to be dropped off. Bus PLUS can only serve a stop designated with a Pierce Transit bus stop sign. There are no surcharges for Bus PLUS on-route or deviated services. Bus PLUS services operate only on weekdays, often only during peak periods.

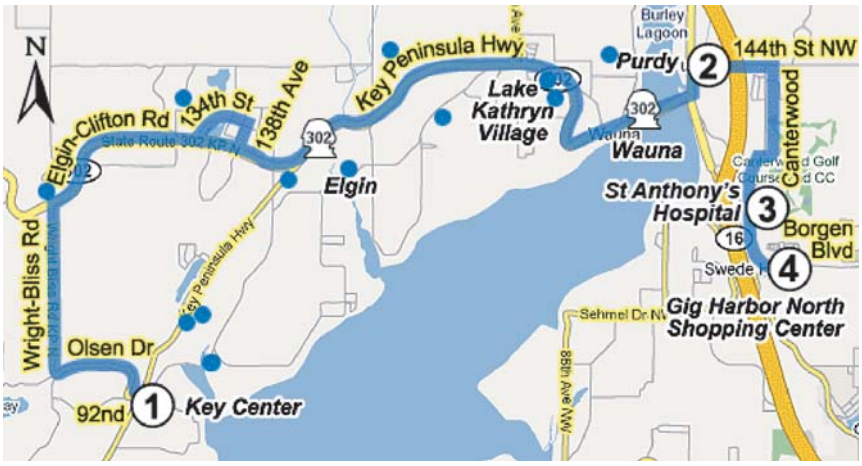
The maps for the Key Peninsula and Mid-County Bus PLUS routes, as operated in 2009, are shown as Figure 26 and Figure 27.

Request Stops (Night Stop)

Request-Stop service is provided on Pierce Transit's local bus routes; the service does not apply to Bus PLUS routes. After 9:00 p.m., a passenger may request to be let off at any point along a local bus route, even if it is not a regular bus stop. The passenger must let the operator know at least a block ahead, and the operator will decide—depending on weather and street and traffic conditions—whether the stop can be made safely.

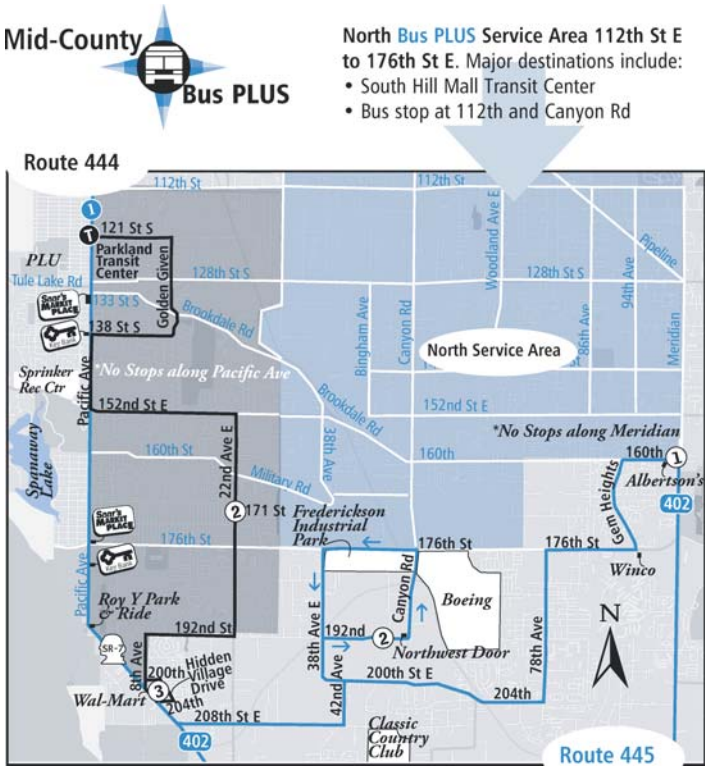
Table 24. Pierce Transit Bus PLUS ridership.

Route Name	Passengers per Revenue Hour	2007 Average Weekday Boardings	2008 Average Weekday Boardings
Key Peninsula	3.10	56	51
Parkland/Spanaway	4.20	71	72
S Hill/Spanaway	2.60	40	52
Mid County	2.80	31	46



Source: Pierce Transit

Figure 26. Pierce Transit Key Peninsula Bus PLUS map.



Source: Pierce Transit

Figure 27. Pierce Transit Mid-County Bus PLUS map.

Productivity Standards and Measures for Flexible Public Transportation Service

Pierce Transit has established performance standards for Bus PLUS service, shown in Table 25.

Reasons for Implementing Flexible Public Transportation Service

- Replacing fixed-route services with low ridership
- Providing transit in a hard-to-serve area

Table 25. Pierce Transit Bus PLUS performance standards.

Routes	Passengers per Vehicle Hour	Cost per Boarding Passenger* ($)
New Routes (< 1 year old)		
Satisfactory	>3.0	<11.30
Unsatisfactory	<3.0	>11.30
Older Routes (1-2 years old)		
Satisfactory	>4.0	<8.50
Unsatisfactory	<4.0	>8.50
Established Routes (> 2 years old)		
Satisfactory	>5.0	<6.80
Unsatisfactory	<5.0	>6.80

*All costs in 2003 dollars.

Marketing Strategies

- Include information on flexible public transportation services in "The Bus Stops Here" (bus schedule book)
- Include information on flexible public transportation services on website
- Use presentations
- Do targeted mailing
- Provide complete rider information at each stop

Other Issues

- Financial constraints required elimination of deviations from one route (Northeast Tacoma) in 2009 and the planned elimination of a second Bus PLUS route (South Hill/Spanaway) in February 2010.
- The current scheduling system, *Route Builder,* is a hybrid of fixed route and paratransit. For deviations, it schedules the bus at the appropriate point along the fixed route to the deviated pickup, then immediately returns the bus to the fixed portion of the route.

4.5 Regional Transportation District

Flexible Transportation Services: Point Deviation and Demand-Responsive Connector (on a limited number of routes)

The Regional Transportation District (RTD) was created in 1969 by the Colorado General Assembly to develop, operate, and maintain a mass transportation system for the benefit of 2.6 million people in RTD's district. RTD's governing body is a publicly elected 15-member Board of Directors, with directors elected by their districts to a 4-year term. Each director's district contains approximately 173,000 residents.

The following RTD staff met with the researchers during an on-site visit to provide the information and background used for this case study:

- Jeff Becker, Service Development Manager

RTD's website, www.rtd-denver.com, contains significant data on all services.

Overall Service Area Characteristics

RTD serves a population of 2.6 million people residing in a 2,377 square mile district including all or parts of eight counties: the City and County of Denver, the City and County of Broom-

field, Boulder and Jefferson Counties, the western portions of Adams and Arapahoe Counties, the northeastern portion of Douglas County, and portions of Weld County annexed by Longmont and Erie. According to the 2007 Census Estimate, the racial makeup of the RTD service area was 84.1 percent White, 0.7 percent American Indian or Alaskan Native, 4.8 percent Black, and 3.5 percent Asian. Hispanics or Latinos of any race were 21.6 percent of the population. The density of the service area is 1,093 persons per square mile. The most densely populated areas of the service area are found in Denver, where the density is 3,616 persons per square mile, and Boulder, where the density is 3,885 persons per square mile. Denver, known as the mile-high city, is located in the Rocky Mountains, and the City is 5,280 feet above sea level.

Flexible Public Transportation Service Area Characteristics

RTD operates flexible public transportation service, known locally as call-n-Ride, in areas defined as the following:

- A geographic area where residents and employees do not have convenient access to one of RTD's fixed-route services.
- Geographic areas with generally modest population and employment density, poor street connectivity, and poor building access.

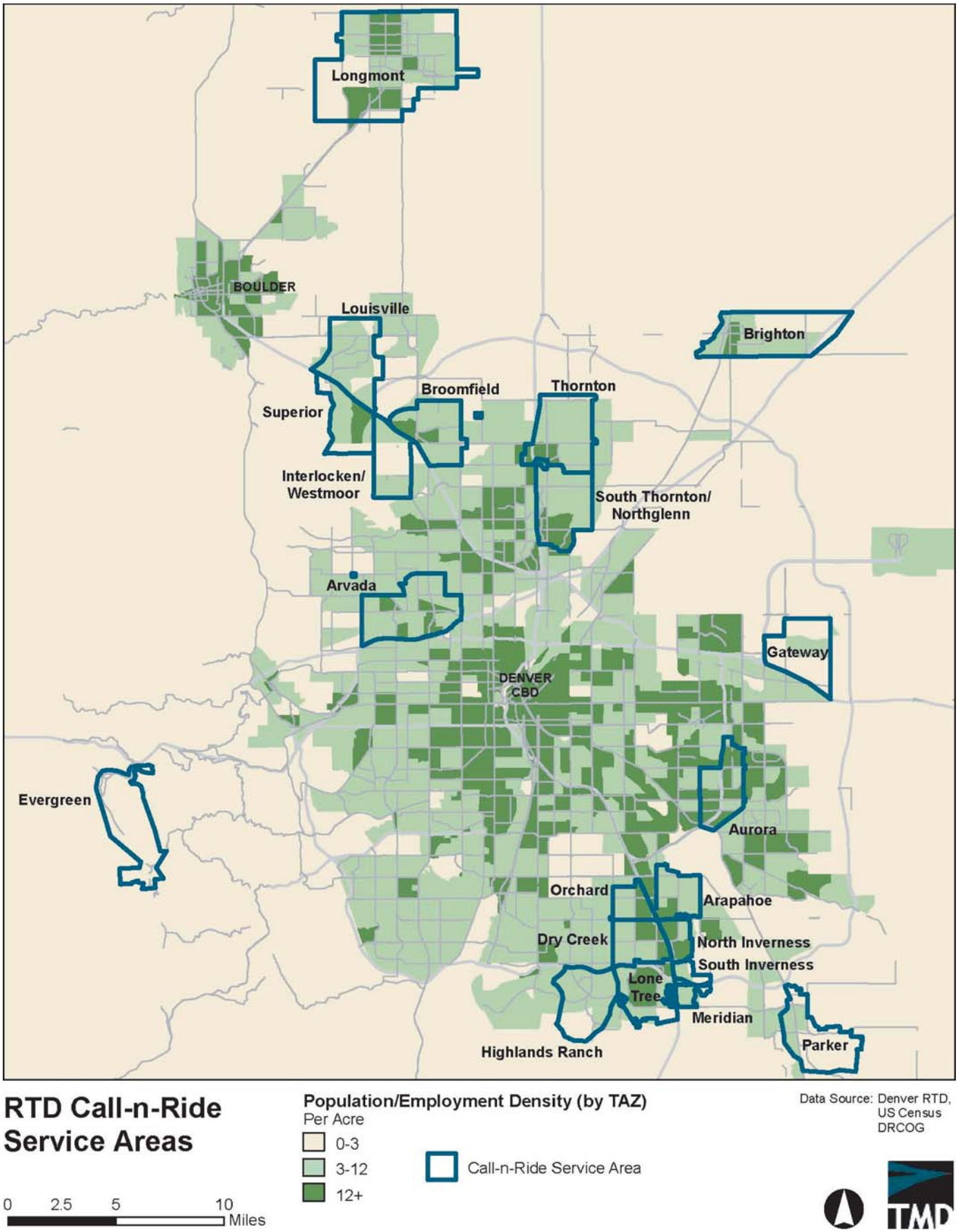
Table 26 shows the demographics, including population density per acre, of areas served by flexible public transportation.

Figure 28 displays a map of the call-n-Ride service areas and the densities.

Table 26. Denver RTD flexible transportation service area demographics.

Flexible Route	Population Density Per Acre	Employment Density	Zero Vehicle Household Density	Median Income	Senior Density	Youth Density
Gateway	2.67	0.57	0.00	$54,800	0.04	0.33
Orchard	3.61	13.72	0.00	$98,000	0.35	1.43
N Inverness	0.28	5.31	0.00	$80,000	0.05	0.50
Meridian	1.94	11.29	0.00	$46,000	0.01	0.00
Interlocken	2.76	1.35	0.00	$64,400	0.19	2.14
S Inverness	0.75	9.20	0.00	$23,000	0.01	0.00
Superior	2.69	2.92	0.00	$79,700	0.03	0.60
Brighton	2.57	1.04	0.08	$50,700	0.66	1.42
Broomfield	5.45	1.98	0.05	$67,600	0.54	1.68
Evergreen	1.17	0.46	0.00	$84,200	0.09	0.20
Arapahoe	6.09	3.08	0.00	$103,500	0.33	1.55
Louisville	3.58	2.25	0.00	$76,600	0.26	1.07
Aurora	9.58	6.08	0.21	$50,000	1.09	1.86
Dry Creek	6.13	6.64	0.00	$82,000	0.54	1.80
N Thornton	7.85	2.31	0.08	$62,800	0.45	1.93
S Thornton	8.86	2.54	0.03	$47,800	0.65	2.03
Lone Tree	4.79	3.83	0.00	$88,400	0.15	1.22
Longmont	4.50	2.07	0.08	$56,000	0.70	1.67
Arvada	6.42	3.38	0.16	$45,000	1.17	1.75
Parker	3.17	1.68	0.00	$80,000	0.12	0.60
Highlands Ranch	5.52	1.11	0.00	$96,600	0.23	1.43

Source: Transportation Management & Design, Inc., 2008.



Source: RTD

Figure 28. call-n-Ride service areas and densities.

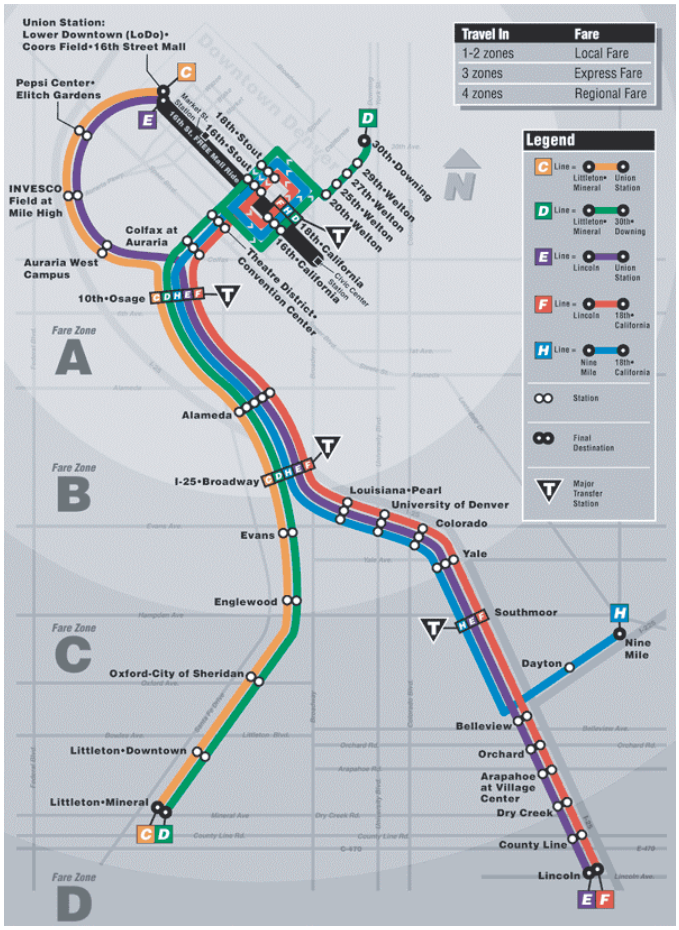
Transit System Description for All Modes

RTD is a multimodal, regional transit system, consisting of three primary categories: fixed-route bus, special services, and light rail. All fixed-route bus and rail services travel 163,987 miles each weekday. RTD serves 10,199 bus stops and 74 park-and-ride facilities.

RTD operates a total of 154 fixed bus routes, including 72 local routes, 13 limited-service routes, 24 express routes, 18 regional routes, and 5 routes serving the Denver International Airport. These routes also include 15 local routes in the City of Boulder and 7 routes in the City of Longmont. Other fixed-route bus services include a free shuttle along the 16th Street Transit Mall in downtown Denver, known as the FREE MallRide. RTD has an active bus fleet of 1,039 buses with a peak requirement of 862 buses.

RTD operates six light rail lines. The light rail lines cover 35 miles of track and serve 37 stations, as shown in Figure 29. Approximately 55,717 passenger trips are made on the light rail lines each weekday, with a fleet of 117 vehicles.

RTD also operates a number of special services, including its complementary ADA paratransit service, known as access-a-Ride, call-n-Ride, special shuttles to sporting events, a service called seniorRide, and vanpools. The call-n-Ride services will be described in more detail in the section on flexible transportation. RTD uses 301 cutaway vehicles for its access-a-Ride services and boards 2,220 passengers per weekday.



Source: RTD

Figure 29. RTD Denver light rail transit.

RTD's annual operating budget in 2008 was $372.9 million. RTD employs 2,500 persons directly and an additional 1,600 private contractor employees.

Flexible Public Transportation Service Description for All Types Operated

In 2000, RTD introduced call-n-Ride service as a supplement to its fixed-route bus service. The service was designed for areas with low passenger density where traditional fixed-route service was inefficient. Today, call-n-Ride features small, wheelchair-accessible, body-on-chassis buses that provide curb-to-curb service in 20 geographic areas. In October 2008, all 20 call-n-Ride service areas combined averaged about 2,150 weekday boardings and close to 500 weekend boardings. Hours of service vary but are generally Monday through Friday, 5:30 a.m. to 8:00 p.m. Three call-n-Rides offer Saturday service between 9:00 a.m. and 6:00 p.m.

Table 27 presents the call-n-Ride service performance data and service information for 2008. The call-n-Ride routes are listed in descending order based upon boardings per service hour.

Passengers wishing to use the call-n-Ride service must first locate the service in their area. Each service area has a designated call-n-Ride phone number that goes directly to the driver's cell phone during normal operating hours. At a safe time, the driver pulls over to the side of the road and accepts the call and schedules the pick-up time. For same-day service, passengers are requested to call at least 2 hours in advance. Trips can also be scheduled up to 2 weeks in advance. Recurring trips may be scheduled in advance with the call-n-Ride driver. In practice, drivers can pick-up passengers with less than 1 hour notice if time permits.

Table 27. 2008 RTD call-n-Ride service characteristics.

Performance Data			Service Information						
Route	Boardings Per Service Hour	Boardings Per Acre	In-Service Hours	Area Coverage (acres)	Peak Headway	Miles of Existing RTD Route*	Number of Connections		Number of Connections (weighted)
							Timed Transfer	Non-Timed Transfer	
Gateway	19.1	0.113	29.0	4,914	30	2.9	7	–	7
Orchard	9.7	0.024	20.5	1,715	–	1.1	2	–	2
N Inverness	9.5	0.034	26.5	1,414	10	1.2	2	–	2
Meridian	8.7	0.278	21.0	713	15	0.7	2	–	2
Interlocken	7.7	0.036	16.5	3,593	30	3.1	7	–	7
S Inverness	7.4	0.125	20.5	742	10	0.7	2	–	2
Superior	5.7	0.041	14.5	3,699	30	4.7	8	–	8
Brighton	4.5	0.009	14.5	7,340	–	1.4	–	4	1.3
Broomfield	4.5	0.014	14.5	4,752	30	4.4	11	–	11
Evergreen	4.4	0.020	29.0	6,268	–	1.1	–	3	1
Arapahoe	4.4	0.023	14.5	2,766	–	0.7	3	–	11
Louisville	4.1	0.046	16.5	5,469	30	3.9	8	–	8
Aurora	4.0	0.015	14.5	3,962	60	5.5	11 (partial)	–	3
Dry Creek	3.8	0.017	14.5	3,157	30	1.2	3	–	3
N Thornton	3.8	0.014	14.5	6,044	–	1.8	–	6	2
S Thornton	3.5	0.010	14.5	5,567	–	3.7		7	2.3
Lone Tree	3.3	0.016	14.5	4,235	60	2.4	5	–	5
Longmont	3.0	0.010	32.5	17,599	–	2.5	–	6	2
Arvada	2.9	0.006	14.5	6,716	–	3.9	–	–	0
Parker	2.9	0.010	14.5	5,126	–	1.4	–	3	1
Highlands Ranch	2.7	0.008	14.5	4,861	–	1.5	–	9	3

*Miles of route per square mile of service area
– = Not applicable to this route.

At the time of the case study site visit, RTD was phasing in a computerized system that allowed passengers the opportunity to book call-n-Ride trips online. This new technology will be described later in this case study.

call-n-Ride services cost the same as cash fares for local bus services, with free transfers allowed. Riders can also present RTD passes and tickets when boarding.

In 2008, RTD conducted a survey, *RTD Call-N-Ride Customer Satisfaction & Travel Characteristics* (The Howell Research Group, 2009), of all of its services, including call-n-Ride. Some of the key findings of the survey relating to call-n-Ride are presented below.

With regard to evaluation of service, some of the survey's key findings were the following:

- call-n-Ride service was rated exceptionally high. More than 7 out of 10 riders (71 percent) rated overall service as excellent, while 23 percent rated it good. A very small percentage of riders (4 percent) rated the service as fair, and only 1% rated it poor.
- In addition to overall service, there were 24 specific dimensions of service in 8 performance categories that were evaluated by call-n-Ride passengers. Seven of the eight performance categories received an average rating of better than good. The composite ratings for five performance areas approached a rating of excellent: **bus driver performance, security, comfort, reservations,** and **customer information. Convenience** received a composite rating slightly below good due to relatively lower ratings regarding *availability of weekend service* and *availability of evening service.*
- When asked which performance category was most in need of improvement, 31 percent of the call-n-Ride passengers said **none.** The most frequently selected area for improvement was **pricing/fares** (21 percent), followed by **convenience** (13 percent), and **travel time** (10 percent).
- The majority of specific service dimensions (15 of 24) received average ratings that approached excellent. Only two service dimensions received an average rating below good: *availability of weekend service* and *availability of evening service.* Only a few call-n-Rides offer service on Saturday and/or Sunday, and there is no call-n-Ride service after 8:00 p.m. on any day.

With regard to trip characteristics, some of the survey's key findings were the following:

- Nearly three out of four riders (74 percent) rode call-n-Ride for commuting to/from work. The largest percentage of work commuters were traveling to/from the Southeast business parks (30 percent of all riders).
- The remaining passengers rode call-n-Ride for a variety of non-work purposes: shopping/eating out (8 percent), school/college (7 percent), personal business (5 percent), social/recreation (3 percent), and medical appointments (3 percent).
- In 2008, two-thirds of the call-n-Ride riders (67 percent) paid their fare with some form of prepayment, and 28 percent paid by cash. Monthly pass/ValuPass (36 percent), Eco Pass (13 percent), and 10-Ride Ticketbook (11 percent) were the most frequently used types of prepayment.
- A large portion of call-n-Ride passengers (19 percent) used a special fare discount: primarily a senior discount (8 percent) followed by disabled (7 percent) and student—19 and under (4 percent).
- The vast majority of riders caught their call-n-Ride bus either at home (44 percent) or at an RTD park-and-ride, rail station, or bus stop (42 percent).
- On average, call-n-Ride passengers traveled 11.9 miles one way (including all modes of travel) and took 32.5 minutes to reach their final destination when using call-n-Ride service.
- The majority of call-n-Ride passengers (62 percent) made one or more transfers to/from a regular RTD bus for their trip, while nearly one-half (49 percent) used light rail for a portion of their trip.

- In 2008, call-n-Ride riders had taken, on average, 6.1 one-way trips on RTD call-n-Ride during the past week.
- It appears that call-n-Ride has been successful in introducing RTD to new riders (those who have ridden RTD for 1 year or less). Nearly one-third of the call-n-Ride passengers (32 percent) were new riders.

With regard to rider characteristics, some of the survey's key findings were the following:

- RTD call-n-Ride passengers represent all demographic and socio-economic segments of the Denver Metro Area, and their characteristics are comparable to regular RTD bus riders. As a whole, call-n-Ride passengers are more likely to be female, single, 45 years or older, have some college education or higher, be employed in a professional/managerial occupation, be a non-minority, have an annual household income under $50,000, and be transit dependent.
- While 12 percent of all call-n-Ride riders were Hispanic, only 3 percent of all riders spoke Spanish and had difficulty with English.
- The majority of all call-n-Ride riders (56 percent) are classified as "captive" or transit dependent. Captive riders are defined as those who do not have a car available at the time they ride RTD or have a physical/mental disability that prevents them from driving a car. "Choice" riders (those who have a car available and are able to drive it) account for 44 percent of all call-n-Ride passengers.
- call-n-Ride riders were heavy users of other RTD services. Nearly two out of three (65 percent) had ridden a regular RTD bus during the past week (an average of 5.2 one-way trips), while 74 percent had ridden a regular bus at least once in the past 12 months. The majority of all call-n-Ride riders (52 percent) had ridden RTD light rail during the past week (an average of 4.2 one-way trips), while 71 percent had ridden light rail at least once in the past 12 months.
- The majority of call-n-Ride passengers (62 percent) had used one or more of RTD's special services within the past 12 months—primarily the 16th Street Mall Shuttle (51 percent) and skyRide (20 percent).
- Consistent with the high percentage of transit-dependent riders, 51 percent of all call-n-Ride passengers said "no car available/do not drive" was their most important reason for riding call-n-Ride. The second most frequently cited reason was "cheaper than driving" (21 percent).

Productivity Standards and Measures for Flexible Public Transportation Service

According to RTD's 2008 service performance report, RTD routes that fit into the following parameters need to be evaluated for marketing, revision, or elimination: the least productive 10 percent of routes by the measure of subsidy per boardings or the measure of boardings per hour and/or routes for which both of these measures have fallen below 25 percent of the average for all routes. The performance charts illustrate the *acceptable performance domain containing all routes meeting the 10-percent minimums for each class of service.* The calculation of the 10-percent and 25-percent standards are made from the annual, unweighted data (assuming the data have a normal distribution) and by using the appropriate formulas for standard deviation and confidence intervals; however, the standard deviation is applied to the weighted average. Table 28 gives the current year weighted averages and standards by class of service.

Policy Objectives for Implementing Flexible Public Transportation Service

As previously mentioned, RTD introduced call-n-Ride service in 2000, as a supplement to its fixed-route bus service. The service was and is designed for service in areas with low passenger

Table 28. 2008 RTD service standards.

Service Class	Subsidy Per Boarding ($)			Boardings Per Hour		
	Average	10% Max	25% Max	Average	10% Min	25% Min
CBD Local	2.68	5.70	4.26	38.5	18.6	**28.1**
Urban Local	3.51	9.14	6.46	30.5	17.6	**23.8**
Suburban Local	6.92	13.49	10.36	17.6	9.0	**13.1**
Express	4.53	10.10	7.45	46.7	19.6	**32.5**
Regional	5.28	18.08	11.98	27.1	16.0	**21.3**
skyRide	3.91	5.68	4.83	23.3	17.7	**20.3**
call-n-Ride	11.14	18.19	14.83	4.9	2.7	**3.8**
Mall	0.66	–	–	261.7	–	–
Light Rail	3.77	–	–	129.7	–	–
access-a-Ride	45.76	–	–	1.4	–	–
Vanpool	1.84	–	–	3.5	–	–
System 2008	3.52	–	–	33.7	–	–
System 2007	3.70	–	–	31.8	–	–

– = services not subject to the threshold.

density, where traditional fixed-route service was less cost-effective. While a few routes were introduced to replace poorly performing fixed routes, most of the routes were designed to reach members of RTD's service area without service. According to its 2008 passenger survey, call-n-Ride is frequently a person's first encounter with RTD's family of services. It therefore serves an additional objective, to bring riders to transit for the first time.

Marketing Strategies

RTD does extensive market research and outreach with community groups prior to implementing call-n-Ride or any other services. RTD generally relies on its website, printed brochures, direct mail, local promotions, and other standard marketing strategies to inform the public of its flexible public transportation services.

Other Issues

In early 2008, in order to meet budget constraints and to ensure that services are evaluated in accordance with the service standards, RTD made a decision to eliminate the Arvada call-n-Ride service, effective May 4, 2008. This route was implemented in 2005 when the City of Arvada applied for and received a Congestion Mitigation Air Quality (CMAQ) grant. The grant covered 80% of all operating costs. The City of Arvada and RTD each contributed 10 percent to cover the call-n-Ride costs. The minimum service standard is three passenger boardings per hour. The Arvada call-n-Ride had averaged 2.5 passengers per hour since its implementation. The CMAQ grant expired in May 2008, and the service was discontinued. The Gateway call-n-Ride became so successful that ridership warranted higher-capacity fixed-route service. It was replaced by extending two bus routes into the service area in May 2009.

At the time of the site visit for this case study, RTD was in the process of implementing a new technology system for trip booking and vehicle scheduling. The system, marketed as Mobility DR, is intended to manage demand-responsive transit operations for different service types. According to its literature, Mobility DR encompasses the following:

- Automated reservations and vehicle scheduling
- Mobile driver manifest management with automated data collection
- Real-time operations supervision
- Extensive data analysis and reporting

- Web booking and real-time customer notifications
- A true mobile Internet solution, with fully integrated Web and server-based applications

The system uses Internet-connected mobile (tablet-sized) computers to continuously inform drivers of changes in the trip manifest. The application includes map-based navigation, collects operational data for reporting, and handles direct-to-driver telephone trip requests. During the site visit, the tablet computers were observed on board vehicles, with drivers making the expected adjustments from the previous routine of making scheduling decisions independently. Additional information on this technology is available from RTD.

4.6 Jacksonville Transportation Authority

Flexible Transportation Services: Route Deviation and Demand-Responsive Connector

The Jacksonville Expressway Authority was founded in 1955 and funded by toll revenues to build bridges and expressways in Duval County, Florida. In 1971, a merger of the original Expressway Authority and several private bus companies created what is now known as the Jacksonville Transportation Authority (JTA). JTA provides public transportation services for residents and visitors throughout the Jacksonville area. Approved in 1988, a half-cent sales tax referendum was passed to eliminate the original toll funding. An additional voter-approved half-cent sales tax was passed in September 2000 to fund The Better Jacksonville Plan, a $2.2 billion infrastructure and quality-of-life improvement initiative.

Overall Service Area Characteristics

JTA is an independent state agency created by the state of Florida. JTA designs and constructs bridges and highways and provides public transportation services in Duval County, Florida, which includes the City of Jacksonville. The Jacksonville metropolitan area is located in the northeast corner of Florida, with three beach cities to the east bordering the Atlantic Ocean. Nassau County is located to the north, Baker County is located to the west, Clay County is southwest, and St. Johns County is southeast and borders the Atlantic Ocean.

According to the 2000 Census, the area has a population of 795,566 and has three major Interstate highways: I-295 around Jacksonville, I-95 north and south, and I-10 west. There are eight major bridges in the metropolitan area that span the St. Johns River, a waterway that flows through downtown Jacksonville and splits downtown into the Northbank and the Southbank. There are numerous other bridges that span the rivers that are located in the area.

The City of Jacksonville consolidated with Duval County to encompass a land area of 841 square miles, making it the largest city in the continental United States in terms of land mass. Jacksonville ranks as the 14th largest city in the United States in population, with more than 850,000 residents. Jacksonville's topography is flat, with a considerable amount of water, including the St. Johns and Trout Rivers, the Intercoastal Waterway, the Atlantic Ocean, and other creeks and marshlands. Jacksonville also has numerous railroad tracks that have impacts on living patterns and travel. CSX Transportation has its headquarters in downtown Jacksonville. Several military installations, including Mayport Naval Base on the northeast side and NAS (Naval Air Station) on the southwest side, are located in and around Jacksonville.

The population density of the City of Jacksonville is approximately 1,000 people per square mile. The racial makeup of the City, as shown in Table 29, was 65.8 percent White, 27.8 percent African American, 0.3 percent American Indian, 2.7 percent Asian, 0.1 percent Pacific Islander, and 2.7 percent from other races. Hispanic or Latinos of any race were 4.1 percent of the population.

Table 29. Racial/ethnic breakdown of the City of Jacksonville, Duval County, Florida.

Racial/ Ethnic Group	Duval County Number	Duval County Percent
White	512,469	65.8
Black	216,780	27.8
American Indian and Alaska Native	2,598	0.3
Asian	21,137	2.7
Hawaiian/Pacific Islander	466	0.1
Other Race	10,170	1.3
Hispanic Origin*	31,946	4.1
Total Population	**795,566**	

Source: 2000 U.S. Census.
*Per the 2000 Census, people of Hispanic origin can be, and in most cases are, counted in two or more race categories.

Flexible Public Transportation Service Area Characteristics

The demand-responsive connector service areas are large in land mass and are in the suburban areas to the north and south of downtown. The population densities in these areas are low, and there is a considerable amount of water and a number of Interstate highways and railroad tracks that affect travel. To the north of downtown, the Oceanway and Highlands-Airport Ride Request area, as shown in Figure 30, is bounded by water to the south (e.g., St. Johns and Broward Rivers, Dunn Creek), contains an island (Blount Island) and the Jacksonville International Airport, is traversed by Interstates I-95 and I-295 and numerous railroad tracks, and is far less dense than average for the Jacksonville area.

To the south of downtown, the Avenues South Ride Request area has water to the south (Julington Creek), also is traversed by Interstates I-95 and I-295 and numerous railroad tracks, and is far less dense than average for the Jacksonville area. The adjacent connector service, *San Jose Ride Request* is bounded by water to the west and south (St. Johns River and Julington Creek), is traversed by Interstate I-295 and numerous railroad tracks, and is far less dense than average for the Jacksonville area.

The route deviation service, the *Arlington Community Shuttle,* is bounded by water to the north and west (St. Johns River), an airport to the east (Craig Muni), and a major highway to the south (Route 90). The service area is less dense than average for the Jacksonville area. The second route deviation service, the *Baldwin Commuter Shuttle,* parallels I-10 and railroad tracks to the west of downtown Jacksonville along Route 90 and services two low-density communities.

Transit System Description for All Modes

With its 762 employees, JTA operates several public transit services, including express and regular bus service, the downtown 2.5-mile Skyway, trolley services, a Stadium Shuttle for various sporting and entertainment events at the Jacksonville Municipal Stadium and Coliseum, JTA

Source: JTA

Figure 30. Oceanway and Highlands-Airport Ride Request area.

Connexion for persons with disabilities and senior citizens, and Ride Request, which provides flexible public transportation service in several areas throughout the region.

JTA operates a network of 47 fixed bus routes and four trolley routes that provide service weekdays from 3:34 a.m. to 1:45 a.m. Saturday and Sunday service is operated from 4:27 a.m. to 1:00 a.m. JTA's Connexion operates during the same days and hours as the fixed-route service. Additionally, JTA's Skyway service is provided from 6:00 a.m. to 9:00 p.m. on weekdays. Service on the Skyway is only provided on Saturdays and Sundays in connection with special events.

JTA operates a fleet of 162 buses for fixed-route service. The current peak requirement is for 135 vehicles. JTA has a fleet of 12 trolley buses for its trolley services and 9 vehicles for Ride Request service. JTA also has a fleet of 102 vans that are operated by its contractors for the Connexion. JTA has a fleet of 10 vehicles for the Skyway service.

JTA operates the fixed-route service from the facility located at 100 Myrtle Avenue in the City of Jacksonville. Its fixed-route bus service is oriented to downtown Jacksonville and to six transfer stations. The Skyway system has eight stations. The Skyway operations and maintenance facilities are located at 725 Leila Street and 312 Bay Street in Jacksonville.

The basic adult fare for fixed-route bus service is $1.00. Reduced fares are offered to senior citizens, persons with disabilities, and Medicare Card holders. Senior citizens ages 60 and older ride free with a Senior Identification Card or Medicare Card. Persons with disabilities pay $0.25 with

Table 30. 2008 National Transit Data Report for JTA.

Finance and Operation Categories	Fixed-Route Service	Fixed Guideway	Paratransit Service
Unlinked Passengers	10,290,987	502,364	347,088
Revenue Hours	630,403	17,430	204,747
Operating Expenses	$65,639,903	$6,249,168	$18,620,626

Table 31. Selected performance measures for JTA.

All Routes	FY 2007	FY 2008	FY 2009 (Estimates)
Passengers	10,174,120	10,290,987	8,502,824
Total Expenses	$60,981,288	$65,639,903	$65,639,903
Revenue Hours	633,474	657,530	549,790
Passenger Per Revenue Hour	16.1	15.7	15.5
Expense Per Hour	$96.26	$99.83	$119.39
Total Expense per Passenger	$6.00	$6.38	$7.72

a Reduced Fare Card or Medicare Card. The fare on the Skyway system is $0.50 with a reduced fare of $0.10 for senior citizens and persons with disabilities. The fare for ADA paratransit service is zone-based but does not exceed twice the regular fixed-route fare.

Table 30 shows the following financial and operating statistics for its fixed-route and paratransit service, as reported in JTA's National Transit Database Report for FY 2008:

JTA reported an annual ridership of 473,927 and annual vehicle revenue hours of 259,491 for its demand-responsive service.

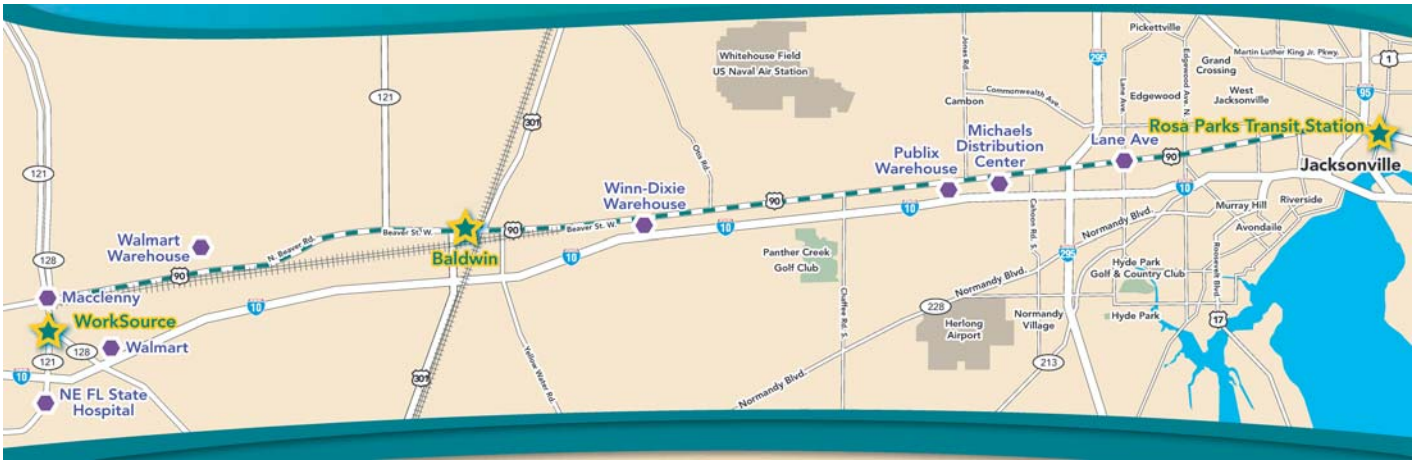
Table 31 shows key performance measures for all JTA services for FY 2007, 2008, and 2009.

Flexible Public Transportation Service Description for All Types Operated

Demand-Responsive Connector

Ride Request is JTA's demand-responsive connector service available upon reservation or request within a defined area and timeframe. Each Ride Request area has a telephone number for passengers to call to let the service know where to pick up and drop off and the time of travel. Customers requesting a trip are advised to call at least 2 hours in advance and are limited to no more than three grocery-sized bags. The rider must be near the curb at least 5 minutes prior to the arranged time. JTA also takes subscriptions for recurring trips.

JTA operates all three of its demand-responsive connector services on weekdays and the Oceanway and Highlands Ride Request on weekdays and Saturdays. JTA offers a wide range of transit passes and tickets. The base cash fare for Ride Request is $2.00 each way per person. The fare is $1.00 for persons over 60 years of age and persons with disabilities. Children, ages 5 years and under, or less than 42 inches tall, ride free with an accompanying adult. All of the route deviation connector vehicles are ADA compliant.



Source: JTA

Figure 31. Baldwin Commuter Shuttle.

Route Deviation

JTA operates two route deviation routes, known as Shuttle routes. One of the routes, the Baldwin Commuter Shuttle, shown in Figure 31, operates as a deviated fixed route, with service between two areas, Macclenny and Baldwin, and downtown Jacksonville.

The Arlington Community Shuttle operates primarily as a loop route in the Arlington community, with route deviations in a specific area around the route.

The Shuttles follow a fixed route within zones but may deviate off route upon request, always returning to their regular routes. Riders have the option of being picked up at a regular bus stop or scheduling a pick-up at other pre-approved locations and by advanced reservations. Off-route drop-offs are made by reservation, and locations are negotiated between the dispatcher and customer, as necessary. All of the route-deviation vehicles are ADA compliant. JTA reports that less than 1 percent of its total passenger trips involve the flexible or route-deviation feature.

Customers requesting pick-up at an off-route designated bus stop are advised to call at least 2 hours in advance of the requested trip. JTA also takes subscriptions for recurring trips. Once on board a bus, riders can simply inform the driver of the location of the stop where they wish to be dropped off. The driver will honor an off-route stop if schedules allow and, in the case of the Baldwin Commuter Shuttle, will deviate one-half mile off Beaver Street.

The base cash fare for the Baldwin Commuter Shuttle is $2.00 each way per person. The fare is $1.00 for persons over 60 years of age and persons with disabilities. There are $12 weekly passes and $40 monthly passes. There is not a surcharge for the Baldwin Commuter Shuttle off-route deviations. The base cash fare for the Arlington Community Shuttle is $1.00 each way per person. The fare is $0.25 for persons with a Connexion ID and free for persons 60 years of age and older. All route deviations are $0.50 per deviation.

Productivity Standards and Measures for Flexible Public Transportation Service

JTA provided draft service design standards for its Request Ride service, shown in Table 32. In areas of high density and low automobile ownership, JTA would operate fixed-route service within ¼ mile of most residences. However, as densities decrease, JTA would operate more flexible service or no service.

Table 32. Draft JTA service design standards.

Average Number of Automobiles per Household	Population Density (Persons Per Square Mile)			
	4,000 and above	2,500–3,999	1,000–2,499	Under 1,000
Under 1.0	Fixed-route (1/4 Mile)	Fixed-route (1/4 Mile)	Connectors/ Loopers	Ride Request
1.0–1.5	Fixed-route (1/4 Mile)	Fixed-route (1/4 Mile)	Connectors/ Loopers	No service
1.6–2.0	Fixed-route (1/4 Mile)	Fixed-route (1/2 Mile)	Ride Request	No service
Over 2.0	Fixed-route (1/2 Mile)	Fixed-route (1/2 Mile)	Ride Request	No service

Table 33. JTA ridership for flexible transportation routes.

Flexible Route Name	FY 2007 Average Daily Ridership	FY 2008 Average Daily Ridership	FY 2009 Average Daily Ridership (to July 2009)
Highlands Airport	96.4	108.6	120.3
Oceanway	16.4	62.5	45.3
Northside Weekend (Started Oct. 2007)	31.6	27.6	28.5
San Jose	23.3	24.5	26.5
Avenues South	39.4	52.4	60.2
Baldwin Commuter Shuttle	3.3	16.6	24.5
Arlington Community Shuttle (start Aug. 2008)	N/A	101	96.0
Total Daily Ridership by Year	**210.4**	**393.2**	**401.3**

Ridership for flexible public transportation service routes are increasing annually, as shown in Table 33:

Policy Objectives for Implementing Flexible Public Transportation Service

- Provide coverage to a large, low-density area
- Reduce or eliminate the expense of providing an ADA-complementary paratransit service
- Serve low demand times
- Balance customer access and routing efficiency
- Lay the groundwork for future fixed-route service
- Respond to community preferences and geography

Marketing Strategies

- Ride Request information is included in system maps or “bus books” and on JTA’s website
- Specially designed brochures are used
- Presentations are made to community groups
- Specially designed print ads for Ride Request are posted

Other Issues

JTA did not report any other issues associated with its flexible public transportation services.

4.7 Charleston Area Regional Transportation Authority

Flexible Transportation Services: Zone Routes

The South Carolina Electric and Gas Company operated the bus system in Charleston, South Carolina, until 1997 when the City of Charleston, City of North Charleston, Town of Mount Pleasant, and Charleston County joined together to create the Charleston Area Regional Transportation Authority or CARTA. CARTA provides public transportation services for residents and visitors throughout the Charleston area. In November 2004, a half-cent sales tax referendum was passed, providing CARTA with the revenue source to relaunch many of the services that had been eliminated or consolidated due to a lack of funding. CARTA added new routes and services such as CARTA Express and CARTA at Night, a premium zone route flexible transportation service.

Operation and maintenance of CARTA's fleet of vehicles, including the staffing and managing of drivers as well as bus scheduling, is contracted out to two for-profit companies.

Overall Service Area Characteristics

The CARTA service area covers 73 square miles with a 2007 service area population of 630,100 persons. The CARTA system serves the downtown business district of the City of Charleston as well as neighborhoods and employment centers in North Charleston, Mount Pleasant, and Charleston County. According to the 2000 Census update, there were 207,957 households and a population density of 996.5 people per square mile. The racial makeup of the CARTA service area was 65.1 percent White, 30.8 percent African American, 1.30 percent Asian, and 2.8 percent from other races. Hispanic or Latinos of any race were 2.40 percent of the population.

Flexible Public Transportation Service Area Characteristics

CARTA operates four flexible zone routes that serve distinct areas in the Charleston Area. Zone Route 1, shown in Figure 32, is operated in North Charleston, which is a primarily suburban area bounded by the Ashley River on the west and the Cooper River on the east.

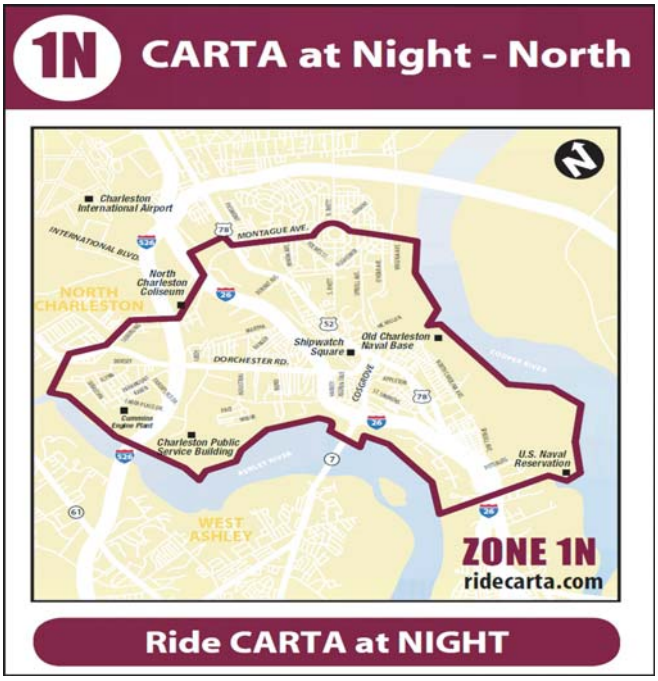
CARTA at Night, Zone Route 2, shown in Figure 33, operates in an area known locally as the Peninsula. This area serves the original Charleston peninsula that includes the downtown area and extends to the Zone 1 boundaries.

CARTA at Night, Zone Route 3, shown in Figure 34, operates in an area known locally as West Ashley. This area serves the city area west of the Peninsula and across the Ashley River from downtown.

CARTA at Night, Zone Route 4, shown in Figure 35, operates in an area known locally as Mt. Pleasant. This area serves the area east of the Peninsula across the Cooper River and includes Mt. Pleasant, Sullivan's Island, Fort Moultrie, and Isle of Palms.

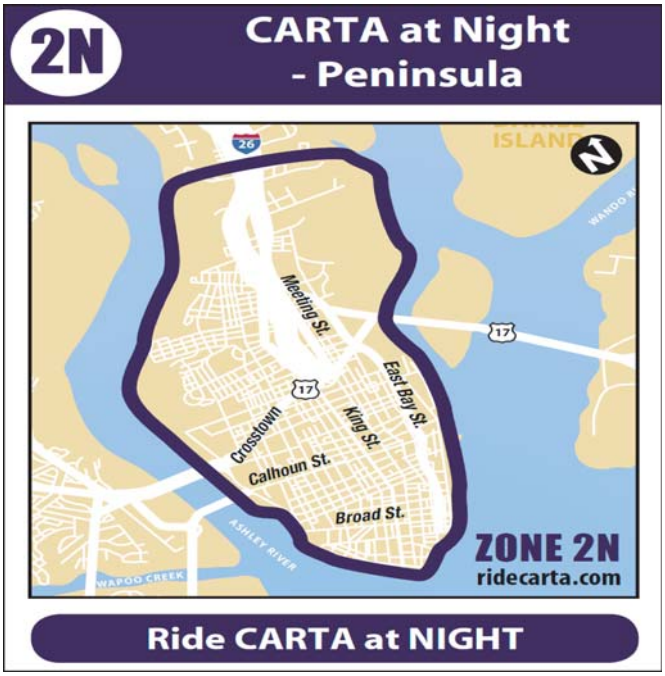
Transit System Description for All Modes

CARTA operates local, express, and neighborhood routes from North Charleston to historic downtown Charleston and Mt. Pleasant to West Ashley. CARTA operates 24 fixed routes, two Express routes, and four flexible transportation routes known as CARTA at Night. CARTA



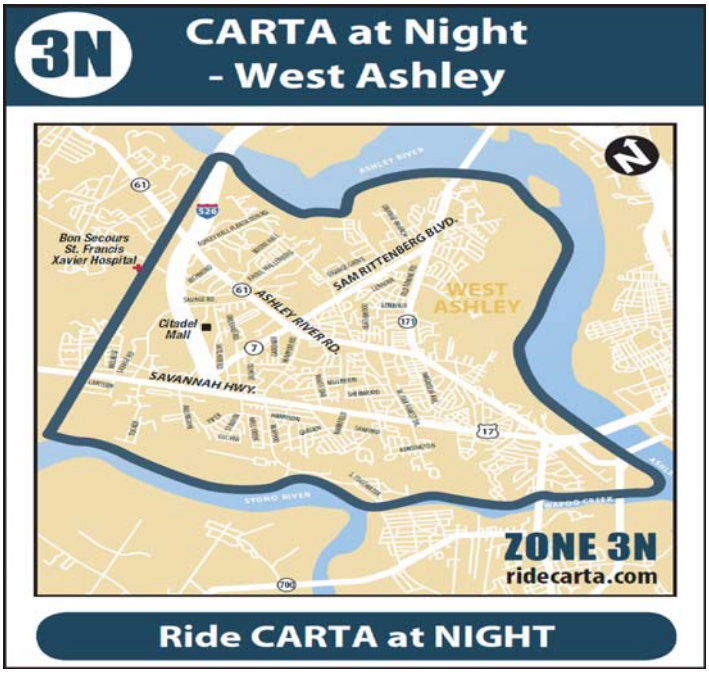
Source: CARTA

Figure 32. CARTA at Night Zone Route 1—North.



Source: CARTA

Figure 33. CARTA at Night Route 2—Peninsula.



Source: CARTA

Figure 34. CARTA at Night Zone Route 3—West Ashley.

Source: CARTA

Figure 35. CARTA at Night Zone Route 4—Mt. Pleasant.

operates an ADA paratransit service known as Tel-A-Ride for passengers unable to get to a regular bus stop. Tel-A-Ride operates a curbside service in a defined service area for those who meet the requirements under the Americans with Disabilities Act. The agency also operates CARTA at Night, a flexible transportation service in four zones only during nighttime hours on weekdays and Saturday.

The regular fare is $1.50 for the fixed-route buses and the downtown area shuttles. The Express fare is $2.50. The CARTA at Night fare is $2.00 cash, or a CARTA Express Pass may be used. All other passes can be used with a $0.75 surcharge. Low income discount fares are available for those who qualify through an eligibility determination. Senior citizens aged 55 and above pay $0.75 for fixed-route and downtown shuttle services during off-peak hours on weekdays and all day Saturdays, Sundays, and holidays. Disabled patrons may ride fixed-route buses for $0.40 all day, every day of the week. Tel-A-Ride fares are $3.00 per trip.

For all modes for 2008, CARTA's ridership was 3,023,403, with annual vehicle revenue hours of 250,000. CARTA operated 57 peak-hour vehicles of varied sizes. CARTA's operating budget was $12,263,988, and it had a total of 212 full- and part-time employees.

Flexible Public Transportation Service Description for All Types Operated

Zone Routes

CARTA uses a fleet of six buses on its four flexible zone routes that operate after most regular bus service has ended. These routes serve urban and established suburban neighborhoods primarily in hard-to-serve areas in Mount Pleasant, the Peninsula, downtown, West Ashley, and North Charleston. Passengers may be transported to any point within the same zone or transfer to a vehicle serving another zone. All buses meet downtown at the Meeting and Saint Mary Street bus stop. The CARTA at Night service starts at 9:30 p.m. and ends at 1:00 a.m. Round trips take 60 to 90 minutes depending on the route. The buses meet and depart at set prescribed times at the downtown bus stop. CARTA at Night service is operated weekdays and Saturdays. CARTA At Night riders pay a single cash fare of $2.00 or use the CARTA Express Pass; all other passes may be used with a $0.75 surcharge.

For 2008, CARTA at Night reported 32,239 in total ridership, 12,792 annual vehicle revenue hours, and an operating budget of $767,520.

Passengers may ride within a zone or transfer to another vehicle serving a different zone. Passengers may call and make a reservation for service or board at any established stop along the route. Passengers may also board any of the flexible route (zone) vehicles at the downtown transfer point without a reservation and just tell the driver where they wish to be taken. CARTA at Night does not serve off-route requests; pick-ups and drop-offs are only at established bus stops. Reservations can be made in advance to a reservation agent, and the agent can communicate with the driver via radio for pick-ups on short notice. CARTA uses small body-on-chassis vehicles for its late night zone flexible service. All of the buses are ADA compliant. CARTA operates a separate complementary ADA paratransit service. CARTA reports that it averages three riders per vehicle revenue hour on its flexible zone route service. Ridership has steadily increased, as shown in Table 34.

CARTA at Night operates on weekdays and Saturdays, with no service on Sundays.

Productivity Standards and Measures for Flexible Public Transportation Service

CARTA did not report specific productivity standards for its flexible public transportation service.

Table 34. CARTA at Night ridership.

Route Name	FY 2007 Ridership	FY 2008 Ridership	FY 2009 Projected Ridership
North Charleston	6,886	10,955	11,894
Downtown	6,886	6,573	10,955
West Ashley	5,008	6,573	6,260
Mount Pleasant	3,130	8,138	7,512
Totals	**21,910**	**32,239**	**36,621**

Policy Objectives for Implementing Flexible Public Transportation Service

- Provide coverage to a large, low-density area
- Serve low demand times
- Lay the groundwork for future fixed-route service
- Respond to community preferences and geography

Marketing Strategies

- Include information on CARTA at Night in system maps or "bus books" and on its website
- Use specially designed brochures
- Use presentations to community groups

Other Issues

- Funding has been an issue but seems to be solved with the half-cent referendum for public transit.
- Comprehensive performance standards have been lacking.
- There are low ridership numbers on flexible routes.
- Reduced fares and farebox recovery ratios may hurt prospects for expanding fixed and flexible routes.

4.8 Mountain Rides Transportation Authority

Flexible Transportation Services: Request Stops (Service Discontinued)

Mountain Rides Transportation Authority (Mountain Rides) is the merged entity that was formerly known as Kart/Peak Bus and Wood River Rideshare, located in Blaine County, Idaho. Mountain Rides provides public transportation services for residents and visitors throughout Blaine County and its adjacent communities. Mountain Rides provides a commuter bus route, a town bus route, ADA paratransit service, and a vanpool service.

Mountain Rides previously provided a flexible transportation service but discontinued this service in October 2008. Even though Mountain Rides no longer provides a flexible transportation service, this case study has been included for illustrating services provided in a rural, low-density community.

Overall Service Area Characteristics

The Mountain Rides service area covers 30 square miles with a 2008 population of 15,000 persons. The Mountain Rides system serves portions of Blaine County and the surrounding areas

of Ketchum, Bellevue, Hailey, Shoshone, Twin Falls, and Sun Valley. According to the 2000 Census, Blaine County had a population of 18,991 (2007 estimate: 21,560). The county seat and largest city is Hailey. There were 7,780 households and 4,839 families residing in the county. The population density of the service area was 500 people per square mile. The racial makeup of the county was 90.73 percent White, 0.13 percent Black or African American, 0.33 percent Native American, 0.73 percent Asian, 0.07 percent Pacific Islander, 6.43 percent from other races, and 1.57 percent from two or more races. Nearly 11 percent of the population was Hispanic or Latino of any race.

Flexible Public Transportation Service Area Characteristics

The area served by the request stop service was a sparsely populated mountainous area with winding roads.

Transit System Description for All Modes

Mountain Rides currently operates two fixed routes, a vanpool service, and ADA-complementary paratransit service. The Valley Route is a commuter bus route that provides service between Bellevue and Sun Valley, with connecting stops through Ketchum and Hailey. The Valley Route operates weekdays, weekends, and holidays from 6:00 a.m. to 10:00 p.m. The Town Route operates fare-free service serving Warm Springs, Ketchum, Dollar, Elkhorn, Sun Valley, and River Run. The Town Route operates year round from 7:00 p.m. to 9:30 p.m. Mountain Rides also operates a vanpool service in Blaine County for employees commuting into the Wood River Valley, including Ketchum, Twin Falls, Hailey, Shoshone, Jerome, and Sun Valley. Monthly fares range from $60 to $190.

Mountain Rides also operates a door-to-door ADA paratransit service for residents in Ketchum and Sun Valley city limits. This service is provided free of charge to those who qualify under the Americans with Disability Act of 1991.

The agency's fiscal 2009 budget is about $2.3 million, provided by Blaine County and local municipalities, federal grants, rider fares, and Sun Valley.

For all services in FY 2008, Mountain Rides reported an annual ridership of 320,000, annual vehicle revenue hours of 24,000, and an operating budget of $2,023,500. Mountain Rides operated 11 peak-hour vehicles with 29 full- and part-time employees.

Flexible Public Transportation Service Description for All Types Operated—Request Stops

In 2008, Mountain Rides operated two summer bus routes, River Run and Warm Springs. The Warm Springs bus service operated at half-hour service frequencies from 7:30 a.m. to 12:00 p.m., 7 days a week. On the end of the Elkhorn Village portion of the route, passengers could request service to and from the Morning Star loop/Harker Center area. For pick-ups, passengers would call a telephone number in advance and the bus would be dispatched to the loop. To return to the loop, riders would request that the bus driver take them to the requested stop. There was no additional fare for the request stop service.

Productivity Standards and Measures for Flexible Public Transportation Service

Selected performance indicators for Mountain Rides are presented in Table 35.

Table 35. Mountain Rides performance indicators.

All Routes	FY 2006	FY 2007	FY 2008	FY 2009
Passengers	321,157	305,086	355,431	276,672
Total Expenses	$1,300,000	$1,650,000	$1,920,000	$1,750,000

Policy Objectives for Implementing Flexible Public Transportation Service

There was only one policy objective, to serve low demand times.

Marketing Strategies

- Included information about flexible transportation in system maps or "bus books"
- Used presentations to community groups
- Used targeted mailings

Other Issues

The primary reason Mountain Rides discontinued its flexible transportation service in October 2008 was that they did not have the dispatch services to support the calls for pick-up. Requested drop-offs were fine once a passenger was on board, but having customers call to request a pick-up was cumbersome and ineffective for their organization, which has a limited administrative staff. Handling pick-up requests was especially hard after hours, when no one was in the office. Passengers were calling the driver's cell phone, which was unsafe, and the calls did not always get answered.

4.9 South Central Adult Services Council, Inc.

Flexible Transportation Services: Route Deviation, Zone Routes, and Demand-Responsive Connector

South Central Adult Services located in North Dakota, is a not-for-profit corporation that has been in operation since May 1983. Its purpose is to create public awareness of elderly persons and their needs; to create an atmosphere in which elderly persons, with help, solve their own problems and meet their own needs; and to coordinate existing services and agencies.

Overall Service Area Characteristics

South Central Adult Services provides its transportation services to residents in the counties of Barnes, LaMoure, Foster, Logan, McIntosh, and Griggs. The population of the South Central Adult Services service area is approximately 28,687 and covers over 5,950 square miles for an overall density of less than five persons per square mile. Table 36 lists selected demographic characteristics of each county.

Flexible Public Transportation Area Characteristics

The flexible public transportation area characteristics are the same as the overall service area characteristics since the flexible services are operated throughout the entire service area.

Table 36. Selected South Central Adult Services area demographics.

County	Population 2008 Estimates	Households	Land Area Square Miles	Population Density Per Square Mile
Barnes	10,282	4,884	1,4921.6	7.9
Foster	3,447	1,540	635.2	5.9
Griggs	2,358	1,178	708.5	3.9
LaMoure	3,986	1,942	1,147.2	4.1
Logan	2,308	963	992.6	2.3
McIntosh	2,639	1,467	975.2	3.5

Transit System Description for All Modes

Transportation services are available throughout the counties served by South Central Adult Services. Transportation is available to take the general public to and from meal sites and for other purposes including medical appointments, shopping, recreation, schools, and personal needs. Figure 36 shows a sample of how information on the South Central Transit Network is provided to the public.

South Central Adult Services provides several types of flexible public transportation services including demand-responsive connector, zone routes, route deviation for persons with disabilities, and route deviation for the general public in the counties served.

South Central Adult Services provides rides on a first-call-first-served basis. Riders must schedule trips in advance since some vehicles will not operate service if there are no reservations or passengers. Riders are asked to call for reservations as far in advance as possible. Fares vary by trip type (medical, within cities, within zones, etc.) and county. The flexible service features are provided mostly in rural, hard-to-serve areas, with senior citizens and persons with disabilities as the primary users. Route deviation is allowed without any distance restrictions within the service area of a particular route. South Central Adult Services averages between one and four passengers per revenue hour for its flexible service, depending upon the route, day of week, and location of service (county). Passengers desiring flexible transportation service must have a prior reservation or a called in request. Unscheduled transportation needs may be accommodated upon request by contacting a county outreach worker.

In Barnes County, South Central Adult Services operates a demand-responsive service in Valley City weekdays from 8:00 a.m. to 5:00 p.m. and weekends from 9:00 a.m. to 2:00 p.m. for a fare of $1.50 each way. There is also service from Valley City to Jamestown, Oriska, Sanborn, Rogers, Leal, Nome, Hastings, Fargo, and other locations on alternating days of the week and month. Fares range from $3.00 to $15.00 per round trip. In addition, taxi services are provided through South Central Adult Services in Valley City every day, 24 hours a day.

In Foster County, demand-responsive service is provided within Carrington on weekdays only for $1.00 per trip. Demand-responsive connector service is provided to Fargo on the first Wednesday and third Tuesday of the month for $15.00 per round trip and to Bismarck on the third Wednesday of the month for $15.00 per round trip. Demand-responsive zone service is provided within Foster County for $5.00 per round trip, to Jamestown on various weekdays for $8.00 per round trip, and to New Rockford every Monday upon request for $5.00 per round trip.

In Griggs County, demand-responsive service is provided within Cooperstown weekdays only for $1.00 per trip. Demand-responsive connector service is provided to Fargo every Thursday for $8.00 per round trip; to Valley City every second Tuesday for $6.00 per round trip; to Jamestown on the first and third Tuesday of the month for $3.00 per round trip; to Grand Forks, Mayville,

South Central Transit Network

Transportation services are available throughout the counties served by South Central Adult Services. All vehicles display the name South Central Transit Network. Transportation is available to take the general public to and from meal sites and for other purposes which include: medical appointments, shopping, recreation, schools and personal needs. Wheelchair accessible vehicles are available. Please make the dispatcher aware of this need when scheduling your ride. Normally, transportation services will not be available on legal holidays.

Rides are provided on a first-call-first-served basis. You must schedule in advance since some trips do not go if there are no passengers. Call for reservations at the following numbers as far in advance as possible. Charges for each trip are posted in each vehicle.

Barnes County

DESTINATION	SCHEDULE	RESERVATIONS
Jamestown	Tuesdays, Thursdays & Saturdays	845-4300
Fargo	Thursdays	845-4300
Local route to Rogers, Wimbledon, Sanborn, Leal, & Dazey	2nd & 4th Fridays. Reservations required	845-4300 1-800-472-0031
Local route to Kathryn, Nome, Fingal & Oriska	1st & 3rd Fridays. Reservations required.	845-4300 1-800-472-0031
Valley City (Local Service)	Monday through Friday - 8:00 am to 4:00 pm and Saturday & Sunday - 9:00 am to 1:45 pm	845-4300
All Barnes county routes originate from Valley City.		
For special transportation needs, contact the Valley City Center at 845-4300.		

LaMoure County

DESTINATION	SCHEDULE	RESERVATIONS
Jamestown	Tuesdays & Wednesdays. Reservations required.	742-2885 or 710-0745
Fargo	2nd & 4th Thursdays. Reservations required	742-2885 or 710-0745
Bismarck	3rd Thursdays. Reservations required.	742-2885 or 710-0745
Aberdeen, Ashley, Oakes, Wishek & Valley City, etc.	1st Thursday or each Monday or Friday of the month upon request. Reservations required.	742-2885 or 710-0745
Meal Sites: LaMoure, Kulm, & Edgeley	Monday through Friday on serving days.	742-2885 or 710-0745
For special transportation needs, contact the outreach worker at 883-5088.		

Source: South Central Adult Services Council, Inc.

Figure 36. South Central Adult Services sample schedules.

and Hillsboro every fourth Tuesday for $8.00 per round trip. In addition, upon request, service is provided between Cooperstown and Binford, Sutton, and Hannaford for $3.00 per round trip.

In LaMoure County, demand-responsive zone service is provided in LaMoure City weekdays only for $1.00. Demand-responsive connector service is provided to Fargo (second and fourth Thursdays) and to Bismarck (third Thursday) for $15.00 per round trip. Demand-responsive service is also provided to Valley City, Oakes, and Jamestown on alternate weekdays for $8.00 per round trip. Service is also provided to Aberdeen upon request for $10.00 per round trip.

In Logan County, demand-responsive service is provided within Napoleon every Tuesday, Wednesday, and Thursday for $1.00 per round trip. Demand-responsive connector service is provided to Bismarck every Wednesday and Friday for $8.00 per round trip and to Jamestown every Monday and the second and fourth Thursday for $10.00 per round trip. Service is provided to Wishek and Linton every Tuesday and Thursday upon request for $5.00 per round trip and to Aberdeen as needed for $10.00 per round trip.

In McIntosh County, service is provided within Ashley every Monday, Wednesday, and Friday for $1.00 per round trip and within Wishek every Tuesday, Wednesday, and Thursday for $1.00 per ride. Demand-responsive connector service is provided from Wishek to Bismarck every Monday for $15.00 per round trip and from Wishek to Jamestown every Monday and third Thursday for $10.00 per round trip. Service is provided from Ashley to Bismarck every Thursday for $15.00 per round trip and between Ashley and Zeeland upon request for $3.00 per round trip. A shuttle service is provided to Zulm for connections to Jamestown and Fargo every Tuesday and the second and fourth Thursdays for $5.00 per round trip. Upon request, service is provided to Aberdeen as needed for $10.00 per round trip.

Flexible Public Transportation Service Description for All Types Operated

South Central Adult Services estimates that approximately one-third of its total ridership stems from the flexible service. South Central Adult Services reported annual ridership for flexible services at approximately 16,900 and annual vehicle hours of 10,400. For the flexible services provided, South Central Adult Services operated 11 vehicles (vans and small chassis buses) with an annual budget of $166,900 and 16 full- and part-time employees.

Productivity Standards and Measures for Flexible Public Transportation Service

In FY 2008, South Central Adult Services reported an annual ridership of 62,738, annual vehicle revenue hours of 30,680, and an operating budget of $650,853. South Central Adult Services operated 22 vehicles with 33 full- and part-time employees. Table 37 shows selected operational statistics for transportation services provided by South Central Adult Services in FY 2008.

In FY 2008, average passengers per hour were 1.1, which is comparable to many purely demand-response services in urban areas.

Reasons for Implementing Flexible Public Transportation Service

- Provide coverage to a large, low-density area
- Respond to community preferences and geography

Table 37. Selected FY 2008 South Central Adult Services operational statistics.

County Name	Ridership	Vehicle Miles	Average Cost Per Ride ($)
Barnes	38,981	182,074	7.02
Foster	4,041	23,369	19.29
Griggs	4,014	41,719	14.01
LaMoure	3,420	45,837	16.48
Logan	3,647	58,264	24.51
McIntosh	8,635	72,894	7.67

Marketing Strategies

- Information on flexible services included on website
- Information on flexible services presented to community groups

Other Issues

South Central Adult Services did not report any other issues.

4.10 Omnitrans

Flexible Transportation Services: Zone Routes, Demand-Responsive Connector

Omnitrans was created in 1976 by a Joint Powers Agreement (JPA) among the County of San Bernardino and the cities of Chino, Colton, Fontana, Loma Linda, Montclair, Ontario, Redlands, Rialto, San Bernardino, and Upland. Since that time, five additional cities (Chino Hills, Highland, Grand Terrace, Rancho Cucamonga, and Yucaipa) have joined and make up the current JPA. Omnitrans was created primarily to provide a standardized system of fares, a universal system of transfers, and expanded transit services and facilities for the benefit of the residents of its member cities.

Overall Service Area Characteristics

San Bernardino County can be divided into three distinct regions. The High Desert represents approximately 90 percent of the county area. The Mountain region encompasses the San Bernardino National Forest and portions of the San Gabriel National Forest to the south of the desert regions. The San Bernardino Valley encompasses the valley south of the Mountain region, bordered by the Los Angeles County line to the west and the Riverside County line to the south. Orange County also borders San Bernardino County at the southwestern end of the county at Chino Hills State Park.

The Omnitrans service area covers over 456 square miles and serves the urbanized area of the San Bernardino Valley region of the county with a population close to 1.3 million. The service area includes the cities of Colton, Fontana, Grand Terrace, Highland, Loma Linda, Redlands, Rialto, San Bernardino, and Yucaipa in the East Valley (east of I-15) and Chino, Chino Hills, Montclair, Ontario, Rancho Cucamonga, and Upland in the West Valley (west of I-15). The overall population density of the service area is 3,070 persons per square mile.

According to the 2000 Census, the racial makeup of the San Bernardino Valley was 55.4 percent White, 9.7 percent African American, and 5.5 percent Asian. Hispanic or Latinos of any race were 44.6 percent of the population. The City of San Bernardino has a high percentage of persons that live below the poverty level (27.6 percent) and have limited access to private vehicles. On the other hand, Chino Hills has the lowest rate of poverty (5.1 percent) and a higher rate of multiple private vehicle ownership per household when compared to other areas. Yet the proportion of public transportation use is not as low in Chino Hills (2.0 percent) as it is in other areas in the Valley. Both Yucaipa (0.7 percent) and Grand Terrace (0.8 percent) residents tend to use public transit less and tend to drive alone to work. This is the result of numerous transportation options (e.g., commuter rail, express bus service, etc.) into job-rich destinations to the west and limited transit options and job opportunities to the east.

The demographics of the Omnitrans' member cities are presented in Table 38.

Table 38. Selected demographics of Omnitrans' member cities.

City	Square Miles	2006 Population	Density (persons per sq. mile)	Median Income ($)	% >65 Years	% With No Vehicles
Chino	18.59	73,343	3,945	68,705	5.4	4.8
Chino Hills	44.88	71,849	1,600	93,133	6.3	1.4
Colton	15.90	51,045	3,210	42,362	10.8	10.8
Fontana	35.78	160,015	4,472	58,481	3.0	3.0
Grand Terrace	3.60	12,227	3,396	64,552	10.7	3.5
Highland	13.62	50,236	3,688	48,050	6.5	9.9
Loma Linda	7.80	21,592	2,767	43,856	15.4	11.2
Montclair	5.20	34,679	6,669	47,026	8.3	8.6
Ontario	36.76	170,373	4,635	46,344	7.5	5.0
Rancho Cucamonga	37.70	141,586	3,755	71,967	7.1	4.9
Redlands	35.98	70,324	1,954	52,111	9.9	4.9
Rialto	21.80	97,524	4,473	50,446	4.5	5.8
San Bernardino	59.85	198,322	3,313	33,915	6.9	10.5
Upland	15.01	73,697	4,909	57,194	11.1	4.7
Yucaipa	27.50	49,388	1,796	45,044	15.5	8.4

Flexible Public Transportation Service Area Characteristics

Omnitrans currently operates flexible public transportation service on two routes in the communities of Chino Hills and Yucaipa. As shown in Table 38, Chino Hills encompasses 44.88 square miles with a population of 71,849 persons. The population density is 1,600 persons per square mile. The median age in Chino Hills is 32. Eighty-five percent of residents live in owner-occupied homes, and residents have an average median income of $93,133 per year. Yucaipa is a comparable community of 27.5 square miles with a population of 49,388 and densities of 1,796 persons per square mile. The median age of Yucaipa residents is 36. Seventy-six percent of residents live in owner-occupied homes, and residents have an average median income of $45,044 per year. Over 90 percent of residents in both communities have access to at least one vehicle.

Transit System Description for All Modes

According to its *Short Range Transit Plan: FY 2008–2013* (IBI Group et al. 2007), Omnitrans carried nearly 15 million passengers and operated nearly 800,000 revenue hours. It used a fleet of 273 vehicles and employed 719 persons with a total operating budget of $72,279,817. The basic cash fare was $1.35.

Omnitrans' fixed-route transit system provides scheduled, general public service along planned, predetermined routes in accordance with established frequencies. Those frequencies are generally based on passenger volumes: enough people have to ride each bus so that productivity and farebox recovery standards are met.

Based on the 2006 *Omnitrans On-Board User Intercept Survey* (Omnitrans, 2006), the typical Omnitrans fixed-route rider is between the ages of 20 and 49 (66 percent), has an income less than $20,000 (52 percent), and is equally likely to be male or female. The typical user is classified as transit-dependent, meaning they do not have access to an automobile to complete the needed trip. Only 15 percent of those surveyed reported that an automobile was available for their trip. Only 36 percent of users are in possession of a driver's license; of the remainder, 73 percent have at least one licensed driver in their household.

Omnitrans operates 29 fixed bus routes, including 17 routes in the East Valley (east of I-15), 11 routes in the West Valley (west of I-15), and one regional express route to the City of Riverside. TransCenters are a key component of Omnitrans service. Omnitrans' service is designed on a hub-and-spoke principle where the TransCenter functions as the hub and routes radiate out to major destinations. Transfers typically occur at these hubs but also occur at timed transfer points throughout the region. There are two types of TransCenters: on-street facilities and off-street facilities. TransCenters are located near major destinations, downtowns, and civic centers. With the opening of the Chino TransCenter in FY 2005, Omnitrans has a total of 13 TransCenters, including TransCenters located in Pomona, Montclair, Ontario, and South Fontana, and the Fourth Street Transit Mall located in downtown San Bernardino. The remaining TransCenters include Montclair Plaza, Redlands Mall, Inland Center Mall, Ontario Mills Mall, Chino TransCenter, Fontana Metrolink Station, Ontario Airport, and the Arrowhead Regional Medical Center. Each TransCenter varies in size and amenities.

Omnitrans operates complementary paratransit services known as Access, in accordance with ADA requirements.

Flexible Public Transportation Service Description for All Types Operated

Zone Routes and Demand-Response Connector

OmniLink is a general public dial-a-ride service designed for low-density service areas. OmniLink was introduced as a new Omnitrans program in Yucaipa in 1993 to provide coverage in low-density and low-demand areas that are difficult to serve with fixed-route transit. Service in Chino Hills was started in January 2002. Both OmniLink services are described below.

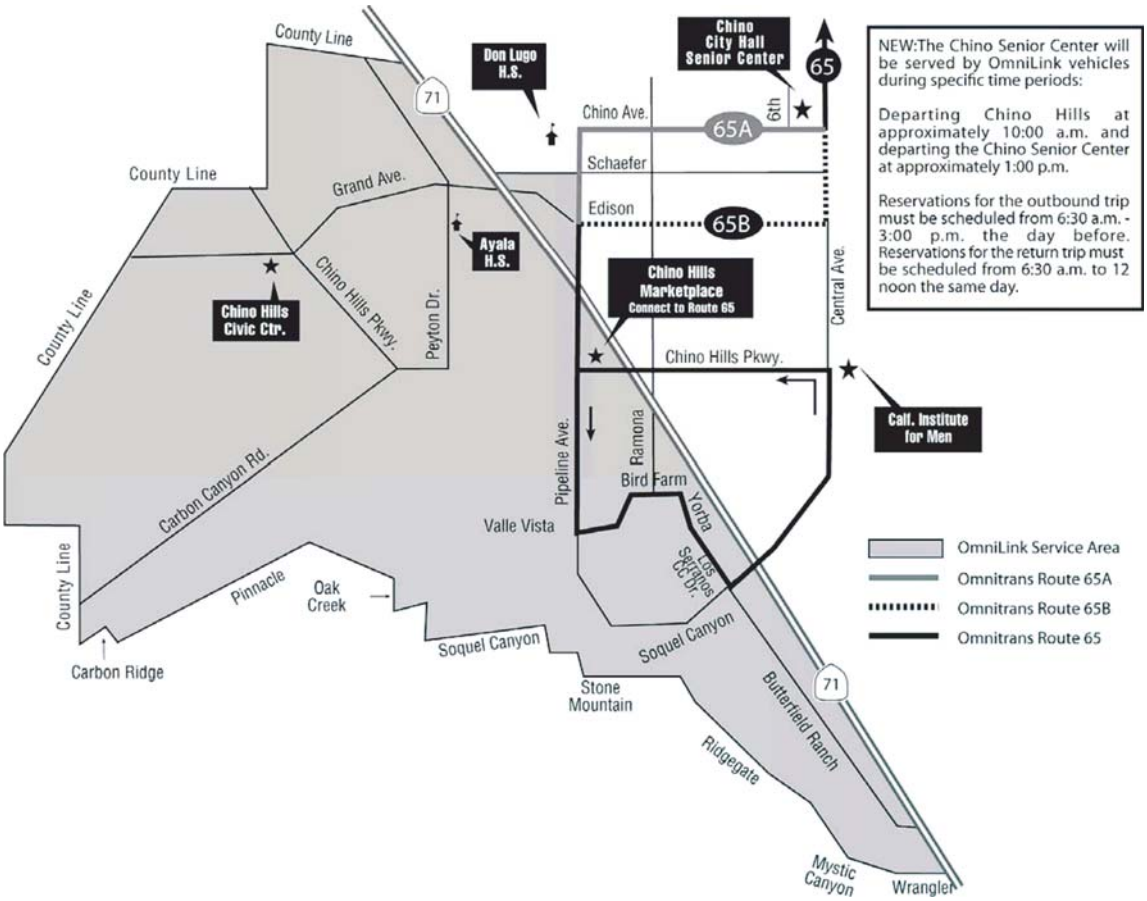
Chino Hills OmniLink. This is a dial-a-ride service for Chino Hills west of SR-71 to the county line. Chino Hills OmniLink is pulsed (formally scheduled) to meet OmniLink Route 65 at the Chino Hills Marketplace. Chino Hills OmniLink provides demand-response service within the corporate boundaries of Chino Hills (see Figure 37). A shuttle service is operated on weekdays between Chino Hills and the City of Chino to provide access to the Chino Senior Center. The weekday service is scheduled to depart outbound from Chino Hills at 10:00 a.m. and inbound from the Chino Senior Center at 1:00 p.m. and only operates if requested in advance.

Yucaipa OmniLink. Yucaipa OmniLink serves Yucaipa and Calimesa (areas served originally by the Yucaipa/Calimesa Dial-A-Ride, which started in 1993). Yucaipa OmniLink provides demand-response service within the corporate boundaries of Yucaipa and for trips between Yucaipa and neighboring Calimesa (see Figure 38). Service is provided for Calimesa trips that either originate or end in Yucaipa. Service is not provided for trips that begin and end within Calimesa.

In both Chino Hills and Yucaipa, service is provided Monday to Friday, 7:00 a.m. to 6:00 p.m. Service is not provided on New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving, and Christmas.

Trip bookings can be made 30 minutes before and after service start and end times. Advance reservations can be made up to 3 days in advance. "Repeater" subscription bookings can be made for one calendar month for trips that occur at least 3 days a week (same time between the same origin and destination). Same day bookings are accommodated on a space-available basis.

All advance and repeater bookings are confirmed at the time of the booking and entered into Trapeze PASS as an unassigned trip (not assigned to a run). There is no route optimization using Trapeze PASS. OmniLink route optimization can be implemented in conjunction with Access



Source: Omnitrans

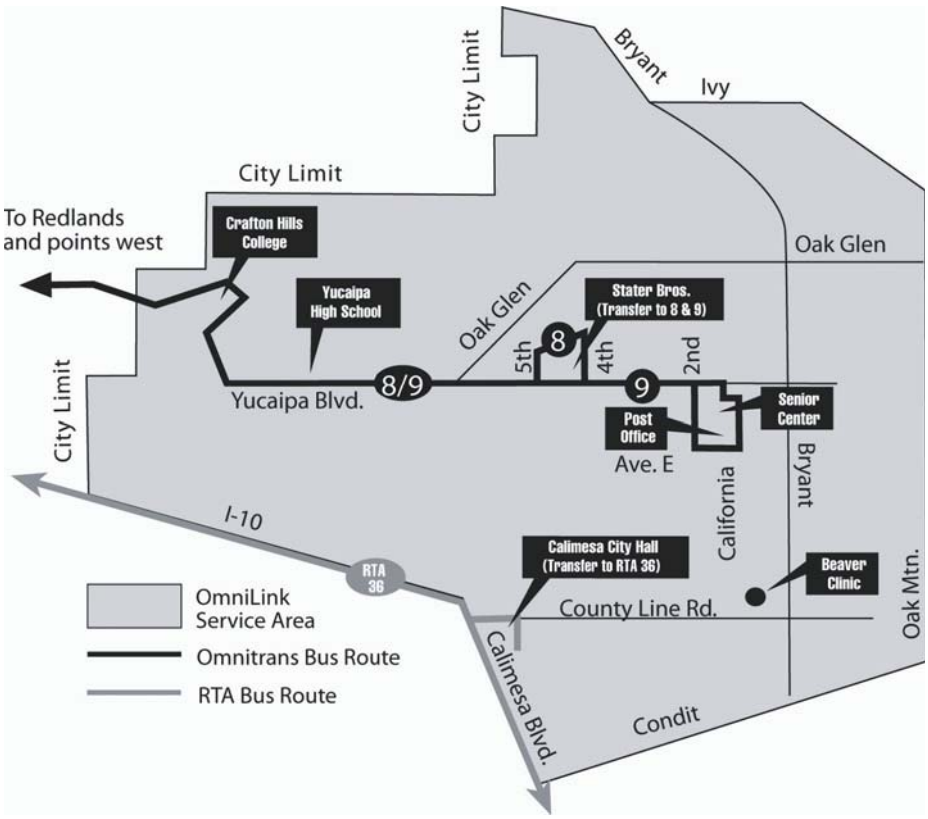
Figure 37. OmniLink Chino Hills service area.

operating procedures. Additional Trapeze PASS training may be required for those First Transit staff responsible for OmniLink scheduling and dispatch.

A single scheduler/dispatcher handles both OmniLink services. The scheduler/dispatcher is responsible for booking, scheduling, and dispatching each trip. With Yucaipa OmniLink, all trips are assigned to a run on the day of service. With Chino Hills OmniLink, most assignments are made the day before service is required. For Chino Hills, driver manifests are posted at 5:00 p.m. the night before. Same day bookings in Chino Hills are assigned by the dispatcher on the day of service.

Trip assignments are made via Mobile Data Terminals (MDTs) and cell phone voice dispatch. Trip assignments are often made 1 or 2 hours out from the pick-up time. A 40-minute pick-up window is used for trip assignment. Using Trapeze PASS software and a split screen, the schedulers/dispatchers drag individual trips from the unassigned list to a particular route. Trip assignments appear on the MDT screen. Drivers update the electronic dispatch lists via the MDTs and maintain a paper trip sheet as backup. Although vehicles are equipped with Automatic Vehicle Locator (AVL) technology, this technology is not fully used in the trip assignment process. Both service areas are rather compact, and the dispatchers assign trips based on their knowledge of the service area.

OmniLink is a general public, dial-a-ride service. No preregistration is required. Trip booking information is recorded when a passenger books the first trip.



Source: Omnitrans

Figure 38. OmniLink Yucaipa service area.

In addition to providing policy-based service coverage in low-density areas, OmniLink service is designed to provide feeder service to/from Omnitrans fixed-route bus service. Currently, only Chino Hills is pulsed to make connections with fixed-route service. Both OmniLink services are operated under contract, currently with First Transit. Under the terms of the service agreement, Omnitrans is responsible for service vehicles and the provision of facilities, scheduling hardware and software, service and policy planning, administrative oversight, customer relations, and budget planning. First Transit is responsible for hiring, training, and supervising all scheduling/dispatch and operations and maintenance staff; processing all trip requests; and maintaining and operating all service vehicles in accordance with Omnitrans specifications.

The cash fare for OmniLink routes is $3.00, with 10-ticket booklets available at a 10-percent discount. Farebox recovery ratios in FY 2009 were 7.66 percent for the Chino Hills OmniLink and 8.91 percent for the Yucaipa OmniLink. A total of eight vehicles are used on the Yucaipa and Chino Hills OmniLink routes during peak periods.

According to the 2007 Short-Range Transit Plan, OmniLink dispatchers identified school, shopping, and medical trips as the key trip purposes for both OmniLink services. The dispatchers identified students and senior citizens as key market segments. The data suggest a high use by seniors (over 59 percent for Chino Hills and 52 percent for Yucaipa). A review of an OmniLink trip report produced by Trapeze PASS in November 2006 strongly suggested the underrepresentation of general public passengers and a possible overrepresentation of senior citizen ridership. From the review of November 2006 data, 59 percent of Chino Hills OmniLink trips and 21 percent of Yucaipa OmniLink trips were made by students.

Table 39. Omnitrans' OmniLink performance standards.

Route	Passengers Per Revenue Hour		
	Goal	Minimum	FY 2009 Actual
Chino Hills	3.00	2.30	2.91
Yucaipa	4.20	3.5	3.12

Productivity Standards and Measures for Flexible Public Transportation Service

Omnitrans has established the following performance standards for OmniLink routes, shown in Table 39.

A schedule of liquidated damages and incentives has been established for each OmniLink service based on productivity and on-time performance.

Policy Objectives for Implementing Flexible Public Transportation Service

OmniLink was introduced as a new Omnitrans program in 1993 to provide coverage in low-density and low-demand areas that are difficult to serve with fixed-route transit.

Marketing Strategies

- Include information on OmniLink in system map or "bus book"
- Use specially designed brochures
- Use presentations to community groups

Other Issues

Omnitrans' 2007 SRTP identified a decrease in farebox recovery ratios for both OmniLink routes, even as ridership increased. Omnitrans did not decrease service, but hopes to make productivity enhancements through scheduling improvements.

References

Arrillaga, B. and G. E. Mouchahoir (1974). *Demand-Responsive Transportation System Planning Guidelines,* UMTA-VA-06-0012-74-6. Washington, DC: Urban Mass Transportation Administration.

Bureau of Public Transportation (1988). *Handbook for Purchasing a Small Transit Vehicle.* Pennsylvania Department of Transportation, Urban Mass Transportation Administration, U.S. DOT.

Burkhardt, J. E., B. Hamby, A. T. McGavock, ATE Management & Service Company, Inc., and Urbitran Associates, Inc. (1995). *TCRP Report 6: Users Manual for Assessing Service-Delivery Systems for Rural Passenger Transportation.* Washington, DC: Transportation Research Board, National Research Council.

Burkhardt, J. E., C. A. Nelson, G. Murray, and D. Koffman (2004). *TCRP Report 101: Toolkit for Rural Community Coordinated Transportation Services.* Washington, DC: Transportation Research Board of the National Academies.

Cervero, R. and C. Beutler (1999). *Adaptive Transit: Enhancing Suburban Transit Services, Report 424.* Berkeley, CA: University of California Transportation Center.

Cole, L. M. (1968). *Tomorrow's Transportation: New Systems for the Urban Future.* Washington, DC: U.S. Department of Housing and Urban Development.

Flusberg, M. (1976). "An Innovative Public Transportation System for a Small City: The Merrill, Wisconsin, Case Study." In *Transportation Research Record 606,* Transportation Research Board, National Research Council, 54–59.

IBI Group, Arellano Associates, and Connetics Transportation Group (2007). *Short Range Transit Plan: FY 2008–2013.* San Bernardino County, CA: Omnitrans.

KFH Group, Inc., Urbitran Associates, Inc., McCollom Management Consulting, Inc., and Cambridge Systematics (2008). *TCRP Report 124: Guidebook for Measuring, Assessing, and Improving Performance of Demand-Response Transportation.* Washington, DC: Transportation Research Board of the National Academies.

Koffman, D. (2004). *TCRP Synthesis 53: Operational Experiences with Flexible Transit Services.* Washington, DC: Transportation Research Board of the National Academies.

Mason County Transit Development Plan, 2009–2014 and 2008 Annual Report (2009). Shelton, WA: Mason County Public Transportation Benefit Authority.

Mergel, J. (1976). *Small City Transit: Merrill, Wisconsin, Point Deviation Service in a Rural Community.* Cambridge, MA: Transportation Systems Center.

Mistretta, M., J. A. Goodwill, R. Gregg, and C. DeAnnutis (2009). *Best Practices in Transit Service Planning.* Washington, DC: U.S. Department of Transportation, Office of Research and Special Programs (Center for Urban Transportation Research, Tampa, FL), available at http://www.ntis.gov or http://www.cutr.usf.edu/.

Neff, J. and M. Dickens (2009). *2009 Public Transportation Fact Book: 60th Edition.* Washington, DC: American Public Transportation Association, available at http://www.apta.com.

Omnitrans (2006). *Omnitrans On-Board User Intercept Survey.* San Bernardino County, CA, available at http://www.omnitrans.org.

Pierce Transit Finance, Audit & Administration Department (2009). *Pierce Transit Budget, Lakewood, Washington 2009.* Pierce Transit, available at http://www.piercetransit.org/budget/2009_FINAL_BUDGET.pdf.

St. Joseph Transit Rider's Guide (2007), available at: http://www.ci.st-joseph.mo.us/transit/Riders%20Guide.pdf

The Howell Research Group (2009). *RTD Call-N-Ride Customer Satisfaction & Travel Characteristics.* Denver, CO: Denver Regional Transit District (RTD).

Transportation Management & Design, Inc. (2008). *RTD Call-N-Ride Performance Review.* Denver, CO: Denver Regional Transit District (RTD).

Urbitran Associates, Inc., Multisystems, Inc., SG Associates, Inc., and Robert Cervero (1999). *TCRP Report 55: Guidelines for Enhancing Suburban Mobility Using Public Transportation.* Washington, DC: Transportation Research Board, National Research Council.

Unpublished Material

Appendixes to the contractor's final report for TCRP Project B-35 are not published herein but are available on the TRB website (www.trb.org) by searching for "TCRP Report 140". The appendix titles are the following:

- Appendix A: Flexible Public Transportation Survey Respondents
- Appendix B: Summary of Flexible Public Transportation Survey Responses
- Appendix C: Flexible Public Transportation Services Website Information

Abbreviations and acronyms used without definitions in TRB publications:

AAAE	American Association of Airport Executives
AASHO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
ACI–NA	Airports Council International–North America
ACRP	Airport Cooperative Research Program
ADA	Americans with Disabilities Act
APTA	American Public Transportation Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATA	Air Transport Association
ATA	American Trucking Associations
CTAA	Community Transportation Association of America
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
DHS	Department of Homeland Security
DOE	Department of Energy
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
HMCRP	Hazardous Materials Cooperative Research Program
IEEE	Institute of Electrical and Electronics Engineers
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITE	Institute of Transportation Engineers
NASA	National Aeronautics and Space Administration
NASAO	National Association of State Aviation Officials
NCFRP	National Cooperative Freight Research Program
NCHRP	National Cooperative Highway Research Program
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
PHMSA	Pipeline and Hazardous Materials Safety Administration
RITA	Research and Innovative Technology Administration
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005)
TCRP	Transit Cooperative Research Program
TEA-21	Transportation Equity Act for the 21st Century (1998)
TRB	Transportation Research Board
TSA	Transportation Security Administration
U.S.DOT	United States Department of Transportation