Guidebook for Measuring, Assessing, and Improving Performance of Demand-Response Transportation

DETAILS

123 pages | | PAPERBACK
ISBN 978-0-309-42050-1 | DOI 10.17226/23112

AUTHORS

TRANSIT COOPERATIVE RESEARCH PROGRAM

TCRP REPORT 124

Guidebook for Measuring, Assessing, and Improving Performance of Demand-Response Transportation

KFH Group, Inc.
Bethesda, MD

in association with

Urbitran Associates, Inc.
New York, NY

McCollom Management Consulting, Inc.
Darnestown, MD

Cambridge Systematics, Inc.
Bethesda, MD

Subject Areas
Public Transit

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

TRANSPORTATION RESEARCH BOARD

WASHINGTON, D.C.
2008
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.

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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 124

Project B-31
ISSN 1073-4872
ISBN: 978-0-309-09923-3
Library of Congress Control Number 2008921822

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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

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Printed in the United States of America

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CRP STAFF FOR TCRP REPORT 124

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Crawford F. Jencks, *Deputy Director, Cooperative Research Programs*
Dianne S. Schwager, *Senior Program Officer*
Eileen P. Delaney, *Director of Publications*
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Keith Gates, *FTA Liaison*
Pamela Boswell, *APTA Liaison*
Kristi Ross, *Other Liaison*
Peter Shaw, *TRB Liaison*

AUTHOR ACKNOWLEDGMENTS

The research conducted for this Guidebook was performed through TCRP Project B-31 by the KFH Group, Inc., with assistance from Urbitran Associates, Inc.; McCollom Management Consulting, Inc.; and Cambridge Systematics, Inc.

Elizabeth (Buffy) Ellis, AICP, of the KFH Group was the Principal Investigator for the project and primary author of the Guidebook. Ken Hosen and Samantha Erickson of the KFH Group and David Sampson and Jill Cahoon of Urbitran Associates assisted with the research and data collection from the DRT systems participating in the project. David Sampson also contributed to preparation of the chapter on improving performance. Brian McCollom of McCollom Management Consulting prepared much of the chapter on performance data and definitions. Robert Stanley of Cambridge Systematics contributed to the early efforts of the research. Sue Knapp and Ken Hosen of the KFH Group provided review and advice throughout the project.

The research team gratefully acknowledges the assistance and support of Dianne Schwager, TCRP Senior Program Officer for the project, and of the Project Panel, whose members provided valuable guidance and input. We would also like to sincerely thank the many DRT systems that participated in the research project for sharing their data, insights, and time with the research team. Their experiences with efforts to improve their own demand-response services and willingness to share those experiences enrich this Guidebook.

FOREWORD

By Dianne S. Schwager
Staff Officer
Transportation Research Board

TCRP Report 124: *Guidebook for Measuring, Assessing, and Improving Performance of Demand-Response Transportation*, will be of interest to public transportation systems that provide demand-response transportation (DRT) services and to the communities they serve. The Guidebook is a resource to assist DRT systems to measure, assess, and improve their performance, focusing on DRT in urban areas. A companion report is being prepared, through a continuation of this research, which focuses on DRT in rural areas.

Improving DRT performance requires an understanding of the characteristics of DRT and the environment within which it operates. Improving performance also requires that DRT systems measure where they are now and the progress of their performance over time. To do so, DRT systems need consistent data and clearly defined performance measures, which will facilitate their own internal assessment as well as comparisons of performance across the industry. Once DRT systems have assessed their performance and documented where they stand relative to their own service and compared to others, opportunities for improvement can then be considered.

The research conducted to develop this Guidebook included developing a typology of DRT systems in urban areas with categories based on criteria affecting performance; defining key performance data and a limited set of performance measures for DRT; identifying the various factors that influence DRT performance; collecting performance data from DRT systems representative of the defined categories; identifying policies, procedures, practices, and strategies—collectively referred to as management actions—that DRT systems have implemented to improve their performance; and documenting quantitative and qualitative effects on performance from those management actions.

The Guidebook addresses the diversity of DRT systems, service areas, and passengers; identifies the important controllable factors affecting DRT performance; and includes performance assessment methods based on reliable data and meaningful measures. Such assessment methods will allow relevant assessments of DRT performance over time and across DRT systems.

CONTENTS

CHAPTER 1

Introduction

Demand-response transportation (DRT) systems are under pressure to improve performance, with growing demand for service and increasing costs at many transit systems around the country.

Given the nature of DRT service, with relatively low productivity and corresponding high per-trip costs compared to fixed-route services, such pressures are not new. A 1976 report on DRT and other paratransit services found that one of the pressing issues for the then-new industry was finding ways of "reducing costs and increasing productivity."[1]

Improving performance, however, requires an understanding of the characteristics of DRT and the environment within which it operates. Improving performance also requires that DRT systems measure where they are now and the progress of their performance over time. To do so, DRT systems need consistent data and clearly defined performance measures, which will facilitate their own internal assessment as well as comparisons of performance across the industry. Once DRT systems have assessed their performance and documented where they stand relative to their own service and compared to others, opportunities for improvement can then be considered.

1.1 Objective of Guidebook

This Guidebook has been prepared under the TCRP Project B-31, "Guidebook for Measuring, Assessing, and Improving Performance of Demand-Response Transportation." The objective of the project was to develop a resource that assists DRT systems to measure, assess, and improve their performance, focusing on DRT systems in urban areas. A companion report is being prepared that focuses on rural DRT. As directed by the project's research panel, the Guidebook is also intended to address the diversity of DRT systems, service areas, and passengers; to identify the important controllable factors affecting DRT performance; and to include performance assessment methods based on reliable data and meaningful measures. Such assessment methods will allow relevant assessments of DRT performance over time and across DRT systems.

Research Approach

To meet the research panel's objectives, the research team followed a defined plan, which included the following efforts:

- Developing a typology of DRT systems in urban areas with categories based on criteria affecting performance;

[1] *Paratransit: Proceeding of a Conference November 9-12, 1975*, conducted by the Transportation Research Board and sponsored by the Urban Mass Transportation Administration, Special Report 164, Transportation Research Board, National Research Council, Washington, D.C., 1976, p 212.

- Defining key performance data and a limited set of performance measures for DRT;
- Identifying the various factors that influence DRT performance;
- Collecting performance data from DRT systems representative of the defined categories;
- Identifying policies, procedures, practices, and strategies—collectively referred to as management actions—that DRT systems have implemented to improve their performance; and
- Documenting quantitative and qualitative effects on performance from those management actions.

The results of the research efforts are documented in the Guidebook.

1.2 Guidebook Organization

The Guidebook has seven chapters. Chapters 2 through 4 cover the fundamentals of DRT performance assessment, such as definitions of performance data items included with the National Transit Database (NTD) and selection of performance measures for the Guidebook. Chapters 5 through 7 address more challenging aspects of the project's research, including development of the typology of DRT systems and collection and presentation of performance data from more than 35 DRT systems across the country. Readers of the Guidebook who are well-versed in DRT performance measurement and particularly NTD may find the latter chapters more useful.

Following this introductory Chapter 1, the Guidebook is structured as follows:

Chapter 2: DRT Performance—The Basics provides a framework for the Guidebook, with a brief background on DRT and its performance, establishing a starting point for the chapters that follow.

Chapter 3: Performance Data and Definitions addresses performance data, definitions, and data collection practices and procedures. This is a chapter with much detail, and readers not interested in the particulars of NTD terminology or data collection practices that lead to inconsistent data should skip to Table 3-1, which provides a listing of the key performance data and definitions for the Guidebook.

Chapter 4: Performance Measures identifies the limited set of measures used for the Guidebook, building on the key performance data discussed in Chapter 3.

Chapter 5: Assessing Performance—Typology of DRT Systems presents the categorization of DRT systems developed through the research project, with systems grouped into categories with similar characteristics that affect performance.

Chapter 6: Assessing Performance—Data from Representative Systems presents the performance data from the selected DRT systems representative of the different types of DRT, providing benchmark data for DRT systems.

Chapter 7: Improving Performance discusses the factors that influence DRT performance and presents selected policies, procedures, strategies, and practices i.e. *management actions* identified through the project's research by participating DRT systems as strategies and actions that improved performance. Quantitative and qualitative performance effects of these management actions are also presented.

CHAPTER 2

DRT Performance—The Basics

DRT and its performance are creating considerable interest within the public transit industry. But what exactly *is* DRT? Why is its performance important, particularly now? If performance is important, how is it measured and assessed for DRT? And once performance measures are calculated, then what?

This chapter provides a framework for the Guidebook, with a brief background on DRT and its performance, establishing a starting point for the chapters that follow.

2.1 Start at the Beginning: What *Is* DRT?

A Family of Definitions

Other DRT-related terms have been used, sometimes interchangeably to refer to various forms of public transit that are not traditional fixed-route, fixed-schedule transit services, but rather **respond** in some manner or form, to individualized requests or **demands** for transportation service.

DRT is actually a type of *paratransit service*; the latter encompassing a wide range of transit services defined, essentially, as services that are not conventionally scheduled, fixed-route transit services, but rather are those types of public transportation that fall in-between the private automobile and conventional fixed-route transit (see Figure 2-1).

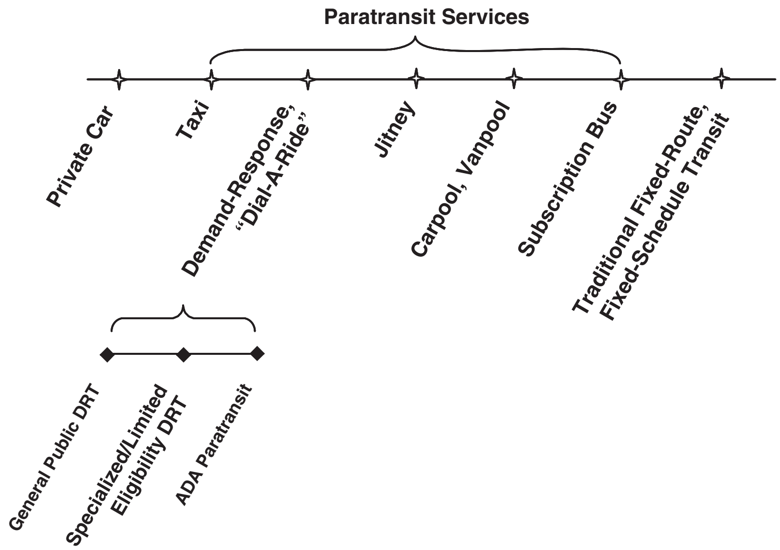
From a terminology standpoint, what may be confusing is that, since enactment of the Americans with Disabilities Act (ADA) in 1990, much of the focus of those of us concerned with DRT has turned to ADA complementary paratransit service. ADA paratransit is actually a *type* of DRT that fixed-route transit systems must provide to individuals with disabilities who cannot use fixed-route service because of their disability.

Paratransit, however, is the broadest term. DRT is a subset of paratransit, and ADA complementary paratransit is a subset of DRT.

DRT—Definitions

Building on the definitions from the earlier literature, DRT is characterized by its flexible routing, shared rides, and activation at the initiation of the rider by prior arrangement (as opposed to, for example, street hail for taxis).

The Federal Transit Administration (FTA) has defined DRT in the following way for purposes of NTD reporting:



Adapted from: "Paratransit—Neglected Options for Urban Mobility," Ronald F. Kirby, et al., The Urban Institute, 1974.

Figure 2-1. Paratransit: service between the private car and conventional fixed-route transit.

Demand-response is a transit mode comprised of passenger cars, vans or small buses operating in response to calls from passengers or their agents to the transit operator, who then dispatches a vehicle to pick up the passengers and transport them to their destinations. A demand-response (DR) operation is characterized by the following:

a. The vehicles do not operate over a fixed route or on a fixed schedule except, perhaps, on a temporary basis to satisfy a special need, and

b. Typically, the vehicle may be dispatched to pick up several passengers at different pick-up points before taking them to their respective destinations and may even be interrupted en route to these destinations to pick up other passengers.

DRT is also known by other terms, particularly in references and publications from earlier years: dial-a-ride, demand-activated transportation, demand-responsive transportation, dial-a-bus, shared-ride paratransit, flexible-route service, and flexible-transport services.

Given the range of the DRT definition, it follows that not all systems providing DRT are the same. One common way to distinguish DRT services is by the rider group or groups that are served. For example, DRT systems may serve the general public, or they may serve only specifically defined groups of riders, such as seniors and persons with disabilities, or "transportation disadvantaged persons," defined within a community to meet local objectives. And, since the early 1990s, there are many DRT systems that provide only ADA paratransit service. This notion of different types of DRT systems has been one focus of the research for this Guidebook, since differences in the type of DRT influence performance.

2.2 Why Measure DRT Performance?

In recent years, there has been growing attention on DRT, and systems around the country are under increasing pressure to improve performance because of escalating demand for service and financial constraints. Pressure to improve performance comes from transit boards; city and county councils; state departments of transportation; and transit managers, among others. Community members and riders may also create pressures for improved performance, should day-to-day service not always meet established objectives or riders' expectations.

While pressures to improve performance and address financial constraints are certainly not limited to DRT, the pressures may be more severe for DRT systems than for their fixed-route counterparts, given the significantly higher per-passenger trip costs for DRT: national data show that a passenger trip on DRT costs more than eight times that of a passenger trip on a bus (see Figure 2-2).

Moreover, efforts to improve DRT performance may increase demand, which then may require additional service and resources, in turn increasing rather than containing or decreasing operating costs. Unlike a fixed-route system that can absorb increased ridership (improved performance) on its routes until the buses are full and no more standees can fit (with a very low marginal cost per additional passenger trip), a DRT system may have to add resources to serve additional trips. Each new trip responds to a rider's individualized request, with a new origin and destination. The marginal cost of each additional trip may be as much as the full cost of a passenger trip.

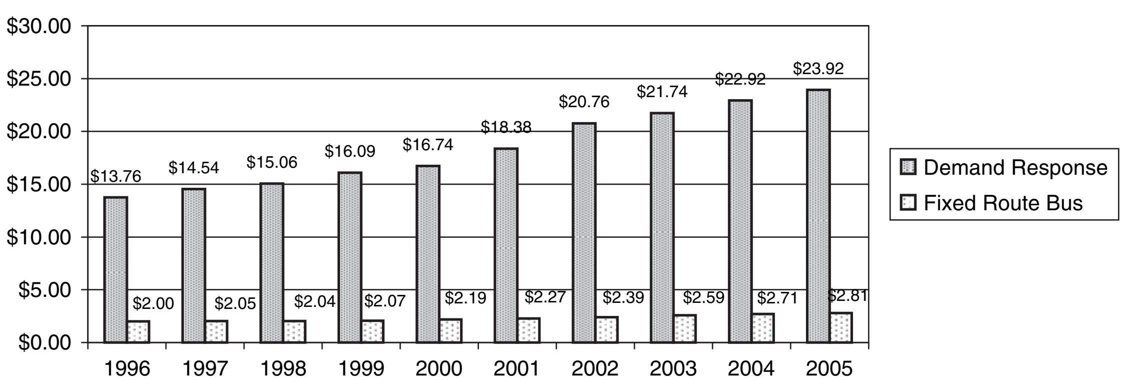
Responding to such pressure requires that, first, DRT systems measure their performance, establishing a baseline. DRT systems must then assess that performance, and depending upon the assessment, take additional steps, as appropriate, to improve performance.

Performance Measurement

Much has been written for the transit industry on performance measurement. *TCRP Report 88: A Guidebook for Developing a Transit Performance-Measurement System*, provides useful information to transit agencies and managers for developing a performance-measurement system, using traditional as well as less-traditional measures.

Essentially, the performance measurement process starts with establishing goals and objectives for service; identifying selected measures or indicators that capture key aspects of DRT service and operations; measuring performance through the collection and tabulation of the data needed to calculate the measures; assessing the resulting measures; and developing actions to address any deficiencies.

The process should also involve a feedback loop so that the goals and objectives are reviewed periodically after performance has been measured and assessed. It may be that, over time, a particular goal or objective needs to be adjusted based on service operations or changes to the overall environment within which the DRT system operates (see Figure 2-3).



Source: National Transit Database.

Figure 2-2. Operating cost per passenger trip, national data 1996–2005.

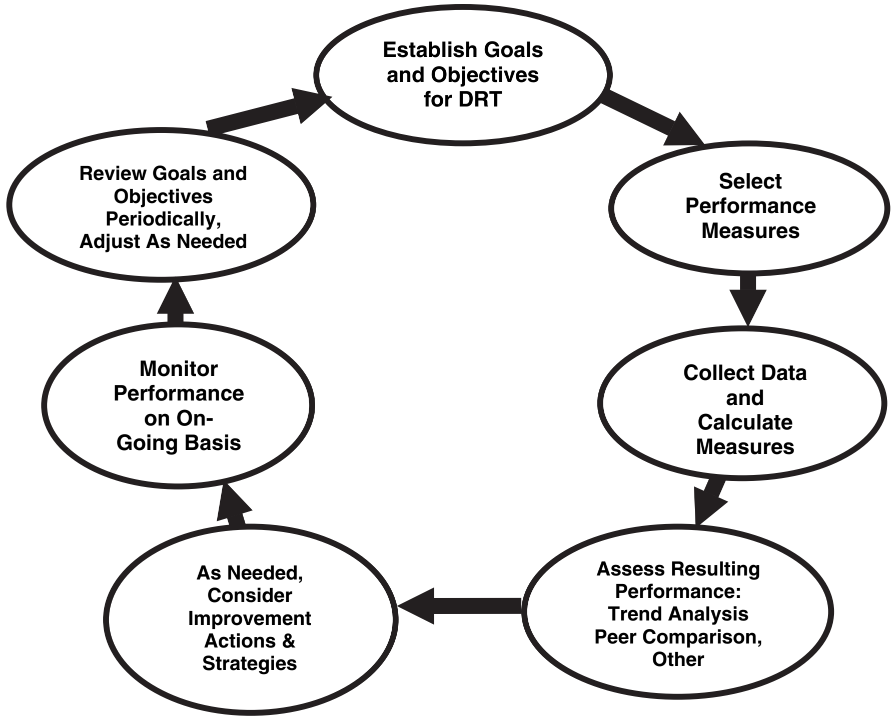


Figure 2-3. DRT performance measurement process.

For purposes of this Guidebook, another step in the performance assessment process for DRT is developing clear definitions for the performance data and for performance measures. DRT systems do not always use the same definitions for data elements, nor do they calculate performance measures in the same way. For example, some systems calculate their productivity using *total vehicle hours* as the denominator and others use *revenue hours*. Comparisons between DRT systems that use these different calculations for determining productivity are less meaningful since the measures are not measuring the same thing.

Some of the differences in both terminology and calculation of measures have arisen over time, and some have come through common software applications and new calculations now possible with the powerful data capabilities of computer-assisted scheduling and dispatch systems that many DRT systems commonly use. It is perhaps even more important to now establish commonality of terms and definitions, as the use of software proliferates and opportunities created for yet new terms and calculation practices.

2.3 Measuring DRT Performance—Issues and Complications

While the chart depicted in Figure 2-3 seems relatively straightforward, the process of measuring DRT performance can be complicated for a variety of reasons.

First, there is the issue of inconsistent data and data collection:

- Data definitions vary. What one DRT system uses to compute a performance measure, miles, for example, may differ from another; the first system may use a figure based on odometer readings, while another calculates miles from pull-out in the morning to pull-in later in the day. Which definition is the right one to use?

- Data collection is not always rigorous. DRT systems that contract some service to taxi companies count the passenger trips provided by taxis, but not necessarily the revenue time, since taxi companies typically charge by mileage rather than time and may not report the time. When the DRT system computes its productivity, the figure will be somewhat overstated, as the taxi passenger trips are included, but the revenue time is not. Or a DRT system may count only its ADA riders when totaling up its passenger trips. If it does not also include the companions and Personal Care Attendants (PCAs), its productivity will be somewhat understated.

Second, DRT performance is affected by the type of riders it serves, its operating environment and other factors, some of which cannot be controlled. How can performance measurement account for such variables?

- The different types of DRT systems have differing characteristics that affect their operations and resulting performance. A DRT system serving the general public in a small community has a different operating environment than does an ADA paratransit system serving a major metropolitan region, and the performance of the two systems will differ.
- Various factors impact DRT performance, and some of these are outside the control of the DRT system. A DRT system that serves a large geographic area with a wide dispersion of origins and destinations will have longer trip lengths than a system that serves a more compact service area with shorter trip lengths. Systems with longer trip lengths will not be able to serve as many passenger trips in a given amount of time, thus their productivity (as measured by passenger trips per hour) will be lower.

Third, goals and objectives for a DRT system may be contradictory, establishing a service dynamic where efforts to achieve one objective adversely affect achievement of another. In a similar way, policies and procedures may also influence performance in contradictory ways.

Examples of contradictory objectives can be found at many DRT systems:

- *Maximizing Productivity versus Achieving High On-Time Performance (OTP)*
  Operationally, if the DRT system schedules passenger trips tightly in an effort to maximize the number of passenger trips served within a given number of service hours, OTP is likely to suffer as actual service on the street may not meet the tight schedule: riders may take longer to get out to the vehicle for their trip than was planned; they may take longer to board than planned; the operator may take extra time getting to a pick-up location because he or she took a wrong turn; traffic may be worse that day; and so on. All of these will serve to undermine a tightly developed schedule and adversely impact on-time performance.
- *Minimizing Telephone Response Time for Trip Reservations versus Maximizing Customer Service*
  DRT systems often establish an objective that a certain percentage of calls for reservations should be answered within, for example, 2 or 3 min. However, depending on call volume and the number of call-takers, this may force call-takers to abbreviate some calls. To the extent that riders need more time on the phone to explain their trip needs or if they have special needs, the response time objective may work at cross purposes toward an objective of maximizing customer service.

Finally, DRT systems may also have policies, practices, or procedures that are contradictory. Examples include:

- *Having operators wait up to 10 min at pick-up locations for riders versus ensuring travel times are not lengthy.*
  If a DRT system routinely has its vehicles wait for longer periods of time at pick-up locations, either because of the established wait time or because riders are slow in appearing for their trips, the travel times of other riders already on the vehicle will be adversely affected.

- *Defining a 30-min on-time window for timely vehicle arrival versus having call-takers inform riders once their trips are booked: "the vehicle will come 15 min before to 15 min after the scheduled time."*

  Many DRT systems do not adequately educate and inform their passengers regarding when to be ready for their pick-ups and how the "on-time window" works in practice. Once a rider schedules her 9:00 a.m. pick-up time and is told, "You need to be ready 15 min before to 15 min after the scheduled time for your vehicle to arrive," what she likely remembers is her scheduled time—9:00 a.m.—not 8:45 a.m. and 9:15 a.m. Experience has shown that many DRT riders believe that the vehicle is *early* if it arrives 15 min before their scheduled time (after all, it's before the scheduled time) and in some cases, the rider will not be ready to depart. When this happens, the rider may be deemed a no-show, which then may require the DRT system to schedule another vehicle to go back and pick up the rider later. Or the operator may be instructed to wait for the rider, typically longer than the established wait time. In both cases, performance is negatively impacted.

A DRT system may not be able to establish completely balanced and complementary objectives, policies, and procedures, given the nature of public transportation in general and DRT in specific. But clarity in establishing those objectives, policies, and procedures is important for effective performance measurement. If a DRT system strives to achieve a very high OTP percentage, for example, it should be clear that this will likely have a negative effect on productivity, other things being equal.

Beyond clarity in establishing objectives for the DRT system, it is also important to understand the characteristics and factors that influence an individual DRT system, only some of which can be influenced or "controlled" by a DRT system.

Understanding Characteristics and Factors Influencing DRT Performance

Understanding the different service characteristics and factors that influence DRT performance may help the DRT manager and DRT governing body put their system's actual performance into a more realistic perspective. Understanding the sometimes-conflicting nature of objectives, policies and procedures may help the DRT system focus on those most important areas or at least recognize that achievement in one performance area may hamper achievement in another. This Guidebook can serve to help DRT managers and policy makers with that understanding. Chapter 7 of the Guidebook includes information on the specific factors that influence DRT performance, identifying those that DRT systems can influence to improve performance. And, as any DRT manager knows, there are some factors that cannot be influenced, but rather should be recognized for their impact on service and performance.

Beyond helping with this understanding, a primary goal of the Guidebook is to provide a how-to resource for DRT performance measurement. What are the key data that should be used? How are the data elements defined and what data are used for what measures? And once the performance data are calculated, what's next?

The Guidebook provides sample data from a wide range of DRT systems from around the country, providing reference points for DRT systems assessing their own performance. Additionally, there is information gleaned from these sampled systems about actions and strategies to improve performance. Again, these data can serve as reference points for other DRT systems interested in similar types of actions that can be considered for improving performance.

Remember the Big Picture

Since the topic of DRT performance measurement necessarily involves such details as how to measure revenue hours, the mechanics of the process may sometimes overshadow the big picture.

For DRT systems, that big picture involves providing transportation to community members who, for different reasons, need the more personalized transportation provided by a demand-response system or, in communities with fixed-route service, may not always be able to use this more traditional transit service. But providing transportation can involve more than operating DRT service day-to-day. It may also involve working with other community organizations to support other specialized transportation services in the area. If the DRT system is part of a larger transit organization, it means that DRT managers work together with their fixed-route counterparts to ensure that the transit system as a whole is available and accessible to all community members.

Moreover, the big picture also means that the DRT system must operate within its policy, financial, and environmental framework. Measuring performance is an important way for the DRT system to chart its course within that framework.

CHAPTER 3

Performance Data and Definitions

To help improve consistency in data definitions and reporting for DRT, this chapter addresses performance data, definitions, and data collection practices and procedures. Practices that lead to inconsistencies are also outlined. Terms and definitions established through the Federal National Transit Database (NTD) are used where appropriate.

For those readers not interested in the details of DRT terminology and data collection, Table 3-1 provides a listing of DRT terms and definitions used for the Guidebook.

3.1 A Trip Is A Trip Is . . . Not Always A Trip

It's not just the term "trip" that may have multiple meanings across DRT systems. Other terms, including miles, hours, passengers, and cancellations have different meanings at different DRT systems. Some of these data are included and reported through the NTD, which provides specific definitions for its terms. The NTD publishes an annual Reporting Manual to assist systems in reporting the data. Despite this, variations exist across DRT systems, affecting comparisons across DRT systems.

Beyond NTD, other data are used for assessing DRT operations and performance, such as cancellations, no-shows, and missed-trips—and the definitions vary. At one system, for example, "missed-trips" includes not only trips where the vehicle never showed up, but also late trips that do show up and transport the rider, with this subset termed "missed but transported."

This chapter addresses performance data used in DRT in two categories—those data elements included in the NTD and those not included (see Table 3-2). Procedures related to data collection are also addressed.

3.2 NTD Data and Definitions for DRT Performance Assessment

NTD–Standardized Data and Definitions for Transit Systems in Urban Areas

All public transit systems that receive funds or benefit from the FTA's Urbanized Area Funding Program (Section 5307) are required to file an annual NTD report. The data required for this report are defined in the annual NTD reporting manual for all transit modes including DRT. (The annual Reporting Manual is published each year and is available on the NTD website at www.ntdprogram.gov).

Table 3-1. DRT terms and definitions used for the guidebook.

Revenue Hours	Revenue hours include all time from the point of the first passenger pick-up to the last passenger drop-off, as long as the DRT operator and vehicle do not return to the dispatching point (e.g., the garage or some other location such as a satellite location or the operator's home) having completed the operator's work assignment. Revenue hours do not include scheduled time off such as operator lunch breaks. (NTD definition)
Revenue Miles	Revenue miles are the distance traveled from the point of the first passenger pick-up to the last passenger drop-off, as long as the DRT vehicle does not return to the dispatching point. Revenue miles do not include travel during scheduled time off such as driver lunch breaks. Revenue miles correspond to revenue hours. (NTD definition)
Vehicle Hours	Vehicle hours cover the time from when a transit vehicle starts (pull-out time) from a garage (or other storage location) to go into revenue service to the time it returns to the garage (pull-in time) after completing its revenue service, as long as the DRT vehicle does not return to the dispatching point. Vehicle hours do not include scheduled time off such as vehicle operator lunch breaks. (NTD definition)
Vehicle Miles	Vehicle miles cover the distance traveled from when a transit vehicle starts (pull-out) from a garage (or other storage location) to go into revenue service to the time it returns to the garage (pull-in time) after completing its revenue service, as long as the DRT vehicle does not return to the dispatching point. Vehicle miles do not include travel during scheduled time off such as vehicle operator lunch breaks. Vehicle miles correspond to vehicle hours. (NTD definition)
Passengers	The NTD term for passengers, or ridership, is unlinked passenger trips (UPT). UPT are the number of passengers who board public transportation vehicles. Passengers are counted each time they board vehicles no matter how many vehicles they use to travel from their origin to their destination. Personal Care Attendants (PCAs) and companions are counted as passengers on DRT as long as they are not employees of the transit system. (NTD definition) The Guidebook uses the term *passenger trips*.
Passenger Miles	Passenger miles are the cumulative sum of the distances ridden by passengers on transit vehicles. (NTD definition)
Operating Expense (Cost)	Operating expenses are the day-to-day operating costs of a transit agency such as labor, fuel, vehicle parts, and utilities. Includes consumable items with a useful life of less than one year or an acquisition cost which equals lesser of (1) the capitalization level established by the government unit for financial statement purposes or (2) $5,000. (NTD definition)
Accident	The NTD term for accidents is *incidents*. An incident is an event and can involve multiple people and vehicles. An event is defined as a safety incident if it involves a transit vehicle or occurs on transit-controlled property and meets specific NTD-defined thresholds, which determine if the incident is *major* or *non-major*. (NTD definition)
On-Time Trip	A trip where the vehicle arrives at the scheduled pick-up (or drop-off) location within the DRT system's definition of *on-time*, often a "window" of time. Many DRT systems include early trips within the count of on-time trips.
Requested Trips	Passenger trips that eligible DRT individuals or their agents ask for.
Scheduled Trips	Trips that are placed onto vehicle schedules for service the next day, including any "excess" trips that are to be placed onto schedules.
Completed Trips	Trips where a passenger was transported from an origin to a destination. A completed trip may carry more than one passenger, if there are two or more passengers traveling from the same origin to the same destination.
Cancellation	A deletion of a trip that has been reserved or scheduled for a passenger. Cancellations can be categorized as:*advance*, *same-day*, and *late*.
Advance Cancellation	A cancellation made before the day of service.
Same-Day Cancellation	A cancellation made on the day the trip is scheduled to occur. Same-day cancellations include trips cancelled early in the day, possibly hours before their scheduled time, as well as trips cancelled with less notice.
Late Cancellation	A cancellation made shortly before the scheduled trip is to occur. The exact time that a cancellation becomes a *late* cancellation for a particular DRT system will depend on DRT policy.
No-Show	A failure of a rider to show up for a scheduled trip at the scheduled time and location, when the vehicle has arrived within the DRT system's definition of *on-time*, and the rider has not cancelled the trip in advance. If a rider cancels the trip at the door when the vehicle arrives, this is also counted as a no-show, though some systems report such occurrences as a subset of no-shows.

(continued on next page)

Table 3-1. (Continued)

Missed Trip	A failure of the vehicle to show up for a scheduled trip. A missed trip can also be defined to include a trip that arrives late, and because of that lateness, the passenger is no longer there for the trip or declines to take the trip. In both cases, the trip is not completed.
Trip Denial	A DRT trip requested by a passenger, but that the DRT system is not able to provide, typically because capacity is not available at the particular requested time.
Trip Length	The distance, measured in miles, from the passenger pick-up to drop-off location. The sum of all passengers' trip lengths is an NTD data element, *passenger miles,* and must be included with DRT systems' annual NTD reports.
Travel Time	The time that the passenger spends on-board the vehicle from time of boarding to arrival time at the destination.
Complaints	An expression of dissatisfaction by a passenger or the passenger's agent over some aspect of the DRT service. DRT systems generally monitor complaints related to service and those over which they control day-to-day.

FTA also makes the reported NTD data available to the public. Since 1997, FTA has posted these data on the Internet at the NTD program site. Using the posted electronic spreadsheets and databases, the performance data of the many transit systems within the NTD databases, including DRT systems, can be accessed.

Beginning in 2006, public transit systems that receive funds from the FTA's Non-Urbanized Area Funding Program (Section 5311) are also required to file an NTD report. This means that rural systems (Section 5311), in addition to urban systems (Section 5307), must file an annual report summarizing transit service and safety data. The reporting requirements for rural systems, however, are tailored to the smaller size of the typical public transportation system in rural areas, while still providing enough information to assess rural services.

The key NTD performance data, identified through earlier project efforts, are discussed below.

Key NTD Performance Data

Revenue Hours, Revenue Miles, Vehicle Hours, and Vehicle Miles

The key to understanding the NTD definitions for these terms is the proper consideration of revenue and deadhead operations.

Revenue service is when the transit vehicle is providing public transportation and is available to carry passengers. Revenue service excludes transportation activities such as exclusive school bus service and charter service. Vehicles operated in fare-free service are considered in revenue service. In some states, revenue hours and miles are called vehicle service hours and miles. The NTD definition of revenue service is based on the operations of fixed-route bus service. Revenue service is defined as the service (miles and hours operated) going from the beginning to the end

Table 3-2. DRT performance data.

DRT Performance Data Included in NTD	DRT Performance Data Not Included in NTD
Revenue Hours	On-Time Trips
Revenue Miles	Requested Trips
Vehicle Hours	Reserved Trips
Vehicle Miles	Scheduled Trips
Unlinked Passenger Trips	Completed Trips
Operating Expense (Cost)	Cancellation
Accidents/Incidents	No-Show
	Missed Trip
	Trip Denial
	Trip Length
	Travel Time
	Complaints

of the bus route and back again. It includes the small amounts of time scheduled as layover/recovery time, typically at both ends of the route. However, revenue service excludes scheduled breaks such as lunch, and it does not include vehicle operator training or maintenance testing. It is related only to passenger service.

Deadhead is the operating time needed to move a transit vehicle before revenue service begins and after revenue service ends. When transit vehicles are deadheading, they operate closed-door and are not available to passengers. Deadhead in fixed-route services can involve travel between the garage and the beginning of a route at the start of the day and back again at the end of the day.

The application of this fixed-route concept to DRT required some adjustments in the definition. Revenue time includes all travel and time from the point of the first passenger pick-up to the last passenger drop-off, as long as the vehicle does not return to the dispatching point. The idea behind this NTD concept is that the DRT vehicle is fully and efficiently scheduled and is transporting passengers between the first passenger pick-up and the last passenger drop-off. While there may be periods of time when there are no passengers riding or the vehicle is stopped, these periods are unavoidable and are similar to scheduled layover/recovery time on fixed-route services.

The NTD definition uses the term *dispatching point* to mean that the DRT operator and vehicle have returned to either the garage or some other location (e.g., a satellite garage or the operator's home) and have completed the operator's work assignment. The operator may have a scheduled time off or is paid stand-by time and is waiting for a passenger to make a real-time request for service.

The scheduled time off may include a meal break. This scheduled time off does not cover operators who quickly grab something to eat as they travel between pick-up and drop-off points, but are not provided a reasonable lunch break.

Vehicle hours and miles cover the time and travel from when a transit vehicle starts (pull-out time) from a garage to go into revenue service to the time it returns to the garage (pull-in time) after completing its revenue service. Since vehicle hours and miles cover the time and travel between pull-out and pull-in, it therefore includes both deadhead and revenue service. In some states, vehicle hours and miles are called total service hours and miles. The specific definitions follow.

Revenue Hours

Definition: Revenue hours include all time from the point of the first passenger pick-up to the last passenger drop-off, as long as the DRT vehicle does not return to the dispatching point. Revenue hours do not include scheduled time off such as driver lunch breaks.

Discussion of Definition: Revenue service occurs when the DRT vehicle is providing public transportation and is available to carry passengers. For DRT service, there may be periods of time when there are no passengers riding or when the vehicle is stopped and waiting to proceed to the next pick-up. This time is considered revenue time as long as the vehicle operator does not return to the dispatching point. Scheduled time off is typically a lunch break, but this does not include the time it might take for an operator to quickly grab something to eat when traveling between pick-up and drop-off points.

The NTD does not provide an extensive definition of a dispatching point. It is understood that the dispatching point can be either the transit system's garage or another location where the operator is waiting for an unscheduled passenger trip assignment. When the operator is at the dispatching point, some transit systems would schedule time off for the operator. Other systems, however, would continue to pay the operator for his time waiting for another passenger trip assignment. In either case, revenue hours should not be recorded.

If **volunteers** are used to provide DRT service, their time is counted as revenue time, using the same definition, that is, the time from the point of the first passenger pick-up to the last passenger drop-off, exclusive of any scheduled time off. If a volunteer driver accompanies the passenger to an appointment, for example a medical appointment, as part of the trip, the time spent at the medical appointment is counted in the same way as scheduled time off; it is not counted as revenue time.

Where DRT service is provided by **taxis** or other providers that are not exclusively providing DRT service (referred to as non-dedicated providers), revenue time is counted the same way, that is, the time from the first passenger pick-up to the time of last passenger drop-off. Often taxis are used to provide DRT trips on a trip-by-trip basis. In such cases, revenue time is simply the time from the passenger pick-up to that passenger's drop-off. However, if taxi service is scheduled to operate with no breaks and be available for DRT service for a part of a day, such as during specific late night hours, then the hours that are dedicated to DRT service are counted as revenue time, using the same definition as above.

Data Collection: Revenue hour data are obtained from driver logs or Mobile Data Terminals (MDTs), which should be configured so that vehicle operators report the actual times that they go into and out of revenue service. For taxi or other non-dedicated service, the taxi or other provider company should be required to report the time from passenger pick-up to passenger drop-off for all trips it provides for the DRT system.

Some DRT systems that use taxis on a limited, supplemental basis through a non-dedicated arrangement neglect to include the revenue time accumulated by the taxi trips when calculating total revenue time, perhaps because taxi companies may not report *time* data. However, such omission will result in an under-reporting of revenue time. When certain performance measures are later calculated, for example, productivity, this will mean the productivity figure is somewhat over-stated if the taxi trips are included, but the taxi revenue time is not.

For those DRT systems that report revenue hour data through their CASD systems, it is important that the right definition be used and system parameters set accordingly so that the correct time is being reported.

Revenue Miles

Definition: Revenue miles are the distance traveled from the point of the first passenger pick-up to the last passenger drop-off, as long as the DRT vehicle does not return to the dispatching point. Revenue miles do not include travel during scheduled time off such as driver lunch breaks. Revenue miles correspond to revenue hours.

Discussion of Definition: For DRT service, the vehicles may travel between a drop-off and a pick-up when there are no passengers riding; even though there is no passenger on-board, the miles traveled are considered revenue miles as long as the operator does not return to the dispatching point or does not have scheduled time off.

The use of paid or **volunteer drivers** is not a factor in determining revenue miles. If volunteers are used to provide DRT service, the miles that they drive between the first passenger pick-up and the last passenger drop-off are counted as revenue miles.

Where DRT service is provided by **taxis or other non-dedicated providers,** revenue miles are counted the same way, that is, the miles operated from the first passenger pick-up to the last passenger drop-off. Often taxis are used to provide DRT trips on a trip-by-trip basis. In such case, revenue miles are simply the miles operated from the passenger pick-up to that passenger's drop-off. However, if taxi service is scheduled to operate with no breaks and be available for DRT service for a part of a day, for example, during specific late night hours, then the miles operated are counted as revenue miles, using the same definition as above.

Data Collection: Revenue mile data are obtained from driver logs or MDTs, which should be configured so that vehicle operators record the actual odometer readings when they go into and out of revenue service. For volunteer services, reporting forms should be developed that will capture revenue miles. For non-dedicated service such as taxi services, arrangements with the taxi company will need to include requirements that vehicle operators report the mileage between the pick-up and drop-off locations, if such data are not routinely collected. These data would then be included on the taxi company invoice to the DRT system. While some DRT systems that use taxis for non-dedicated service check the taxi-reported data using mapping software that calculates distance between two locations, such calculated mileage cannot be used for NTD reporting; NTD requires that actual miles be reported.

As noted above for the collection of revenue hour data, for those DRT systems that report revenue miles data through their CASD systems, it is important that the right definition be used and system parameters set accordingly so that the *correct* mileage is being reported.

Vehicle Hours

Definition: Vehicle hours cover the time from when a transit vehicle starts (pull-out time) from a garage (or other storage location) to go into revenue service to the time it returns to the garage (pull-in time) after completing its revenue service, as long as the DRT vehicle does not return to the dispatching point. Vehicle hours do not include scheduled time off such as vehicle operator lunch breaks.

Discussion of Definition: Vehicle hours cover the time when the DRT vehicle is being operated from the garage pull-out time to garage pull-in time. It is the sum of two types of hours:

- Revenue hours that cover the operating time between the first passenger pick-up and the last passenger drop-off, and
- Deadhead hours that cover the times between garage pull-out and the first passenger pick-up and between the last passenger drop-off and garage pull-in.

Vehicle hours do not cover transportation activities such as exclusive school bus service and charter service.

For DRT service, vehicle hours cover the time from garage pull-out to garage pull-in as long as the DRT vehicle does not return to the dispatching point or the vehicle operator does not have scheduled time off.

If **volunteers** are used to provide DRT service, their time is counted as vehicle hours, using the same definition, that is, the time from garage (or other storage location) pull-out to garage pull-in, exclusive of any scheduled time off. If a volunteer driver accompanies the passenger to an appointment, for example, a medical appointment, as part of the trip, the time spent at the medical appointment is counted in the same way as scheduled time off; it is not counted as part of vehicle hours.

Where DRT service is provided by **taxis or other non-dedicated providers,** vehicle hours are counted the same way as revenue hours, that is, the time from the first passenger pick-up to the time of last passenger drop-off. This means that revenue hours and total hours for non-dedicated service will be the same number. However, if taxi service is scheduled to operate with no breaks and be available for DRT service for a part of a day, for example, during specific late night hours, then the hours that are dedicated to DRT service are counted as vehicle hours, using the same definition as above.

Data Collection: Vehicle hour data are obtained from driver logs or MDTs, which should be configured so that vehicle operators report the actual times that they leave the garage at pull-out and return at pull-in. For volunteer services, reporting forms should be developed that will capture the vehicle hour time. For non-dedicated service such as taxi services, arrangements with the taxi company will need to include requirements that vehicle operators report pick-up and drop-off times, if such data are not routinely collected. These data would then be included on the taxi company invoice to the DRT system.

Some DRT systems mistakenly compute vehicle hour data from operator time records, that is, they report total vehicle hours as the sum of operator pay hours. This is not correct. Vehicle hours, per the NTD definition, include only the time from vehicle pull-out to vehicle pull-in, minus scheduled breaks, and it does not include such time as that needed for pre-trip or post-trip inspections.

Vehicle Miles

Definition: Vehicle miles cover the distance traveled from when a transit vehicle starts (pull-out) from a garage (or other storage location) to go into revenue service to the time it returns to the garage (pull-in time) after completing its revenue service, as long as the DRT vehicle does not return to the dispatching point. Vehicle miles do not include travel during scheduled time off such as vehicle operator lunch breaks. Vehicle miles correspond to vehicle hours.

Discussion of Definition: Vehicle miles cover the distance traveled by the DRT vehicle from the garage pull-out time to garage pull-in time. It is the sum of two types of miles:

- Revenue miles that cover the distance traveled between the first passenger pick-up and the last passenger drop-off, and
- Deadhead miles that cover the distance traveled between garage pull-out and the first passenger pick-up and between the last passenger drop-off and garage pull-in.

Vehicle miles do not cover transportation activities such as exclusive school bus service and charter service.

If **volunteers** are used to provide DRT service, their distances traveled are counted as vehicle miles, using the same definition, that is, the distances traveled from garage (or other storage location) pull-out to garage pull-in, exclusive of any scheduled time off.

Where DRT service is provided by **taxis or other non-dedicated providers,** vehicle miles are counted the same way as revenue miles, that is, the time from the first passenger pick-up to the time of last passenger drop-off. However, if taxi service is scheduled to operate with no breaks and be available for DRT service for a part of a day, for example, during specific late night hours, then the miles operated as part of the DRT service are counted as vehicle miles, using the same definition as above.

Data Collection: Vehicle miles data are obtained from driver logs or MDTs, which should be configured so that vehicle operators report the odometer readings when they leave the garage at pull-out and return at pull-in. For volunteer services, reporting forms should be developed that will capture the vehicle miles. For non-dedicated service such as taxi services, arrangements with the taxi company will need to include requirements that vehicle operators report pick-up and drop-off odometer readings, if such data are not routinely collected. These data would then be included on the taxi company invoice to the DRT system.

Regarding the reporting of revenue hours and miles and vehicle hours and miles, there are several errors that can be made when the statistics are reported that lead to data inconsistencies. These include:

- **Estimation of hours and miles data.** NTD requires the direct recording of revenue and vehicle hours and miles. Some reporters incorrectly assume that estimated values can be reported as NTD allows for reporting unlinked passenger trips and passenger miles. This error occurs most frequently for contracted taxi service where the contract does not require the taxi company to record and report these data.

- **Incorrect treatment of lunches and breaks.** Some transit systems only follow the general rule that revenue service starts at the time of the first passenger pick-up and ends at the last passenger drop-off. These systems do not subtract scheduled lunches and breaks as is required by NTD. Therefore, these systems overstate revenue and vehicle hours.
- **Incorrect use of dispatching point.** Some transit systems exclude breaks in service when the vehicle does not return to a dispatching point or others may count revenue time as only that time when a passenger is on board. These systems will be underreporting revenue hours.

Passengers

Definition: The NTD term for passengers, or ridership, is unlinked passenger trips (UPT). UPT are the number of passengers who board public transportation vehicles. Passengers are counted each time they board vehicles no matter how many vehicles they use to travel from their origin to their destination. PCAs and companions are counted as passengers on DRT as long as they are not employees of the transit system.

Discussion of Definition: Because there is typically little to no transferring of passengers in DRT service, the number of unlinked passenger trips is equal to the number of people transported for most DRT systems.

PCAs and companions are counted as passengers on DRT as long as they are not employees of the transit system. Attendants and companions are included regardless of whether or not they are fare-paying passengers.

Transit system employees are not counted as passengers if they are performing work duties that require traveling on the vehicles and are being paid while traveling. Examples of these work duties are conducting surveys, observing vehicle operations, or serving as an on-board aide or assistant for the passengers. However, transit system employees are counted as passengers if they are traveling for personal reasons including commuting to and from work.

Since there is little or no transferring of passengers on DRT services, use of the term "passenger trips" is more common than "unlinked passenger trips." However, when "passenger trips" is shortened to "trips," this introduces a definitional issue, since "trips" is often used to mean "vehicle trips," not "passenger trips." For improved clarity, this Guidebook uses the term passenger trips when referring to riders' trips or ridership.

There can be inconsistent reporting of passenger trips by DRT systems, with the two most common problems being:

- **Incorrect definition of passengers.** Some reporters incorrectly define passengers in one of the following manners: all fare-paying passengers, ADA-certified riders only, all persons boarding not including children, and all persons boarding not including PCAs and companions.
- **Estimation of ADA UPT.** NTD requires the reporting of UPT attributable to ADA paratransit requirements. This is an issue for transit systems that provide DRT service to riders who do not meet the ADA requirements and report ADA UPT that are less than the UPT reported for the entire DRT service. Some transit systems report only ADA-certified riders. Others include riders certified locally in other categories that may or may not be eligible for ADA-certification such as senior citizens. Finally, some transit systems report ADA UPT that is based on a management estimate typically expressed as a percentage of total UPT. Often the same percentage is used for every NTD report.

Data Collection: Passenger data are obtained from driver logs or MDTs, which should be designed so that vehicle operators record the number of passengers boarding at each pick-up location. For volunteer services, reporting forms should be developed that will capture passenger counts. For non-dedicated service such as taxi services, contract arrangements with the taxi company need to include requirements that vehicle operators report the number of passengers boarding at each pick-up location, if such data are not routinely collected. These data would then be included on the taxi company invoice to the DRT system.

Passenger Miles

Definition: Passenger miles are the cumulative sum of the distances ridden by passengers on transit vehicles. This is an NTD definition.

Discussion of Definition: Passenger miles constitute the second measure of service consumed by transit users after unlinked passenger trips. This measure tracks the distance traveled by each passenger, namely, the distance from the time of boarding until the time of getting off the vehicle.

The annual totals for passenger miles are used in some performance analyses, for example, to assess service effectiveness of fixed-route transit. When it is compared to seat miles, a measure of capacity, an assessment can be made of capacity utilization. This data element is not generally used for assessing DRT system effectiveness, which is more commonly measured by relating passenger trips to revenue hours (productivity). However, passenger mile data often is used to compute average trip length, which is a local external factor that affects DRT productivity.

The NTD requirements for the collection and reporting of passenger miles are identical to those for unlinked passenger trips. If available and reliable, 100% counts of passenger miles must be reported. Many DRT systems collect and report 100% counts; computerized scheduling/dispatch systems can ease this data collection and reporting. If 100% counts are not available and reliable, the passenger mile values must be estimated and reported based on statistical sampling. The FTA requirements are a minimum confidence of 95% and a minimum precision level of ±10%.

The circular *FTA C 2710.2A Sampling Procedures for Obtaining Demand Responsive (DR) System Operating Data Required under the Section 15 Reporting System* provides instructions for meeting the FTA requirements for passenger miles. However, transit systems may use any other procedure that is approved by a qualified statistician that meets the FTA requirements. (A copy of the circular can be found on the NTD website at www.ntdprogram.gov).

There can be inconsistent reporting of passenger miles by transit systems. These problems are similar to those for unlinked passenger trips. The two most common problems are:

- **Incorrect definition of passengers.** Some reporters incorrectly define passengers in one of the following manners: all fare-paying passengers, ADA-certified riders only, all persons boarding not including children, and all persons boarding not including PCA and companions. Therefore, they report only passenger miles for these incorrect definitions of passengers.
- **Improper administration of sampling plans.** The sampling plans generally involve the random selection of vehicles. Sometimes transit systems use processes that appear to them to be more representative than random selection procedures. For example, transit systems may choose to sample a vehicle because it has not been selected by the random process in the last 6 months and it is felt that the vehicle should have been selected.

Data Collection: Two types of data collection can be used to collect passenger mile data. When a system chooses to do 100% data recording, passenger mile data are obtained from driver logs or MDTs, which should be designed so that operators record the number of passengers boarding, the number of passengers alighting, and the vehicle odometer reading at each pick-up location. For volunteer services, reporting forms should be developed that will capture these three data items. For non-dedicated service such as taxi services, contract arrangements with the taxi company need to include requirements that drivers report the number of passengers boarding at each pick-up location, if such data are not routinely collected, along with trip distances. These data would then be included on the taxi company invoice to the DRT system.

The other data collection option is sampling. In this approach, the same three data items are collected on a selected sample of trips.

Operating Expense (Cost)

Definition: Operating expenses are the day-to-day operating costs of a transit agency such as labor, fuel, vehicle parts, and utilities. The accounting definition defines operating expenses as NTD defines operating costs, that is, consumable items with a useful life of less than 1 year. Items with useful lives greater than 1 year are defined as capital assets. The NTD definition requires that the operating expenses be recorded on an accrual basis to ensure that operating expenses are properly matched against the service provided and passengers served.

Discussion of Definition: The NTD allows some capital items with low unit costs to be "expensed" or treated as operating costs even though these assets have a useful life greater than one year. The criterion for these capital items is that the unit acquisition cost equals the lesser of:

- The capitalization level established by the government unit for financial statement purposes, or
- $5,000.

Some transit systems operate several modes of transit service including DRT. It is important for purposes of performance measurement and analysis that the operating costs be separated by transit mode. Most transit expenses are known as direct expenses and can be associated on one-on-one basis with a specific transit mode. Examples include operator labor and fuel costs. However, some expenses, known as indirect, or shared expenses, cannot be directly associated since they support several modes. The majority of these costs, often called overhead costs, are administrative such as accounting and planning. These costs must be allocated on a reasonable basis to the individual transit modes.

Where there are problems with DRT system reporting of operating expenses, it is often related to two issues:

- **Inclusion of capital charges in purchased transportation costs.** Some transit systems contract out for DRT services and require the contractor to provide the vehicles. The contractor charges one unit cost per hour that includes both the operating costs associated with vehicle operations and maintenance and the capital cost associated with providing the vehicle. Some transit systems report the total cost paid by the contractor as operating expenses, when in fact the capital costs should not be included. In such cases, the transit system should require the contractor to report in its monthly invoice the portions of the invoiced costs that are capital and operating. To the extent that DRT systems can obtain from their private contractors operating cost data that separates out any charges for vehicles, they will have data consistent with that reported by directly operated DRT systems so that comparisons across DRT systems are reasonable.
- **Poor cost allocation of joint expenses.** Transit systems that operate more than one mode or type of service must allocate certain shared expenses such as the administrative costs and shared building expenses. Overhead functional areas such as payroll, human resources, and legal services must be allocated fairly among the different modes, including demand-response. Some transit systems may not use reasonable allocation procedures or use procedures that should be updated. At some agencies where fixed-route service is the dominant mode, cost allocation to the DRT mode may be neglected or may be insufficient, which results in an under-reporting of total operating costs for DRT.

Data Collection: The transit system's accounting system records and reports operating expenses. It is important that all operating expenses are included. For example, some DRT systems that contract for service allow their contractor to obtain fuel from the city or county yard; the costs for the fuel should be included as part of operating costs.

If the transit system purchases transit services, it needs to ensure that the contractors provide cost data that are separated into operating and capital costs. This requirement should be explicitly stated in the contract to make it clear to the operator before service starts. Too often, this requirement is not clearly started, but is enforced instead through general language that states that the contractor will provide data required for Federal reporting purposes. Experience suggests that these general contract requirements are often not rigorously enforced.

Accidents

The NTD term for accidents is **incidents,** and its definition is very specific, including the existence of one or more specifically defined conditions, such as injuries, fatalities and non-arson fires. The NTD safety-related data items differ from the other data items in that FTA does not make the reported data available to the public at the individual system report level. Those interested in reviewing the safety records of other transit systems cannot use posted electronic spreadsheets and databases to make safety performance comparisons among individual transit systems as they can for other NTD data items. However, since common definitions are used, data requests can be made to the transit systems.

NTD distinguishes incidents as either major or non-major, and urban DRT systems must report both types of incidents.

Definition: An incident is an event and can involves multiple people and vehicles. An event is defined as a safety incident if it involves a transit vehicle or occurs on transit-controlled property and meets one of the following thresholds:

A *major* incident is defined by NTD as:

- A fatality other than a suicide,
- An injury requiring immediate medical attention away from the scene for two or more persons,
- Property damage equal to or exceeding $25,000,
- An evacuation of a revenue vehicle due to life safety reasons,
- A collision at a grade crossing,
- A mainline derailment,
- A collision with person(s) on rail right-of-way (ROW) resulting in injuries that require immediate medical attention away from the scene for one or more persons, and
- A collision between a rail transit vehicle and another rail transit vehicle or a transit non-revenue vehicle resulting in injuries that require immediate medical attention away from the scene for one or more persons.

It is noted the last three conditions are not applicable to DRT.

A *non-major* incident is defined as the existence of one or more of the following:

- An injury requiring immediate medical attention away from the scene for one person,
- Property damage equal to or exceeding $7,500, but less than $25,000 (since that would mean the incident becomes major), and
- All non-arson fires.

Discussion of Definition: An important element of this definition is that the accident must involve a transit vehicle or occur on transit-controlled property. This means that the accident occurs in an environment under the direct control of the transit system. For DRT systems, this definition typically limits the counting of accidents to those involving transit vehicles since most DRT systems do not own or control other transit facilities such as stations, buildings, or shelters.

Another important element is the requirement that an injury involves immediate medical attention away from the accident scene. This means that injured people who receive treatment at the accident scene are not counted toward the definition of an accident. It also means that injured people who delay receiving treatment after the event also are not counted.

This accident definition is event oriented. The definition goes beyond measuring injuries to passengers and includes events related to property damage and other safety concerns.

Elements of the definition for incidents are also defined specifically in NTD. An injury, for NTD reporting purposes, requires immediate medical attention away from the scene. Immediate medical attention includes, but is not limited to, transport to the hospital by ambulance. If an individual is transported to a hospital or physician's office by another type of emergency vehicle, by passenger vehicle, or through other means of transport, this is also considered an injury. If an individual seeks medical care several hours after an incident or in the days following an incident, this is not considered immediate medical attention. The medical attention received must be at a location other than the location at which the incident occurred. NTD does not require the transit system to follow-up on each person to ensure that they actually received medical attention at the hospital.

A fatality is a transit-caused death that occurs within 30 days of a transit incident. If death occurs after 30 days, it is classified as an injury.

The NTD definitions for accidents and injuries have evolved over the years, and the current thresholds for reporting safety incidents are considerably different than they were prior to changes made to NTD in 2002. Given the threshold for reporting property damage and other aspects of an incident for NTD, DRT systems typically count and monitor other accidents as well—those that do not reach the NTD threshold. Many DRT systems often distinguish accidents as preventable and non-preventable. The NTD definition, though, provides a standard definition consistent across DRT (and other transit) systems.

Data Collection: The data on accidents are collected as part of the claims management function. Specific reports should be prepared monthly to document the events that meet the accident criteria. Since DRT systems typically collect data on all safety-related incidents and accidents, regardless of NTD reporting thresholds, this means that DRT managers have essentially two sets of data on safety incidents.

3.3 Beyond NTD—Other Performance Data and Definitions for DRT

Beyond the NTD data, there are various other data items used to assess DRT operations and performance. Among these is *on-time trips*, which is among the key DRT performance data. This data element and other non-NTD data terms are reviewed in this section of Chapter 3.

It should be noted that not all DRT systems collect all the data discussed below. While many DRT systems have a wealth of data provided through their computer-assisted scheduling and dispatch (CASD) systems (although the increase in data availability with CASD systems creates more opportunity for the evolution of differing terms for the same or similar data items), not all DRT systems have sophisticated CASD systems. These DRT systems have more limited data availability, and they should focus their data collection resources on the key performance data needed to assess their service and operations.

On-Time Trips

Definition: An on-time trip is a trip where the vehicle arrives at the scheduled pick-up location within the DRT system's definition of *on-time*. An on-time trip may also include a trip where the vehicle arrives at the scheduled destination within the DRT system's definition of *on-time for drop-offs*. Most DRT systems monitor on-time at the pick-up end, however some monitor on-time at the drop-off end as well. Many DRT systems include early trips within the count of on-time trips.

Discussion of Definition: *On-time trips* is an important data element for DRT. Data for on-time trips is needed to calculate on-time performance, which is among the key performance measures for DRT (and discussed in Chapter 4).

The definition of on-time, set by DRT system policy, is typically a "window of time." This window is often 30 min, but DRT systems use variations, with windows of 15, 20, 35, 40, and 45 min. DRT systems in rural areas may use a longer window, for example, 1 hour, if a formal window is used at all.

Some DRT systems establish a window of time that is communicated to the passengers when scheduling a trip, but have a somewhat longer window for determining vehicle timeliness. For example, two of the DRT systems participating in the research project have established a 30-min on-time window for their passengers, but the vehicle is not determined late until 15 min after the window ends.

Another issue was reported by one large urban system, where operators report pick-up times both by MDT and paper manifest. After analyzing sampled late trips (beyond the system's 30-min on-time window) for a period of time, this DRT system found that a noticeable number of the late trips were late only by a few minutes as reported by the operators' MDTs. However, the times reported on the *manifests* for these trips were frequently up to several minutes earlier, often within the on-time window. This mismatch tended to result from the operators' practice of reporting times on their manifests before using their MDTs. Based on this analysis, the system determined that the window for calculating vehicle timeliness would add 5 min.

From a data reporting perspective, there are a number of issues with the data element on-time trips, including the following:

- **On-time windows vary.** With varying definitions of on-time, reported numbers have different meanings. A DRT system with a 20-min on-time window and 85% of its trips on-time could generally be said to be providing "better" service quality than a similar DRT system with the same percentage trips on-time, but with a 40-min on-time window (assuming that the two systems have the same distribution of late trips). Given the wide variety among DRT systems and their operating environments, it is reasonable that definitions of on-time vary.
- **On-time measured at vehicle arrival.** In some communities, on-time is measured when the passenger boards the vehicle; however, this is not correct. Once the DRT vehicle arrives at a location, it may be another 5 to 10 min or possibly longer before the passenger has boarded, particularly for systems serving riders who are frail or have disabilities. On-time at the pick-up end is measured when the vehicle arrives at the scheduled location and is ready to transport the rider. For drop-offs, on-time is measured when the vehicle arrives at the scheduled destination.
- **Exceptions to late trips.** Where DRT systems are operated by contractors, it is common that the contract includes *exceptions* for late trips. That is, there will be circumstances beyond the control of the contractor that may impact trip timeliness, such as extreme weather conditions or major traffic incidents beyond normal congestion, where the contractor is not held responsible for late trips. Generally, such late trips will be excluded from the on-time performance calculation for purposes of any liquidated damages.
- **Treatment of no-shows for on-time calculations.** DRT systems use different procedures for no-shows when calculating on-time performance. Some systems include no-shows, so that a trip that arrives on-time is included in the on-time calculation regardless of whether a passenger is

picked up. Other systems may exclude no-shows as no passenger service was provided; on-time performance is calculated then only for *completed* trips. While no-shows should not account for a significant number of trips, different data collection and calculation procedures may impact the resulting performance statistics, particularly when no-shows occur because vehicles are late (which are actually not legitimate no-shows) and such trips are included in the calculation. In this case, the inclusion of illegitimate no-shows will make the performance statistic look better than it should. Where DRT systems have data monitoring procedures that ensure that passenger no-shows are in fact legitimate no-shows (e.g., Automatic Vehicle Location [AVL]), passenger no-shows appropriately can be included as on-time trips.

- **On-time at pick-up end or drop-off end.** While DRT systems generally focus on measuring on-time performance at the pick-up end, timely service at the drop-off end may be more important for the passenger, particularly for a time-sensitive trip such as to work or a medical appointment. It is recommended that DRT systems monitor on-time performance at the drop-off end for those trips that are time-sensitive. Typically, these trips will have an "appointment" time included with the scheduling information, allowing a comparison of actual drop-off time with scheduled appointment time for on-time assessment. An appropriate window for *on-time* at the destination end could be the same window as used at the pick-up end, with the window ending at the scheduled appointment time.

  As part of this discussion, it is important to state that DRT systems need to schedule riders' trips based on *either* the desired pick-up time *or* the desired drop-off time; a DRT system cannot schedule a rider's trip with both a requested pick-up time *and* requested drop-off time, given that both computerized and manual scheduling procedures must have some degree of flexibility for scheduling purposes. Riders must choose which end of the trip to focus on when requesting their trips. When riders have time sensitive trips, the DRT system is better able to provide a timely arrival when riders accept a DRT system-determined pick-up time that is calculated to meet the appointment time. Otherwise, riders may face late arrivals for appointments, as they may not allow adequate time for DRT shared-ride service.

  For those DRT systems that are ADA paratransit, it is also important to note that scheduling trips to destination arrival times may introduce some complications, given that the ADA regulations do not specifically address destination arrival times.
- **Early trips.** For monitoring timeliness, DRT trips are typically classified as on-time, early, late, no-shows, and missed. To determine on-time performance, most DRT systems include early trips with on-time trips. Many riders are happy if their vehicle arrives somewhat early. But early trips can be problematic if the vehicle is very early and the vehicle operator pressures the rider to leave, or if the operator marks the passenger a no-show because the passenger is not ready to leave before the on-time window begins.
- **Data collection procedures vary.** Many DRT systems use vehicle operator-reported data to determine the timeliness of trips. These systems will often use a sample of trips to calculate on-time performance. For those DRT systems with MDTs, the collection of data for calculating on-time performance is greatly facilitated. The MDTs allow operators to enter data for each vehicle trip, so that arrival times at passengers' pick-up and drop-off locations are time-stamped and captured in the CASD system. Most of these DRT systems with MDT technology also have AVL, which allows verification of operator-reported data.
- **Self-reporting bias.** For many DRT systems, the on-time data are recorded by vehicle operators on their trip manifests. There may be tendency for some operators to "round" the pick-up times to fit within the on-time window if their performance evaluation is based on the on-time data. Use of MDTs/AVL can help with the reporting of accurate data. The AVL data can be used to verify operators' locations at specified times, providing a check on operator reporting and specifically on-time performance data. Some DRT systems have been surprised to learn their "true" on-time performance once they have transitioned from operator reporting via manifest to MDTs/AVL. One large DRT system in a major metropolitan region found

its on-time performance went from a reported 91% with manual reporting to 68% once MDT/AVL technology was installed that provided more accurate data. While this might be an extreme case, differences of more than 5 to 10 percentage points for on-time performance are not uncommon once a DRT system transitions from manual reporting to MDTs/AVL.

Data Collection: As noted above, data collection for on-time performance is done through vehicle operator-reported data with written manifests or MDTs. Systems using MDTs typically have vehicle operators also use paper manifests. While MDTs allow for electronic data reporting on all trips, there are times when the MDTs malfunction or there are other system problems, so that the manifests provide back-up data to ensure complete reporting for DRT operations.

Requested Trips

Definition: Requested trips are the passenger trips that eligible DRT individuals or their agents ask for.

Discussion of Definition: While not all DRT systems track the number of requested trips, this can be useful data for monitoring the demand for DRT service and identifying unmet needs. Monitoring the number of trip requests that come to the DRT system's scheduling and dispatch center as well as when those calls come in and the length of the calls can also help with management of the call-taking function. Such information will help identify the size and length of the peak call periods, and this can be used for determining staffing needs and for scheduling staff.

For ADA paratransit systems, the number of requested trips that cannot be served due to inadequate capacity must be tracked because of ADA regulations related to capacity constraints.

Data Collection: Data on requested trips is typically captured in the CASD system. For those systems without a CASD system, these data would be collected manually.

Reserved Trips

Definition: Reserved trips, also called reservations or trip bookings, are those trips that are accepted as trips to be served by the DRT system and include subscription or standing order trips as well as one-time trips, often referred to as demand trips.

Discussion of Definition: Reserved trips are those trips that are accepted by the call-taking function and placed onto schedules, or held as "unscheduled" trips until the vehicle schedules are created the day before service. If a DRT system accepts all of its requests for service, then the number of reserved trips will be the same as the number of requested trips.

Reserved trips are those trips booked or scheduled over the advance reservation period. If the DRT system accepts trips 7 days in advance of a trip, for example, then reserved trips are the total number of trips that are booked or scheduled over the 7-day period. Not all reserved trips, however, will be placed onto a vehicle schedule the day before service, as some reserved trips will be cancelled before the day of service. It can be useful to monitor the total number of trips reserved over the reservation window, as this number will represent the results of the call-takers/reservation staff efforts.

For those systems that accept same-day reservations, the count of reserved trips will also include same-day trips.

Data Collection: Data on reserved trips are calculated by the CASD system. For DRT systems without a CASD system, the data would be provided through the trip reservations function.

Scheduled Trips

Definition: Scheduled trips are those trips that are placed onto vehicle schedules for service the next day, including any "excess" trips that are to be placed onto schedules.

Discussion of Definition: Scheduled trips are those placed onto vehicle schedules as well as any excess that may remain "unscheduled" the day before service. Scheduled trips are the subset of reserved trips that remain when the reservation window closes, that is, scheduled trips will be the number of reserved trips minus the number of trips cancelled in advance. Unscheduled trips are trips that are in fact reserved trips but that have not been "formally" placed onto a vehicle schedule the night before service. These unscheduled trips will typically be inserted into vehicle operators' schedules on the day of service using space created by same-day cancellations or they may be dispatched to an "overflow" provider, for example, a taxi company.

For those systems that accept same-day reservations, scheduled trips will also include same-day trips. But, such trips, of course, are placed onto vehicle schedules on the day of service, rather that the day before.

Some DRT systems refer to scheduled trips as "manifested" trips, since these are the trips that are actually put onto driver manifests. The number of trips scheduled for next-day service is the template for which capacity is to be provided.

Data Collection: Data on scheduled trips are calculated by the CASD system. For DRT systems without a CASD system, the data would be provided by the scheduling function.

Completed Trips

Definition: Completed trips are those trips where a passenger was transported from an origin to a destination. A completed trip may carry more than one passenger, if there are two or more passengers traveling from the same origin to the same destination.

Discussion of Definition: Completed trips, which may also be called performed trips, are a subset of scheduled trips, as some trips will not be completed because of same-day cancellations, no-shows and missed trips. DRT systems, particularly large systems, often report the proportion of completed trips to scheduled trips.

Data Collection: Data on completed trips is collected by vehicle operators, who report the data on their manifests, or MDTs, or both. For systems that have MDTs, the data on completed trips is also captured in the CASD system.

Cancellation

Definition: A cancellation is a deletion of a trip that has been reserved or scheduled for a passenger.

Discussion of Definition: There are different kinds of cancellations, with the distinguishing factor being *when* the cancellation occurs. A trip may be cancelled 3 days before the scheduled trip is to occur; a trip may be cancelled the morning of the day of the scheduled trip; or it may be cancelled 30 min before the vehicle is scheduled to arrive. A scheduled trip cancelled 3 days before should have limited impact on a DRT system: the capacity for that trip can be used for another trip. However, a trip cancelled 30 min before scheduled vehicle arrival is typically a wasted resource, as the vehicle is likely already on its way for pick-up. For this reason, most DRT systems have a policy that addresses cancellations that happen late in the process, and typically the policy combines late cancellations with no-shows, as the two often have the same negative impact on DRT system operations.

Because the result of the cancellation on DRT operations varies by when the cancellation happens, the Guidebook recommends that DRT systems differentiate among cancellations.

Advance Cancellation

Definition: An advance cancellation is generally defined as a cancellation made *before the day of service*. Advance cancellations may be called simply cancellations, but the term *advance cancellation* is more accurate, distinguishing these from other cancellations.

Same-Day Cancellation

Definition: A same-day cancellation is a cancellation made on the day the trip is scheduled to occur. Same-day cancellations include trips cancelled early in the day, possibly hours before their scheduled time, as well as trips cancelled with less notice. While some DRT systems that monitor same-day cancels include late cancellations within this tally, the Guidebook suggests that if same-day cancellations are monitored and reported, this number should be distinct from advance cancellations and late cancellations.

Monitoring same-day cancels allows the system to monitor scheduled capacity that typically becomes available on the service day. At least one DRT system reports that it uses this information when taking reservations and "overbooks"—knowing that those additional trips can be inserted into its schedules each service day, using the capacity generated by the same-day cancellations. This is essentially what the airline industry has done for decades—overbooking —to ensure efficient use of plane capacity.

Late Cancellation

Definition: A late cancellation is a cancellation made shortly before the scheduled trip is to occur. The exact time that a cancellation becomes a *late* cancellation for a particular DRT system will depend on DRT policy and the degree to which the scheduling and dispatch functions can make adjustments and "re-use" the space made by that cancellation. One DRT system may define a late cancellation as one that is made 1 hour before the scheduled pick-up time of the trip. Others may define a late cancellation as one made several hours or more before the trip. For ADA paratransit service, the FTA has commented that a late cancellation for purposes of rider sanctions should be the operational equivalent of a no-show.

Determining the specifics of the definitions related to cancelled trips is a matter of DRT system policy. *TCRP Synthesis 60: Practices in No-show and Late Cancellations Policies for ADA Paratransit* provides detailed information on DRT system practices related to cancellation and no-show policies for DRT systems that provide ADA paratransit service, including FTA guidance on this topic.

Data Collection: DRT systems should be mindful in their handling of cancellation reporting, as sometimes trips are inappropriately classified as late cancellations. For example, when a DRT system is handling a late trip, it may re-schedule that trip onto another vehicle or possibly send it to a supplemental provider such as a taxi company. In such case, it should ensure that the original trip, which has become a late trip, is not changed to a late cancellation or other status.

No-Show

Definition: A no-show is defined as a failure of a rider to show up for a scheduled trip at the scheduled time and location, when the vehicle has arrived within the DRT system's definition of *on-time*, and the rider has not cancelled the trip in advance. If a rider cancels the trip at the door when the vehicle arrives, this is also typically counted as a no-show, though some systems report such occurrences as a subset of no-shows.

Discussion of Definition: No-show is one DRT data term that is fairly unambiguous. No-shows have a detrimental impact on DRT operations, and it is very important to monitor their occurrence.

Data Collection: No-shows are reported by vehicle operators. Many DRT systems require that vehicle operators obtain approval from a dispatcher before marking a passenger as a no-show. This allows the dispatcher the opportunity to try and contact the passenger so that the trip might be provided, and it also provides a level of supervision over the vehicle operator.

Missed-Trip

Definition: A missed trip is defined as a failure of the vehicle to show up for a scheduled trip. A missed trip can also be defined to include a trip that arrives late, and because of that lateness, the passenger is no longer there for the trip or declines to take the trip. In both cases, the trip is not completed. This more expansive definition of a missed trip is recommended.

Discussion of Definition: Some DRT systems use the term *vehicle no-show* instead of missed-trip. There may also be confusion with the term "missed trip" since some DRT systems combine missed trips and late trips together for purposes of contractor monitoring or for other reasons. But they are not the same operationally: a missed trip results with an incompleted passenger trip because of vehicle operator or other DRT system error, whereas a late trip, no matter how late, results in a completed trip.

Because the term "missed trip" has a negative connotation, the Guidebook recommends that missed trips be categorized by their lateness; for example, 15- or 30-min increments could be used. A trip that is 15 min late and the rider declines to go is not the same as a trip that arrives an hour late and the rider is not even there anymore. By categorizing missed trips by their degree of lateness, the DRT system can more effectively monitor service.

Data Collection: Data on missed trips are obtained from vehicle operator records or dispatcher data. The degree of the lateness of the vehicle should also be collected from vehicle operator and/or MDT records and reported.

Trip Denial

Definition: A trip denial is a DRT trip requested by a passenger but that the DRT system is not able to provide, typically because capacity is not available at the particular requested time. For ADA paratransit systems, the definition is considerably more complicated.

A trip denial, for ADA paratransit, is a trip that the DRT system cannot provide within a 1-hour before-and-after "negotiation" window of the rider's requested pick-up time. The ADA regulations allow an ADA paratransit system to "negotiate" requested trips up to 1 hour before and 1 hour after the rider's requested pick-up time. If a rider's trip cannot be scheduled at the exact time requested, the ADA system can offer an alternative time within the allowed negotiation window. If the rider turns down such an alternative trip, however, the ADA paratransit system does not have to record that as a denial but rather as a "refusal." If there are no trips *at all* for the rider during the negotiation window, then clearly the trip is a denial. However, the DRT system may have a trip beyond the negotiation window for the rider and if the rider accepts that alternative, the trip is to be recorded as a denial, *even though* the rider has accepted the trip. Additionally, ADA paratransit systems are to be sensitive to riders' time constraints when booking trips and using the negotiation window. For example, if an alternative trip offered within the negotiation window would mean that the rider has to leave work before her work-day ends, then such alternative trip, even though it is within the negotiation window, is not a real alternative for her.

Discussion of Definition: Prior to the ADA, DRT systems may or may not have collected data on trip denials. For immediate response DRT systems, trip denials were typically not recorded in any systematic way because it was during peak demand times that denials occurred and DRT control room staff was too busy to record denials. For advance reservation DRT systems, DRT staff may have had more time to record denials, but this data element was not always recorded on an ongoing basis. This changed with the ADA. Denials now receive considerable attention for those systems that provide ADA paratransit service.

Data Collection: Data on trip denials are captured during the trip reservation process. DRT systems that are ADA paratransit should maintain records on any trip denials, though it is noted that the procedure for counting such denials has been an issue raised by the FTA.

Trip Length

Definition: Trip length is the distance measured in miles, from the passenger pick-up to the drop-off location. The sum of all passengers' trip lengths is an NTD data element—*passenger miles*—and must be included with DRT systems' annual NTD reports.

Discussion of Definition: For NTD, systems must report either 100% counts of passenger miles or a sampling method can be used, which meets statistical accuracy with a minimum confidence of 95% and minimum precision level of ±10%. The 1988 FTA Circular *C 2710.2A Sampling Procedures for Obtaining Demand Response (DR) System Operating Data Required under the Section 15 Reporting System* provides instructions for meeting NTD requirements for reporting passenger miles.

Data Collection: Data on trip length is recorded by vehicle operators through their manifests or through MDTs.

Travel Time

Definition: Travel time is the time that the passenger spends on-board the vehicle from time of boarding to arrival time at the destination.

Discussion of Definition: The time that passengers spend traveling on the transit vehicle is called travel time. Another way of looking at this data item is that it is the time that corresponds to *passenger miles.*

Travel time is a useful data element, providing data to help measure both the degree to which the scheduling function has grouped similar passenger trips for greater efficiency and service quality from the passengers' perspective.

Travel time is also important to monitor for ADA paratransit systems. Under the regulations concerning capacity constraints, systems must not have substantial numbers of trips with excessive travel times.

Data Collection: Data on travel time is recorded by vehicle operators through their manifests or through MDTs.

Complaints

Definition: A complaint is an expression of dissatisfaction by a passenger or the passenger's agent over some aspect of the DRT service. DRT systems generally monitor complaints related to service and those over which they control day-to-day. Such complaints may be referred to as *valid* complaints.

Discussion of Definition: DRT systems can generate complaints for various reasons. There may be complaints about the hours of service that are operated, or someone in the community may complain that the vehicles are "driving around empty." These would not typically be included within a system's count of valid service complaints. DRT systems are primarily concerned about complaints related to service operations, for example, was the trip late? Was the vehicle operator rude? Are the vehicles dirty? These are service complaints, and DRT systems monitor these complaints as feedback on the quality of service.

When reporting complaints, typically the number of complaints is compared to a measure of service provided, such as total passenger trips or revenue hours, for example, total service complaints per 1,000 passenger trips. This puts the number of complaints into perspective.

Issues related to the collection and reporting of DRT service complaints include the following:

- **Formal versus informal complaint.** A DRT system may record a complaint only when the complainer does so formally. This may involve contacting the DRT system during office hours and providing specific information to a specific staff member on the incident as well as providing personal information such as name, address, and phone number and other contact information. In these cases, passengers may not follow through with a legitimate complaint because of the effort required. Additionally, some systems only record written complaints and do not accept or track complaints provided over the telephone or in person. This could mean that complaints are under-reported.

- **Complaints related to circumstances beyond the DRT system's control.** There may be complaints generated because of a particular event that the DRT system cannot control. For example, during a day of severe weather, many trips may be late. Complaints generated because of such late trips may or may not be included within the "official" count of complaints. Depending on the practices of the DRT systems, there will be variation in the reported totals.
- **Multiple complaints on the same event.** DRT systems may count each valid complaint that is received. Or they may try to distinguish whether complaints relate to the same event. For example, if a vehicle is very late in dropping off a passenger at a human service agency, staff at the agency may file a complaint, and the rider or a family member of the rider may also file a complaint about the late trip. Is this two separate complaints, or should these be counted as one complaint registered on a single event?

Data Collection: The complaint process including data collection varies among DRT systems. Where service is contracted, complaints are often directed to the public agency. Alternatively, complaints may be given directly to the contractor, who then must notify the public agency of the complaints, or complaints may be given to either the contractor or the public agency. At several large urban DRT systems with contracted call centers, complaints are directed to the call center contractor, which then determines which entity should respond to the complaint. Many large systems have complaint tracking software to assist in complaint monitoring and response.

Given the range in how complaints are defined, handled, and reported across DRT systems, it is more useful for DRT systems to monitor complaints internally, rather than compare their complaint performance to that experienced at other DRT systems.

CHAPTER 4

Performance Measures

Using the performance data identified in Chapter 3, this chapter identifies the key performance measures selected for the Guidebook. While there are many different measures that can be used to evaluate DRT, it does not take a long list to capture the important aspects of performance. One of the objectives of the research project was to select a *limited* number of measures to assess DRT's efficiency, effectiveness, and quality.

4.1 Performance Measures for DRT—The Many

The literature review conducted as part of the research project underlying this Guidebook found more then 60 different measures that have been used to assess DRT service. The more common of these are shown in Table 4-1.

For an individual DRT system, selection of the performance measures to be used for monitoring and assessing service will depend upon the system's specific goals and objectives, and it may also depend on the type of DRT service that is provided as well as other local factors. DRT systems that provide ADA paratransit service, for example, must collect and monitor a greater range of performance data than would typically be used by a general public DRT system.

DRT systems may also need to assess their performance using measures selected by their state departments of transportation. A number of states provide state funding to their transit systems, including DRT, and require that the systems report specified performance data as a condition of the financial support. DRT systems may have other organizations to which they must report performance, such as other funding agencies and, for those operating coordinated services, specified performance data may be required for the coordinated human service agencies.

4.2 Key Performance Measures for DRT—The Few

From the many DRT performance measures found through the literature review, a limited number were identified as key performances measures. Using a smaller set of measures to assess transit performance may be preferable to using a long list of indicators (*1, 2*). This approach allows a DRT system to concentrate on essential elements of service performance. Depending on the results of those limited measures, the DRT system may need to delve deeper into its operations, examining additional and more detailed data to identify reasons behind the performance results.

The key performance measures for DRT selected for the Guidebook are shown in Table 4-2 and discussed below.

Table 4-1. Common performance measures used for DRT.

Operating Cost per Passenger Trip
Operating Cost per Vehicle Hour
Operating Cost per Vehicle Mile
Operating Cost per Passenger Mile
Passenger Revenue per Total Operating Cost (Farebox Recovery Ratio)
Passenger Trips per Vehicle Hour
Passenger Trips per Vehicle Mile
Accidents per 100,000 Vehicle Miles
No-Shows per Scheduled Trips
On-Time Pick-Ups to Total Pick-Ups (On-Time Performance)
Complaints per 1,000 Passenger Trips
Average Trip Length
Average Vehicle Travel Time
System Speed
Response Time (as measured by the minimum time between when service is requested and when provided)
Trip Denials per Trips Requested

Passenger Trips per Revenue Hour

Passenger trips per revenue hour measures the productivity of a DRT system. Many consider this the most important single measure of DRT performance, assessing the system's effectiveness.

As a performance measure, productivity captures the ability of the DRT system to schedule and serve passenger trips with similar origins, destinations, and time parameters, using the least number of in-service vehicles and revenue hours. This is the essence of shared-ride, public DRT service.

productivity =
total passenger trips ÷ total revenue hours

But there are various factors that affect the ability of a DRT system to be productive, including, importantly, the size of the service area, distribution of residential areas and destination areas, and the patterns of riders' trips. If the service area is large and passengers request trips to distant and dispersed destinations, it will be harder to effectively schedule two or more riders on the same vehicle, and this will mean a lower productivity. If there are limited group trips, that is, opportunities to schedule riders on the same vehicle at the same time for travel to a common destination, this will also mean a lower productivity.

Other factors that impact productivity include the level of no-shows and late cancellations; scheduling efficiency; dispatcher skills, and ability to schedule trips in real-time; vehicle operator experience and familiarly with the service area and passengers' trip-making patterns; and the operating environment including traffic and the roadway network.

Table 4-2. Key DRT performance measures selected for guidebook.

Passenger Trips per Revenue Hour
Operating Cost per Revenue Hour
Operating Cost per Passenger Trip
Safety Incidents per 100,000 Vehicle Miles
On-Time Performance

The type of DRT service—particularly whether it functions as ADA paratransit or not—also affects productivity, because ADA regulations have effective limits on the flexibility that a DRT system has to maximize shared riding. This also may mean a lower productivity. Some of these are examples of *uncontrollable* factors affecting the performance of DRT systems as measured by *passenger trips per revenue hour*. Such factors impacting DRT performance are discussed in more detail in Chapter 5.

From a DRT performance perspective, the emphasis on productivity stems in great part from the fact that small changes in productivity can be very cost effective. Larger changes can be even more cost effective. Table 4-3 provides a hypothetical example of a fictitious medium-sized DRT system, operating 75,000 annual revenue hours. If this system could increase its current productivity of 1.8 passenger trips per revenue hour to 2.0, it could accomplish two improvements: (1) it would increase its ridership by 15,000 annual passenger trips within the same operating cost and (2) decrease the operating cost per passenger trip by 10%, from $25.00 to $22.50 per passenger trip (Scenario "A"). On the other hand, if the system has to serve the additional 15,000 passenger trips at the original productivity level of 1.8, it would need to increase revenue hours, with a corresponding operating cost increase of over 11% (Scenario "B"). And finally, if a productivity increase from 1.8 to 2.0 enabled the system to decrease its revenue hours, while serving the original 135,000 passenger trips, it could hypothetically reduce its annual operating cost by 10% (Scenario "C").

While the productivity measure has been calculated with either *revenue* hours or *vehicle* hours, revenue hours have generally been used for demand-response transportation. Revenue hours are also typically used for measuring fixed-route productivity as well.

Productivity is sometimes measured as *passenger trips per mile*. Given the low passenger volumes on DRT relative to mileage, this ratio usually results in a number less than one. Such resulting numbers are not particularly logical given that an actual passenger trip is not less than one; passenger trips per hour is an easier number to visualize.

Performance Considerations

Poor performance on *passenger trips per revenue hour* may result from a number of causes:

- Scheduling practices that do not effectively group similar passenger trips,
- Limited dispatch control that is not able to effectively manage service operations and respond to changes on a real-time basis,
- Scheduled revenue hours are not aligned with ridership demand,
- High rates of no-shows and late cancels,
- Low ridership levels,
- Low density of passengers within the service area,
- Lengthy passenger trips, and
- Vehicle operator inexperience.

Table 4-3. Effects of productivity on hypothetical DRT system.

Scenario	Revenue Hours	Annual Passenger Trips	Productivity	Operating Costs for Revenue Hours	Operating Cost per Revenue Hour	Operating Cost per Passenger Trip
"A"	75,000	135,000	1.8	$3,375,000	$45.00	$25.00
	75,000	150,000	2.0	$3,375,000	$45.00	$22.50
"B"	75,000	135,000	1.8	$3,375,000	$45.00	$25.00
	83,333	150,000	1.8	$3,750,000	$45.00	$25.00
"C"	75,000	135,000	1.8	$3,375,000	$45.00	$25.00
	67,500	135,000	2.0	$3,037,500	$45.00	$22.50

Operating Cost per Revenue Hour

Operating cost per hour is generally considered the key cost-efficiency measure, assessing the financial resources needed to produce a unit of service, defined as an hour of revenue service. In other words, what does it cost the DRT system to put service on the street? This measure, however, does not evaluate *use* of the DRT service, and, as such, should be assessed in conjunction with the performance measures that evaluate ridership utilization.

> operating cost per revenue hour =
> total operating cost ÷ total revenue hours

Similar to the productivity measure, practices vary as to whether the measure uses *revenue hours* or *vehicle hours* in the denominator. Revenue hours are preferred for several reasons including the following:

- It is consistent with the denominator normally used for the productivity measure—passenger trips per *revenue hour*.
- It facilitates incorporation of taxi-based and other non-dedicated provider data. When DRT service is provided by taxis or other non-dedicated vehicles, it is usually trip specific—from a particular origin to a particular destination—and the concept of deadhead mileage and time is not relevant. Non-dedicated providers should be required to provide to the DRT system their mileage and time data for each trip that they provide, regardless of how they are paid, so that revenue miles and time can be computed, and included with data for dedicated service.
- Governments, as sponsors and funders of public transit service, are primarily interested in buying revenue hours of service. It is the transit operators' responsibility to provide them efficiently by minimizing deadhead.

Operating cost per mile is another service efficiency measure often used for performance assessments, either in addition to or instead of operating cost per hour. However, cost per hour is often the more important measure because the largest proportion of costs (wages and salaries) is paid on an hourly basis (*3*).

Performance Considerations

The elements in this measure are the DRT operating costs, with the major components of costs related to staff labor and vehicle operations and their maintenance, and the amount of revenue service, as measured by hours. This latter data element is determined by the established service span; demand for service; allocation of revenue hours as determined by vehicle availability; vehicle operator assignments; and scheduling practices.

There are various reasons that a DRT system's performance on operating cost per revenue hour may not meet objectives, including:

- Costs for labor, particularly vehicle operators;
- Costs for maintenance, from an older fleet, problem vehicles, accidents, costs for fuel;
- High proportion of paid vehicle operator hours to revenue vehicle hours;
- High costs for administration; and
- Inefficient number of revenue vehicle hours, resulting from a poor service design or from scheduling practices.

Vehicle operator labor is a major cost center. For the transit industry in general, labor including fringe benefits may account for up to 70 to 80% of total operating costs, with the majority of employees working in vehicle operations. The labor rates paid to vehicle operators are somewhat controllable, but will depend on the local job market and wages paid for similar positions at competing organizations. For some DRT systems, the rates may be influenced by a labor contract.

Maintenance is another important cost center. Based on NTD data for the transit industry in general, vehicle maintenance may account for up to 20% of operating expenses. DRT management has some control over this factor, but costs will also depend on the type of vehicles, their age, and the vehicles' operating conditions, the latter of which is influenced by service area characteristics and weather.

Operating Cost per Passenger Trip

Operating cost per passenger trip is a critical cost-effectiveness measure. It combines elements of the first two measures—*operating cost* per revenue hour and *passenger trips* per revenue hour, relating productivity to the hourly operating cost. As a composite measure, a DRT system may have low operating costs but if productivity is also low, the operating cost per passenger trip may be high. Conversely, a DRT system may have a relatively high cost on a revenue hourly basis, but if its productivity is high, the cost per passenger trip may be low.

> operating cost per passenger trip =
> total operating cost ÷ total passenger trips

Operating cost per passenger trip is a measure that decision makers typically look to: what does it cost to provide a trip for one passenger? It is important because it examines a DRT system's ability to carry out a core function—that is, transport passengers in a cost-effective manner.

Performance Considerations

Reasons that a DRT system might show poor performance on this measure include the following:

- High operating costs
  - Costs for labor, particularly vehicle operators
  - Costs for maintenance from an older fleet, problem vehicles, accidents, costs for fuel
  - High administrative costs.
- Low productivity
  - Scheduling practices that do not effectively group similar passenger trips
  - Limited dispatch control that is not able to effectively manage service operations and respond to changes on a real-time basis
  - Scheduled revenue hours that are not aligned with ridership demand
  - Low ridership levels
  - High rates of no-shows and late cancels
  - Low density of passengers within the service area
  - Lengthy passenger trips.

Improving performance requires a reduction in operating costs and/or an increase in the number of passenger trips that are served—productivity—without expansion of resources and therefore costs.

Safety Incidents per 100,000 Vehicle Miles

Safety is a primary concern for all transit systems, including DRT. While the safety performance measure may not get the same attention as *operating cost per revenue hour* or *operating cost per passenger trip* in a DRT system's monthly report, when the measure does get attention, it is probably not because of good performance. Safety performance should be included with the set of key performance measures, given its critical role within a DRT system.

As a performance measure, the safety incident rate can be seen as one that incorporates an assessment of both service operations as well as passenger service quality. The safety of the DRT system may not be an attribute that passengers consider each day as they ride the DRT system, but safety is a dimension of customer service quality (*4*).

Calculation

Given the different ways the DRT systems define and measure safety and their accident rates, it was determined that the Guidebook use the NTD definitions to assess safety. As described in Chapter 3, these are very specific definitions.

The performance measure is the sum of NTD major and non-major safety incidents divided by total vehicle miles times 100,000. The measure compares the raw number of safety incidents to the miles traveled by the system, which places the raw number into the perspective of miles traveled by the system.

> safety incidents per 100,000 vehicle miles =
> [(NTD major + non-major safety incidents) ÷
> (total vehicle miles) x 100,000]

In addition to reporting accidents through NTD, DRT systems monitor safety incidents through their own internal procedures and practices, typically assessing preventable versus unpreventable accidents and counting all incidents and accidents, without regard to a pre-determined dollar threshold. The thresholds for reporting NTD-defined safety incidents related to property damage are relatively high, particularly for smaller systems.

Performance Considerations

A DRT system's performance on safety can be improved by ensuring that vehicle operators are well trained, vehicles are well maintained, and operating policies and procedures support safe operations day-to-day.

Poor performance on safety may result from a variety of reasons:

- Limited vehicle operator training and/or retraining;
- Inexperienced vehicle operators;
- Vehicle issues such as the vehicle type or design and their condition;
- Scheduling practices that result in a system speed that forces vehicle operators to rush, which then increases opportunities for accidents;
- Environmental factors such as bad weather; and
- The system's commitment to safety.

On-Time Performance

On-time performance is perhaps the most important measure of service quality from a DRT rider's perspective. On-time performance measures the reliability of the system: does the vehicle arrive for the pick-up when it was promised?

> on-time performance =
> (total on-time trips, including no-shows,
> + early trips) ÷
> (total completed trips + no-shows + missed-trips)

Timeliness is often important at the drop-off end as well, though on-time performance at the drop-off end is not routinely measured and reported by DRT systems. DRT systems should assess on-time performance at the drop-off end for time-sensitive trips, those with pre-determined "appointment" times. This would be a separate assessment, since only those trips with an appointment time would be included for this assessment.

As discussed in the last chapter, the definition of "on-time trips" varies among DRT systems. Data collection also varies, with many systems using vehicle operator-reported data and some using MDTs. Also as noted in Chapter 3, the measurement of on-time performance at the destination end has been an issue in some cases at DRT systems that are ADA paratransit, given that the ADA regulations do not specifically address destination arrival times.

Calculation

On-time performance should be calculated based on all completed trips and also on no-shows and missed trips, using definitions discussed in Chapter 3. It is important that procedures be developed to ensure that no-shows are in fact legitimate no-shows. This would include procedures that require vehicle operators to wait for the prescribed waiting period before they claim a rider is a no-show and to check with dispatch before leaving for their next stop.

The Guidebook also suggests that early trips be included with on-time trips. However, the count of early trips should also be maintained separately so that early trips can be monitored. As discussed in Chapter 3, many riders are happy if their vehicle comes somewhat early, but riders should not be pressured into early departures if they are not ready to go until the window begins.

In terms of calculating on-time performance, some DRT systems base measurement on a sample of trips. This may be the random choice of a pre-determined number of days per month. If such a process is used, it is important that the days are representative of the service. For example, if service is provided Saturdays and Sundays as well as weekdays, the sample should consider weekend days as well.

A number of systems have designed statistically valid sampling techniques. One of the larger DRT systems included in the research uses a statistically based sampling process to measure trip timeliness on a real-time basis. Each day, before the start of service, a random sample of trips is selected for on-time measurement and entered into a computer program written by transit agency staff. At the scheduled time of each selected trip, the dispatcher is prompted by the computer program to check the trip by contacting the vehicle operator by radio at the scheduled time of arrival to ask the vehicle operator of his specific location and then checking the AVL at the same time to confirm the operator's location. The dispatcher then records the resulting data for on-time performance monitoring. The month-end performance statistic that is reported is considered accurate at the 95% confidence level with +/-5% accuracy.

The calculation of on-time performance may also be done using all trips. This is facilitated when the DRT system has MDTs and trip-by-trip data collection is automated. Where AVL technology is also available, this can serve to check the vehicle operator-reported MDT data when this is needed.

Performance Considerations

Poor on-time performance may result from various factors, including the following:

- Vehicle operator schedules that are not adequately prepared or that overbook trips, so vehicle operators cannot maintain the schedule;
- Incorrect information on schedules so that vehicle operators do not have the proper information for timely service (bad addresses, lack of details on just where to pick up the passenger such as back door, side street, etc.);
- Limited dispatch practices to make real-time changes to tackle service problems and help vehicle operators who are running late;
- Staffing issues such as no back-up operators (such back-up vehicle operators are often referred to as the "extra board"), inexperience, or an inadequate number of operators;

- Vehicle breakdowns or road calls, resulting from vehicle design issues or maintenance practices that do not keep vehicles in good working order; and
- Passengers' habits (e.g., excessive dwell time because passengers are not ready to board upon vehicle arrival, use of wrong mobility aide).

4.3 Additional Performance Measures for DRT

There are a variety of other performance measures that DRT systems typically monitor. Some of these are *interim* measures, assessing a specific aspect of DRT service that impacts efficiency, effectiveness, or service quality. The more common of these other measures are identified below, using performance data discussed in the previous chapter.

No-Show/Late Cancellation Rate

While there is some variation in how this measure is calculated, typically the no-show and late cancellation rate measures the percent of scheduled trips that are not completed due to passenger no-shows and late cancellations. The Guidebook recommends that this be calculated as the sum of passenger no-shows and late cancelled trips (with late cancels defined differently by DRT systems) divided by the total number of scheduled trips. The denominator—number of scheduled trips—is the total of the trips that are placed onto vehicle schedules for service, as defined in Chapter 3.

no-show/late cancellation rate =
(total no-shows + total late cancellations) ÷
total number of scheduled trips

It is noted that the no-show/late cancel rate can be considered an interim measure, monitored because of the important affect that no-shows and late cancellations have on productivity and operating costs. They are combined together for performance measurement purposes as they have a similarly negative impact on DRT operations: for most DRT systems, they represent lost resources with adverse impacts on productivity.

In an effort to minimize the negative impacts of no-shows and late cancellations, most DRT systems have adopted policies addressing no-shows and late cancellations. There is considerable variation among these policies, but broadly, they all establish penalties for passengers who repeatedly cancel their trips with little notice or fail to appear for their scheduled trips. Implementation and enforcement of such policies can significantly reduce the occurrences of no-shows and late cancellations; this is discussed in detail in Chapter 7.

Cancellation Rate

As discussed in Chapter 3, there are different types of cancellations. For thorough monitoring of cancellations, the Guidebook recommends that DRT systems assess the rate of advance cancellations as well as the rate of same-day cancellations.

To assess the degree of advance cancellations, the DRT system can compare all advance cancellations received over the reservation period to the total number of trip reservations. While advance cancellations do not have the same detrimental affect as a same-day or late cancel, they do represent efforts of the reservations/scheduling staff which do not result in service. One strategy to address high rates of advance cancellations is to shorten the reservation window. This is discussed in detail in Chapter 7.

advanced cancellation rate = total advance cancellations ÷ total number of reserved trips
same day cancellation rate = total same-day cancellations ÷ total number of scheduled trips

Monitoring same-day cancellations is more important than advance cancellations from a service perspective, as these represent trips that are scheduled, but not taken. The same-day cancellation rate compares total same-day cancels to total scheduled trips. DRT systems may be able to use at least some of the capacity created by same-day cancellations, but this will vary by the system's scheduling and dispatch practices; how much time the DRT system has to respond to a same-day cancel; and policies related to will-calls and same-day trips.

Missed-Trip Rate

The missed-trip rate measures the percent of trips that are not completed because the DRT vehicle fails to arrive at the scheduled location, or the vehicle arrives late and the passenger declines to take the trip or is not even there anymore. The measure is computed as the number of missed trips divided by the total number of scheduled trips.

Missed-trips rate = total missed trips ÷ total number of scheduled trips

As discussed in Chapter 3, it is useful to assess the *degree* of lateness of missed trips. A missed trip that is only minutes late is not the same as one that is an hour or more late.

Performance Considerations

Missed trips result from the same causes as poor on-time performance. Missed trips may also result from a lack of rider confidence in the DRT service. When the system is relatively reliable, riders are more likely to wait an extra amount of time for a vehicle that may be running late. However, if the DRT service is often late, riders may be less likely to wait much beyond the on-time window for their vehicle. In such cases, they may find alternative transportation or forego the trip.

Trip Denial Rate

The trip denial rate has become an important measure for those DRT systems that are ADA paratransit. The ADA's prohibition of capacity constraints includes the requirement that ADA paratransit systems meet all expected demand for service, though it is recognized that there may be an insubstantial number of trips that cannot be met as long as such trip denials are not attributable to the design of the paratransit system.

trip denial rate = total trip denials ÷ total number of requested trips

As noted in Chapter 3, the definition of denials for ADA paratransit is somewhat complicated, and DRT systems that provide ADA paratransit service should ensure that they understand the definitional issues.

Complaint Rate

In addition to monitoring and responding to complaints, some DRT systems measure and report their rate of complaints, by comparing the number of complaints received to service provided, such as total service complaints per 1,000 passenger trips. The denominator may be total passenger trips completed or it may be total trips scheduled. Rather than passenger trips, some DRT systems compare complaints to revenue hours of service provided.

> complaints per 1,000 passenger trips =
> (total valid complaints ÷ total passenger trips) x 1,000
> or
> complaints per 1,000 revenue hours =
> (total valid complaints ÷ total revenue hours) x 1,000

The complaint rate can be monitored over time as an indicator of customer satisfaction. It is important that DRT systems maintain a consistently defined measure, so that trends and comparisons month-to-month or year-to-year are meaningful over time. If the calculation method is modified, this should be clearly noted on any trend line comparison, to ensure proper assessment.

Some systems have established a standard related to complaints, for example, the DRT system should have no more than *x complaints per 1,000 passenger trips*. Such a standard may be included in a contract document for a contracted DRT operator, with associated incentives and liquidated damages.

Other DRT systems purposefully exclude a measurement of complaints from their standards, believing that complaints should be facilitated and encouraged as a method of monitoring service. One large DRT system purposefully did not include any measure of complaints when it structured performance standards for its contractors, and made the filing of complaints very easy for riders as a way to monitor contractor performance.

Average Passenger Trip Length

The size of the DRT system service area, distribution of riders' origins and destinations, and degree of shared riding will affect the average passenger trip length. This can be a useful measure for a DRT system to monitor as it has an important affect on system productivity, with longer trip lengths having a negative affect on productivity. The average trip length should be monitored over time, as changes may be reflected in system productivity, and it may also be useful in comparisons to peer systems given its affect on productivity.

> average passenger trip length =
> total passenger miles ÷ total number of passenger trips

Average Travel Time

Average travel time is computed as the sum of all passengers' travel times divided by the total number of passenger trips.

> average travel time =
> total passenger travel time ÷ total number of passenger trips

This is not a measure that is routinely reported by DRT systems, but it is useful, indicating both the degree of shared riding and service quality for the passengers. One of the premises of

DRT is the grouping of passengers with similar trip patterns—ride sharing—to maximize productivity. If passengers' travel times are short, comparable to travel by private vehicle, it indicates that the scheduling function has not achieved much ride-sharing. On the other hand, if many passengers' travel times are long, it may indicate too much ride-sharing, and passengers may be overly inconvenienced with long on-board times to reach their destinations. Balancing ride-sharing with passenger travel times is a key objective of the scheduling function.

While the average travel time for a DRT system provides a composite measure across the system, it may also be useful to analyze sampled individual trips on a regular basis. This may be particularly important for DRT systems that provide ADA service, given regulations on capacity constraints and specifically trips with excessive lengths. For example, a DRT system may want to review trips that are over an established length of time. For a small DRT system, this might be sampled trips over 45 min. For a large DRT system, this may be sampled trips over 60 or 80 min.

CHAPTER 5

Assessing Performance—Typology of DRT Systems

Once a DRT system has measured its performance—calculating the various measures selected to gauge how well its operations are performing—it then must assess that performance, analyzing and interpreting the results. Assessing DRT performance is the topic of this chapter, which includes the following:

- A brief review of different methodologies that can be used to assess DRT performance.
- The typology of DRT systems developed through the research project. This typology groups DRT systems into seven categories with similar characteristics that affect their performance.

Developing a typology of DRT systems was one of the objectives of the research project, to facilitate the comparison of a DRT system's performance to that of similar systems. Such comparisons can be useful for assessing performance, and they are more useful when the comparisons are with systems that share attributes affecting performance.

5.1 Different Ways to Assess Performance

There are several different ways that DRT performance can be assessed. Many DRT systems use more than one method to assess their performance, both to monitor and manage DRT operations and to present performance results to their boards or other interested groups. Using a combination of methods may provide a more thorough assessment.

Trend Analysis

Also called a *time series analysis*, trend analysis is probably the most common assessment methodology. With this method, a DRT system compares its own performance on the same measures over time, typically on a monthly and annual basis, where the annual data are shown by month to account for the seasonal variability of DRT service. Such an analysis allows the system to monitor its performance and measure progress over time. The DRT system may need to reach certain performance standards, or monitoring may be done to watch trends and identify areas for improvement.

When using trend analysis, a DRT system should note any specific time points when significant changes are introduced or major events occur that impact performance. This will allow subsequent assessments to review performance trends in light of the major change or event. For example, if the DRT service area changes or if the system introduces new or different technology, it is important to document when that event occurs on the trend line in the performance monitoring reports (see Figure 5-1). This will inform the review of the resulting performance and provide a context for any deviations in resulting performance.

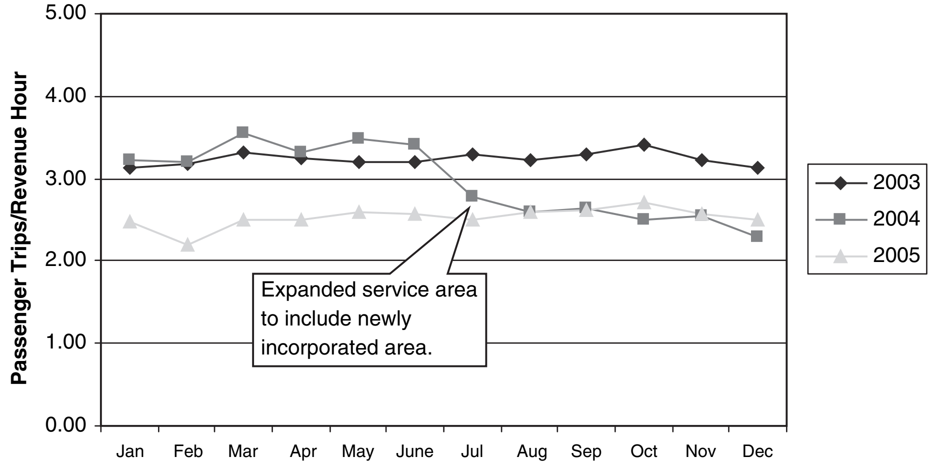


Figure 5-1. Example of DRT productivity trends.

Comparison to Established Norms or Standards

With this method, the DRT system compares its performance to an established standard or norm. While there are no hard and fast standards that must be met by all DRT systems, some norms have developed over time. Generally, for example, a norm of 90% on-time performance for trip pick-ups has evolved, though there is no industrywide requirement dictating such performance for DRT timeliness and despite the fact that DRT systems define "on-time" in varying ways.

For ADA paratransit, however, regulations establish de facto standards for service in specific areas and these in turn affect performance. Based on the regulations and subsequent court interpretations, for example, it has been established that ADA paratransit systems must serve all expected demands for service.[1] This has become a standard for DRT systems that provide ADA paratransit service.

In addition, a DRT system may set its own standards for performance achievement. This is particularly true when service is provided by contract. Specific standards may be set in contract documents, establishing performance levels that the contractor is expected to meet. This can be beneficial in ensuring contractor attention to performance. Caution is needed, however, in setting those standards, as sometimes they may be unrealistic, setting up a difficult dynamic that may harm the contracting relationship. For contracted service as well as directly operated service, standards must be evaluated periodically, to ensure they are reasonable and continue to be reasonable in light of any changing conditions that influence performance.

State and regional funding organizations may also set standards that must be met by DRT systems for continued funding consideration. The state of California, for instance, has set specific standards for the achievement of farebox recovery for systems that receive certain state transit funds.

Comparison to Peers

Comparison to peers is another approach to assessing DRT performance and a common performance assessment methodology. With this approach, the DRT system identifies a number of

[1] While the term "zero denials" is commonly used in relation to meeting ADA paratransit demand, the regulations and subsequent court decisions require that ADA paratransit systems meet all expected demand for service, with recognition that there may be an insubstantial number of trips that cannot be met as long as such denials are not attributable to the design of the paratransit system.

systems that share basic characteristics; researches the performance of those similar systems on selected performance measures; and compares its own performance to that of the peers.

Despite widespread use, peer assessments typically include caveats, which state something to the effect that peer system comparisons should be "treated with caution," as selected DRT systems may share similar characteristics but other attributes, beyond basic similarities, may cause performance differences. This means that direct comparisons are not exactly "apples to apples."

While it may be that peer assessments should be used judiciously, they provide useful information for a DRT system interested in knowing the performance of others on specific measures, and they show the range of performance achieved by the other DRT systems. Importantly, such comparisons can provide a context for assessing an individual system's own performance.

Although a trend analysis of the DRT system's own performance over time may provide the "truest" assessment of performance, given that the operating environment and factors affecting performance generally do not change significantly over the short-term, peer comparisons provide a framework for reviewing a DRT system's own performance. And understanding the different factors and characteristics that affect peer systems' performance may help an individual DRT system consider strategies to improve its own performance.

Choosing peers, however, may not always be straightforward, and reported performance may be based on data and data definitions inconsistent across the peer groups. Addressing these issues—which will provide for more accurate peer assessments—was one of the objectives of this research project.

5.2 Developing a Typology of DRT Systems—Which Systems Are Similar?

Measuring a DRT system against similar systems can be useful for assessing performance. Given the considerable range in types of DRT systems, however, it may not always be clear as to which systems are appropriate peers.

Typology of DRT Systems with Categories of "Similar" Systems

One of the objectives of the research for this Guidebook was to develop a typology of DRT systems, so that DRT systems are categorized into groups within which systems share characteristics that influence performance.

Using the earlier literature on DRT from the 1970s and 1980s as well as more recent reports and published information, various characteristics and criteria were reviewed, each having some degree of influence on the operations and resulting performance of DRT service, in the attempt to develop a typology of DRT systems. These criteria are identified in Table 5-1 and described briefly in the following sections.

Criteria Influencing DRT Performance

Ridership Market Served

A key characteristic influencing DRT performance is the type of riders that are served (*1, 5*). In the early years of DRT, the major distinction was between systems that served the general public and those that served specific population segments of the community, often seniors and persons with disabilities. In terms of performance, DRT systems serving the general public can typically achieve higher productivities than systems serving specialized markets, for a number of reasons:

Table 5-1. Criteria influencing DRT performance.

Ridership market served
Service area/ operating environment
Type of routing and scheduling
Type of operator: public vs. private contractor
Dedicated vs. non-dedicated vehicles
Advance request vs. immediate response
Use of advanced technology
Door-to-door vs. curb-to-curb
Use of volunteers
Provision of Medicaid transportation

- The pool of potential riders from the general public is larger, creating a higher density of potential demand.
- Dwell time at pick-up locations is shorter for general public riders. This includes both the established wait time, set by policy, and the time needed for rider boarding and alighting. Data from several DRT systems in the mid 1990s found that dwell times at pick-ups for ambulatory riders, which make up the large majority of general public riders, averaged 2 to 4 min, while that time for riders using wheelchairs, which may be a significant portion of the specialized rider market, was 4 to 6 min (*6*).
- There tend to be fewer late cancellations and no-shows at systems serving the general public as general public riders are typically less likely to cancel trips on short notice or no-show trips because of health issues and inclement weather.

In the years post ADA, a key performance distinction among DRT systems is between those that function as ADA paratransit and those that do not (*2, 7, 8*). Importantly, the ADA regulations establish requirements that systems must meet, a number of which, essentially, set general or specific standards that affect performance (*2*). Among these include regulations that specify when and where service is to be provided, the fare structure parameters, that all trip purposes be served, that trip requests be taken for next-day service, and that capacity constraints are not allowed.

DRT systems that are not ADA paratransit do not have to meet such requirements and have more flexibility in providing service. These non-ADA paratransit systems can use a variety of policies and practices to ensure service meets available funding levels or locally determined parameters. Such systems may, for example, set days and hours of service without regard to fixed-route service; they may prioritize trips; and they may schedule frequently requested trips to predetermined times, that is, group trips to achieve higher productivities. This greater flexibility also means that such DRT systems have more latitude to make certain changes to improve performance. This is a significant difference between ADA paratransit systems and other DRT systems.

Service Area or Operating Environment

The service area influences DRT performance in several significant ways: number of people living in the service area, geographic size, and distribution of residential areas and trip destination areas. A service area with a larger population will have a larger pool of potential riders. A service area that is large geographically will tend to have longer trip lengths, and a low-density dispersion of residential areas and trip destinations across a service area will also mean longer trip lengths and less opportunity to group trips.

Trip length is a particularly important performance factor: DRT systems can serve fewer longer trips in a given amount of time compared to shorter trips, which impacts both productivity and cost per passenger trip (*2*).

Other aspects of the service area may also impact performance, such as geographic features influencing the ease or difficulty of travel throughout the community. In a related way, traffic congestion and the street network complexity in larger urban areas also impact performance, resulting in long travel times which limit DRT performance in the same way as long trip lengths. Larger urban areas may also have long trip lengths, depending on passengers' travel patterns. For larger urban areas, then, the compounding effects of traffic congestion, complicated street network, and long trip lengths put significant constraints on DRT productivity.

Type of Routing and Scheduling

The type of routing/scheduling structure has an important influence on DRT operations and performance (*1, 2, 5, 7, 9, 10*). DRT systems with a very flexible or unconstrained routing/scheduling structure will not be as productive as those with a less-flexible, constrained structure. The distinction is often described as "many-to-many," with many different pick-ups going to many different drop-offs or destinations, versus "many-to-few," "few-to-few," or "few-to-one," which groups riders traveling to only a few drop-offs or just one drop-off. The former type of DRT will have many individualized trips, with less opportunity to group trips and thus fewer trips provided in a given amount of time, whereas the latter have more opportunity to group passengers since there are limited destinations. The grouping of passenger trips will increase productivity and decrease cost per passenger trip.

Type of Operator—Public Agency versus Contractor

DRT systems can be differentiated by whether they are directly operated by a public agency versus privately operated by contract (*2, 8, 11*). The major performance distinction between the two is generally considered to be cost. With differences in labor costs between public and private transit entities and the fact that labor is the dominant single component of transit operating costs, it is generally accepted that DRT services that are contracted to private entities will result in some cost savings compared to services directly operated by a public entity. Recent research suggests that cost differences may not be statistically significant, however (*12*). According to this research, this may be due, in part, to use of financial penalties for contracted service, to the extent that contractors may be bidding price structures that cover expected losses due to the penalties, or they may be scheduling vehicles in such way as to avoid conditions that result in the penalties.

Dedicated versus Non-Dedicated Vehicles

The issue of dedicated versus non-dedicated vehicles is important from several perspectives when differentiating types of DRT service. Use of non-dedicated service may improve cost efficiency since the public entity sponsor purchases only that amount of service that is needed. Yet dedicated service provides more control to the sponsoring public agency, which may result in somewhat higher quality service. From a data collection perspective, data collection may be somewhat more difficult with non-dedicated services, particularly taxis, and this may impact efforts of the public entity sponsor in monitoring performance.

Advanced Request versus Immediate Request Service

From the perspective of a DRT system, there are several performance differences between immediate and advance request service. With immediate request service, a DRT system is able to change and insert trips on a real-time basis, providing the opportunity for higher productivity (*13*). Cancellations and no-shows are less frequent with immediate response DRT systems (*14*).

With advance reservation service, however, a DRT system can focus on refining the service-day schedule and operators' manifests, providing an opportunity for performance improvements. Late cancellations and no-shows, though, will negate some of this effort, creating "holes" in operators' schedules. To the extent that a DRT system can re-fill these "holes" with new or re-scheduled trips, some of the detrimental affects of late cancellations and no-shows can be mitigated.

DRT research has found, based on a simulation study of advanced technology, that higher rates of late cancellations negatively impact productivity. A DRT system with a lower rate of cancellations will be able to achieve higher productivity than one with a higher rate of cancellations. Assessing the damage of cancellations, the study found "...the average decrease in vehicle productivity due to cancellations appears to be an increasing function of the cancellation rate, with an approximate 4 to 5% decrease in productivity for every 10% increase in the cancellation rate" (*15*).

Use of Advanced Technology

Considerable research has been conducted that analyzes the impact of advanced technology on DRT performance, with the general conclusion being that use of advanced technology provides various performance improvements. In particular, the literature suggests that use of CASD systems can improve productivity (*12, 16, 17, 18, 19*) though reportedly the magnitude of improvement was generally not large. Improvements in such areas as the reservations function, dynamic dispatching, and providing improved information to riders have also been reported (*19*).

In addition to CASD, an AVL system has been found to improve DRT performance, according to some published accounts and research, including simulation studies (*15, 20, 21, 22*). Improvements relate to higher on-time performance and productivity gains to the extent that the real-time information provided through AVL can be used to make scheduling adjustments.

Door-To-Door versus Curb-To-Curb Service

The distinction between DRT that operates as door-to-door and curb-to-curb is another criterion affecting DRT operations and performance. From an operational perspective, door-to-door service is usually considered to increase dwell time, measured as the time that the vehicle spends from the time it arrives at the pick-up or drop-off location to the time that it departs, given that the vehicle operator goes to the door of the passenger's building at both the pick-up and drop-off to provide assistance to and from the vehicle. However, the paratransit industry lacks good, quantifiable data as to the extent of the effect, and there are some who maintain that door-to-door service may shorten dwell time (at least at the pick-up end) as the operator is helping the rider negotiate, and negotiate more quickly with the assistance, the distance from the pick-up building to the vehicle.

A recent study conducted for a large metropolitan ADA paratransit system attempted to analyze the differences in dwell time between ADA systems that are door-to-door versus curb-to-curb (*23*). Interestingly, based on information obtained from nine large ADA paratransit systems around the country, the study reported that the systems did not collect detailed data on dwell time and none considered dwell time a factor that needed close attention as it related to productivity or efficiency. According to the study, the systems reported similar dwell times regardless of whether they were door-to-door or curb-to-curb (though the study notes that the dwell times were often anecdotally estimated).

Use of Volunteers

The use of volunteers for DRT is another practice that affects DRT performance. DRT systems, particularly in rural areas and smaller communities, may use volunteers as drivers in conjunction with paid drivers as well as volunteers to serve in other capacities, such as administrative assistance (*1, 24*). Use of volunteers will provide a different cost structure than a system that uses only paid staff. For example, if operating statistics for the volunteer component are included in the system's total operating data and costs, performance on measures that use operating costs may look "better" given that there will be no labor costs for the volunteers.

TCRP Report 91: Economic Benefits of Coordinating Human Service Transportation and Transit Services (*25*), quantifies specific cost savings for several specialized transportation systems that use volunteers.

Provision of Medicaid Non-Emergency Transportation

The provision of Medicaid non-emergency transportation is yet another factor that can affect the operations and performance of DRT systems, and its impact on DRT performance is mixed

(*26*). Providing Medicaid transportation may have the potential to enhance performance, as the addition of the Medicaid clients adds to the pool of riders, thus allowing the system to schedule more trips per unit of service supplied. Yet, Medicaid trips may also hinder performance. Where such trips are long, to distant medical facilities, performance will be negatively impacted. Other Medicaid-related factors can negatively impact performance, including the level of record-keeping required for Medicaid transportation providers and the eligibility verification process which can be difficult and time-consuming. Additionally, state Medicaid agencies typically require specific software programs to interface with central state records and these programs are expensive to purchase. Significantly, Medicaid's impacts on DRT service are affected by location, since each state takes its own approach to overseeing the program, with varying requirements on the transportation providers.

Typology of DRT Systems Developed for Guidebook

The typology of DRT systems developed through the research project builds on earlier attempts to categorize DRT services. It also recognizes that a useful typology will use fewer rather than more categories and that the categories have clear demarcations that can be translated into discrete groupings.

Early attempts to classify DRT services began in the 1970s with the early development of DRT (*1, 3, 5, 9*), with the common criteria used to classify DRT services including:

- Ridership market served: general public versus a target market such as seniors or non-ambulatory riders;
- Service area or operating environment: urban/higher density versus non-urban/lower density; and
- Type of routing and scheduling structure: very flexible or unconstrained ("many-to-many") versus less flexible or constrained ("few-to-few," "few-to-one") on a semi-scheduled basis.

More recent attempts to classify DRT include these same criteria among the primary criteria for distinguishing types of DRT service, though in some cases the terminology has changed (*2, 7, 8*). Significantly, the criterion of ridership market includes the distinction of DRT that provides ADA paratransit service, recognizing the impact that the ADA regulations have on operations and performance.

The typology adopted for the Guidebook uses two of these criteria: ridership market and service area. The third criterion—type of routing and scheduling—has an important effect on performance, but this is difficult to capture with discrete categories since DRT systems are not *solely* many-to-many or many-to-one or few-to-one and so on. Rather, systems typically have a mix of trips, using various routing/scheduling parameters.

Based on the two primary criteria of ridership market and service area, defined by population size of service area, the typology developed for this project for DRT systems is shown in Table 5-2.

Table 5-2. Typology of DRT systems.

Small Urban DRT Systems *50,000 – up to 200,000 Population*			Large Urban DRT Systems *200,000 - 1 Million Population*		Largest Urban DRT Systems *Over 1 Million Population*	
ADA Paratransit Only	Limited Eligibility DRT	General Public DRT	ADA Paratransit Only	Other DRT	ADA Paratransit Only	Other DRT

While clearly there are a number of characteristics that influence DRT operations and resulting performance, it was determined that a useful typology would have fewer rather than many categories and that the categories would be relevant in practice, practical in application, and straightforward to apply.

Small Urban DRT Systems

Within the "Small Urban" DRT category, there are three types of DRT systems. "ADA Paratransit Only" refers to those systems that are designed and operated as ADA complementary paratransit systems. It would include systems that follow the ADA regulations strictly, as well as those that go somewhat beyond the strict, mandated ADA paratransit requirements, offering, for example, service to ADA-eligible riders beyond the ¾-mi corridors around fixed routes and systems that provide premium services to ADA-eligible riders, such as will-call trips and same-day taxi service. DRT systems in this category, however, are those that are defined predominately by the ADA regulations.

"Limited Eligibility DRT" includes DRT systems that serve specialized groups, typically seniors and riders with disabilities, sometimes defined as ADA-eligible. Also included in this category would be systems that serve senior, disabled, and low-income riders, as well as other locally defined specialized rider markets.

The third DRT system type within the small urban DRT category is "General Public DRT," and this is the least common type of urban DRT. However, there are some smaller cities and communities that provide general public DRT as the only form of local transit. And some communities that have provided general public DRT service since the 1970s decided to continue such service, even after introducing fixed-route service. In a number of these communities, the DRT service is re-configured so that it provides DRT service to only ADA-eligible riders within the ¾-mi corridors of the fixed-routes and general public DRT service beyond the ADA-defined corridors.

Large Urban DRT Systems

The "Large Urban" DRT category includes demand-response systems operating in urban areas with populations of more than 200,000 and up to one million. Within this group are two categories of DRT systems: "ADA Paratransit Only" and "Other DRT." The "ADA Paratransit Only" systems are defined in the same way as in the small urban DRT group, and "Other" includes all other DRT systems, such as those serving senior and disabled riders as well as those serving specialized markets and the general public. Since there are very few DRT systems serving general public riders in areas of this population size, it was determined that the typology would not include a separate category for general public DRT systems.

Largest Urban DRT Systems

The "Largest Urban" DRT group includes those DRT systems operating in major cities with more than one million population, and includes the same two categories of DRT systems as in the Large Urban DRT group: "ADA Paratransit Only" and "Other."

The Typology in Practice

Using the typology of DRT systems, the next chapter of the Guidebook provides performance data for representative DRT systems within each of the seven categories for the five key performance measures selected for the project. These data can serve as benchmarks for other DRT systems interested in comparing their own performance to that of similar systems.

CHAPTER 6

Assessing Performance—Data from Representative Systems

Using the typology of DRT systems described in Chapter 5, this chapter presents performance data for representative DRT systems for the five performance measures selected for the Guidebook, facilitating performance comparisons among similar types of DRT systems.

The chapter includes the following:

- The selection of representative DRT systems.
- Performance data from the representative systems, providing benchmarks within each of the seven DRT system categories.
- Additional details about the characteristics of individual DRT systems affecting their performance are provided in an attachment to this chapter.

6.1 Representative DRT Systems Within the Typology

To assist DRT systems in comparing their performance against other systems, the Guidebook provides representative data for a number of DRT systems within each category of the DRT typology defined in Chapter 5.

Selecting Representative DRT Systems

To find representative DRT systems within each of the seven categories of DRT, various DRT systems of different types and in different cities across the country were contacted for participation in this research project. This was not an attempt to provide a statistically valid sample of systems, but rather to provide valid reference points for each category of DRT system. There was an attempt made to provide geographic diversity of representative DRT systems, but no objective to seek "stars" or "poor performers" to frame the data.

Collecting Data from Representative DRT Systems

Once representative DRT systems agreed to participate, the researchers collected the performance data—NTD-defined and other data for FY 2005—using on-site visits and telephone interviews. Information about the system and its operating environment was also collected to develop an understanding of the factors and circumstances affecting each system's performance. It was also agreed with the participating systems that the research report would not relate specific performance data to individual systems. The participating systems are listed in Table 6-1, and their locations are shown in Figure 6-1.

Table 6-1. DRT systems participating as representative systems.

DRT Systems	City and State
ACCESS (Orange County Transportation Authority)	Orange, California
ACCESS, King County Metro	Seattle, Washington
ACCESS Lynx Paratransit Service	Orlando, Florida
ACCESS Transportation Systems (Port Authority of Allegheny County)	Pittsburgh, Pennsylvania
access-a-Ride (Regional Transportation District)	Denver, Colorado
ADA Paratransit – C.A.T. (Cities Area Transit)	Grand Forks, North Dakota
Ames Transit Agency/CyRide	Ames, Iowa
CAT ADA Paratransit (Citizens Area Transit)	Las Vegas, Nevada
CCT Connect – SEPTA (Southeastern Pennsylvania Transportation Authority)	Philadelphia, Pennsylvania
Champaign-Urbana MTD (Mass Transit District)	Champaign-Urbana, Illinois
Charlotte Dial-A-Ride Services CATS (Charlotte Area Transit System)	Charlotte, North Carolina
CitiAccess	Lubbock, Texas
City of Glendale Dial-A-Ride	Glendale, Arizona
Corona Dial-A-Ride	City of Corona, California
CountyRide (Baltimore County)	Baltimore, Maryland
DART Paratransit (Dallas Area Rapid Transit)	Dallas, Texas
Eau Claire Paratransit	Eau Claire, Wisconsin
Fastran	Fairfax County, Virginia
JTA Connexion (Jacksonville Transportation Authority)	Jacksonville, Florida
Kitsap Transit ACCESS	Bremerton, Washington
Lift, Tri-Met	Portland, Oregon
LinkPlus	Wenatchee, Washington
Logan Call-A-Ride	Logan, Utah
Medical Motor Service of Rochester & Monroe County, Inc.	Rochester, New York
Metro Mobility	Minneapolis/St. Paul, Minnesota
METROLift (Metropolitan Transit Authority)	Houston, Texas
Mobility/Paratransit (Maryland Transit Administration)	Baltimore, Maryland
MTS Rides (Monterey-Salinas Transit)	Monterey, California
Piedmont Wagon Transit	Hickory, North Carolina
RABA Demand-Response (Redding Area Bus Authority)	Redding, California
Reserve-A-Max – MAX Transit	Holland, Michigan
Roseville Transit Dial-A-Ride	Roseville, California
RTC/Access (Regional Transportation Commission)	Reno, Nevada
Spokane Transit Paratransit	Spokane, Washington
SweetHART (Housatonic Area Regional Transit)	Danbury, Connecticut
Teleride (Chatham Area Transit)	Savannah, Georgia
TransIT-plus	Frederick, Maryland
UTA Flextrans Paratransit Service (Utah Transit Authority)	Salt Lake City, Utah
Zips Dial-A-Ride (Rochester City Lines)	Rochester, Minnesota

Figure 6-1. Representative DRT systems participating in research project.

In collecting the data from the DRT systems, it was discovered that there were cases where the reported data did not fit NTD definitions. In such cases, additional information was requested so that adjustments could be made to ensure the data were more consistent with NTD.

Two common reporting problems were found. The first was the inclusion of vehicle capital costs with operating data. In several cases, the capital costs of vehicles were included in operating cost data for DRT systems that contract services. There were examples of this with DRT systems in both the small urban and largest urban categories.

The second problem related to reporting supplemental, non-dedicated taxi services. There were several systems using supplementary taxi services where the taxi trips were included, but not any miles or hours for the taxi service, or the taxi costs were included but there was no taxi service data included.

There was a third issue, which was found at three systems, two small and one large urban system, with contracted service. And that was the absence of any city administrative costs over the contracted service cost with the reported total DRT operating costs.

With additional information from the DRT systems concerning data reporting issues, adjustments were made to the data. The adjustments did not make major differences in the resulting performance results, and all instances of adjusted performance data are noted in the results presented in this chapter.

6.2 Comparing Your Performance Against Other Systems—Performance Data of Representative DRT Systems

This section provides the performance data for the five key measures for the representative DRT systems. For four of the five measures, the data are organized within the three major groups of urban DRT systems: small urban, large urban, and largest urban DRT. Performance data on the safety measure, the fifth performance measure, then follows.

Small Urban DRT Systems

Within the small urban DRT systems, data were collected from 14 representative systems: of these, there are five systems within the category of *ADA paratransit only*, six systems within *limited eligibility* DRT, and three systems within the *general public* category. Performance data are provided below for these systems.

1. Productivity—Passenger Trips per Revenue Hour

Productivity may be the single most significant performance measure for a DRT system. In the early years of DRT, when much of the service was provided in smaller communities for the general public on an immediate response basis, a wide range of productivity was reported, from two up to more than ten passengers per hour (*5*). A more typical range was four to six passenger trips per hour for immediate response and general public DRT service (*27*).

With the passage of the ADA and with the trends toward serving limited segments of the population on an advance reservation basis, DRT productivity is generally lower. This is reflected in the performance data from the representative systems collected for this research project, as shown in Figure 6-2, with the majority of the systems' productivity ranging between two and four passenger trips per revenue hour. Systems serving the general public tend to be somewhat more productive than those serving only ADA paratransit riders or those serving limited eligibility riders.

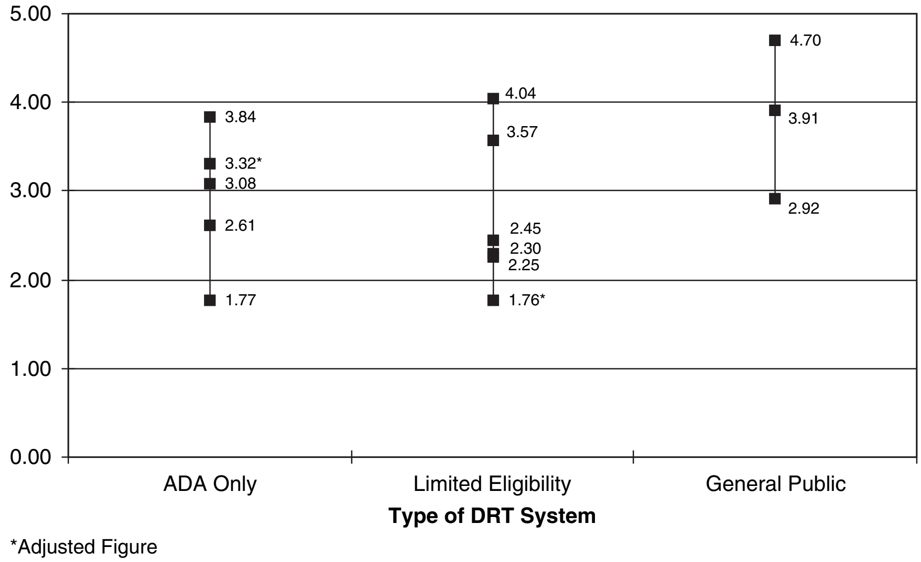


Figure 6-2. Small urban DRT systems: passenger trips per revenue hour.

2. Operating Cost per Revenue Hour

Among the representative small urban DRT systems, there is a wide range on the performance measure operating cost per revenue hour (see Figure 6-3). The range is almost $20 per revenue hour to $80 per revenue hour, with this range occurring in the *ADA paratransit only* category. The system at the high end is a full-scale transit entity, providing the full range of functions needed for transit operations and using a cost-allocation procedure that allocates, among other costs, a share of all fixed facilities to DRT. There is less variation shown in the *limited eligibility* category, and very little variation shown in the *general public* category, influenced by the fact that

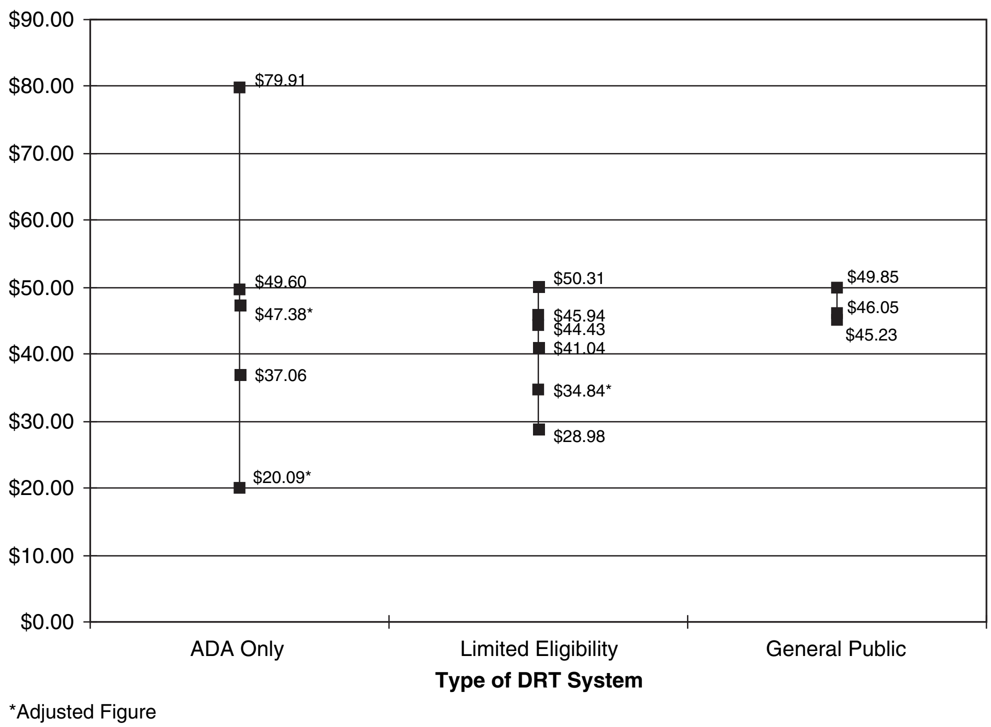


Figure 6-3. Small urban DRT systems: operating cost per revenue hour.

the three representative systems in this latter category are similar—all city-based programs operated by national or regional private contractors.

Within all three categories of small urban DRT, the majority of the systems (11 out of 14) cluster between $35 and $50 per revenue hour. Nine of the 14 systems range between $40 and $50 per revenue hour.

3. Operating Cost per Passenger Trip

On this measure, the small urban DRT systems range from $8 to $22 per passenger trip (see Figure 6-4).

Examining the small urban systems as a whole as well as within the three categories, there appear to be two distinct groupings of systems on this measure—those with a cost per passenger trip ranging from $8 to $13 and those ranging from $17 to $22. There does not seem to be a discernable pattern to the two clusters: DRT systems in the group with the lower cost per passenger trip include systems with a relatively high productivity and those with a relatively low productivity. For those systems with a lower productivity, to achieve the lower cost per passenger trip, the system must also have a relatively low operating cost per revenue hour.

4. On-Time Performance (OTP)

Of the 14 representative small urban DRT systems, four do not formally measure their OTP, although one of these four "advertises" an on-time window.

A 30-min window is the most common (with six systems using 30-min windows) that is provided to riders for their trip pick-up, followed by a 20-min window (three systems), and 15-min window (two systems).

All but one of the ten systems reporting OTP statistics report percentages above 90%, with two reporting 100%. The one system below 90% is barely below, reporting an 89% OTP (see Figure 6-5).

Not surprisingly, MDTs and AVL are not common among small urban DRT systems. Only one participating system in this group of small urban DRT reports use of MDTs and AVL during the study time frame.

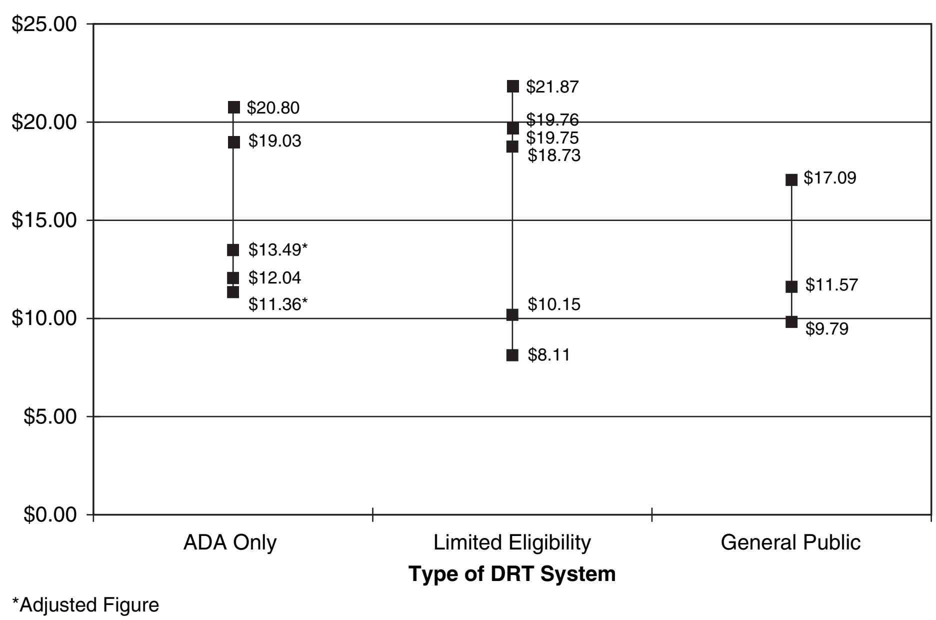


Figure 6-4. Small urban DRT systems: operating cost per passenger trip.

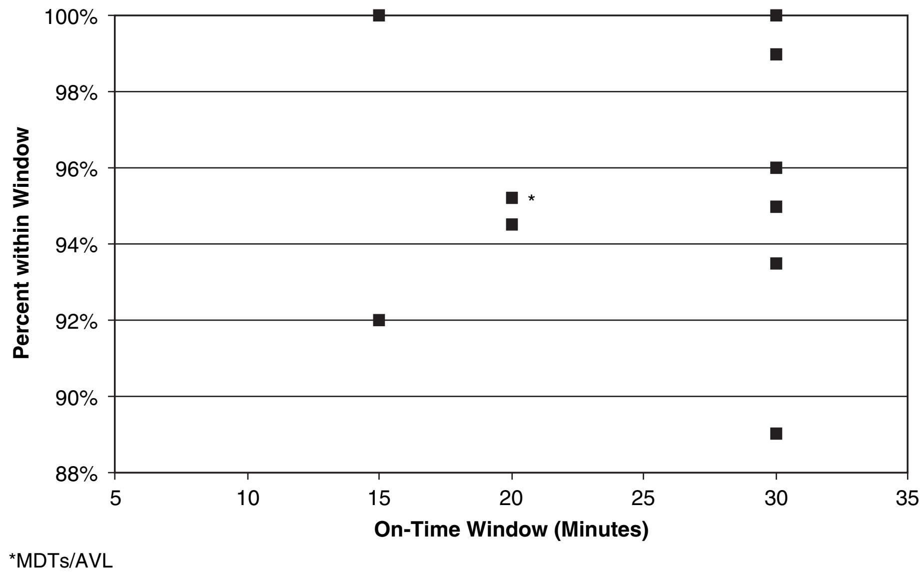


Figure 6-5. Small urban DRT systems: on-time performance by on-time window.

Large Urban DRT Systems

The research project included ten large urban DRT systems as representative—those operating in areas with populations of more than 200,000 and up to one million. Five of these operate *ADA paratransit only*. Of the remaining five, four are *limited eligibility* and one is *general public*. This latter category is labeled "*other*" to account for the one general public DRT system in the group.

Reported, and adjusted in some cases, performance data on the performance measures are discussed below.

1. Passenger Trips per Revenue Hour

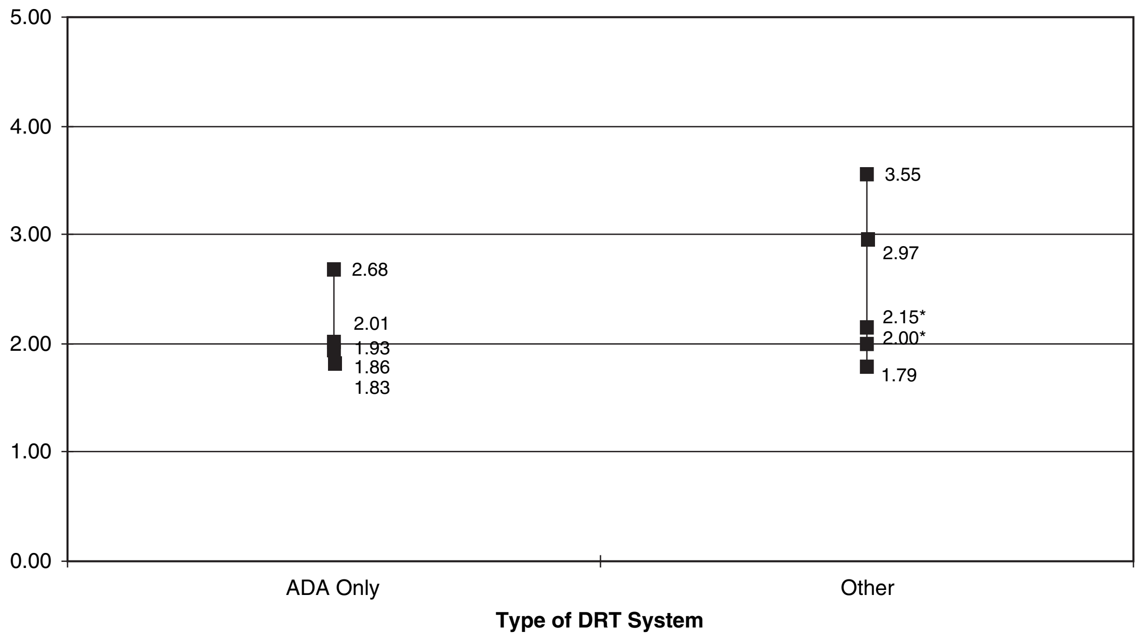
The range on the productivity measure for the large urban systems is 1.79 to 3.55 (see Figure 6-6), a smaller range than seen for the small urban systems. The range is even less if the supplemental van program is subtracted out from the DRT system with the 3.55 productivity. This system directly operates DRT service, and also has a supplemental program providing vehicles and support (e.g., fuel, maintenance) to local human service agencies so that they can transport their clients with specialized transportation needs. Without the data for this supplemental van program, the DRT system's productivity is 3.0 passenger trips per revenue hour. This would make the range of productivity of the representative systems in the large urban category 1.8 to 3.0.

Within both categories of large urban systems, there is a clustering of productivity between 1.8 and 2.2.

2. Operating Cost per Revenue Hour

For this performance measure, the large urban systems range from $32 to $77 per revenue hour (see Figure 6-7). While this is a wide range, it is smaller than that seen for the small urban systems ($20 to $80/revenue hour). For the large systems, the variation was somewhat greater for systems in the *other* category compared to the *ADA only* category.

For all ten representative systems in the large urban category, most of the systems (seven out of ten) fell within the range of $44 to $69 per revenue hour.



*Adjusted Figure

Figure 6-6. Large urban DRT systems: passenger trips per revenue hour.

3. Operating Cost per Passenger Trip

The large systems show a range of performance on the measure operating cost per passenger trip, from a low of $15 to a high of almost $36 (see Figure 6-8). This can be compared to the range seen for the small urban systems of $8 to $22 per passenger trip.

In the *ADA only* category, there is a clustering on the measure between $24 and $28 per passenger trip, while the data in the *other* category shows more variance.

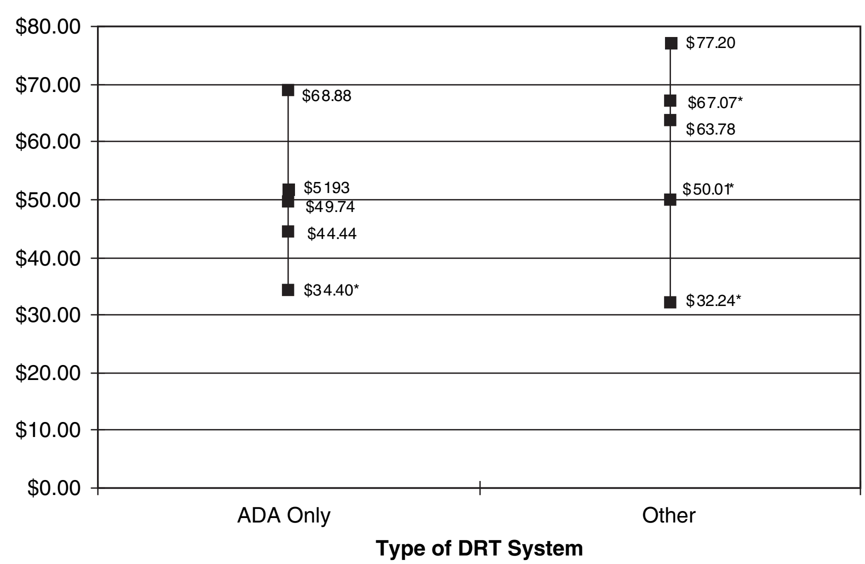


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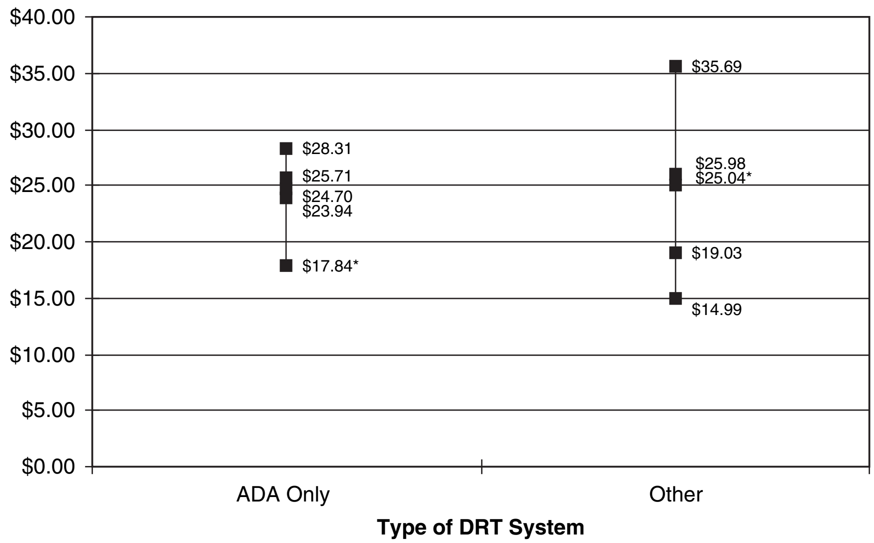
Figure 6-7. Large urban DRT systems: operating cost per revenue hour.



*Adjusted Figure

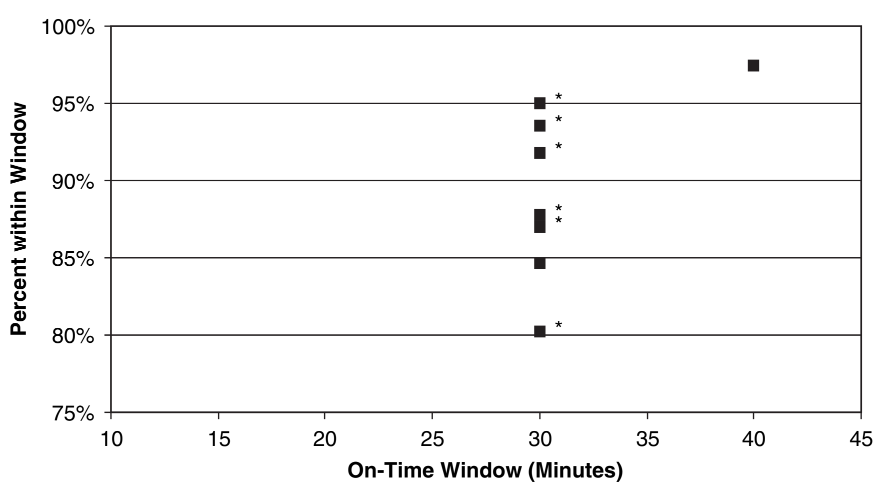
Figure 6-8. Large urban DRT systems: operating cost per passenger trip.

4. On-Time Performance

Of the ten representative DRT systems in this group, only one does not measure OTP data. The non-reporter is a limited eligibility system that provides no ADA paratransit service.

Eight of the nine systems that measure OTP use a 30-min window to define on-time. The ninth system uses a 40-min window; this is a limited eligibility DRT system that provides no ADA service and operates in a relatively large service area.

Eight of the participating DRT systems in the large urban category that measure OTP provided performance data for the research project. One system which monitors OTP indicated problems with the available data, so it did not provide any OTP figures. As shown in Figure 6-9, the systems using a 30-min window reported performance ranging from 80 to 95%. The system with a longer, 40-min window reported the highest performance at 97.5%.



*MDTs/AVL

Figure 6-9. Large urban DRT systems: on-time performance by on-time window.

Six of the eight systems providing OTP data use MDTs and AVL. With this technology, reported OTP data tends to be more reliable.

Largest Urban DRT Systems

Thirteen representative DRT systems are included in the largest urban category, those operating in areas with a population larger than one million. Of the 13, nine are in the *ADA paratransit only* group and four are in the *other/limited eligibility* group. Three of the four in this latter category are *limited eligibility* DRT systems, and the fourth, while available for *general public* use, is essentially limited eligibility in practice.

Reported, and adjusted in some cases, performance is discussed below.

Passenger Trips per Revenue Hour

Productivities achieved by the largest urban systems, not surprisingly, are lower than those obtained by the two other main categories of systems (see Figure 6-10). For the *ADA only* systems, the range is 1.3 to 2.3. For four of the five *other/limited eligibility* systems, the range is slightly higher, from 1.5 to 2.4. This latter grouping of systems also includes a system that reached a productivity of 4.35, a level comparable to that achieved by a small urban general public system, and clearly the highest productivity among the largest systems. This system is predominately a subscription service for human service agency clients and regularly transports group loads, benefiting its productivity figure. The system, without any ADA service, has considerable latitude to make adjustments that improve its efficiencies and has done so in recent years, "zoning" roughly one-quarter of its riders so that they have to use the closest facility for their trip purpose. This strategy reduces trip lengths and creates more opportunities for shared riding.

Operating Cost per Revenue Hour

On this performance measure, the largest urban systems ranged from $35 to $76 per revenue hour, with a clustering between $47 to $63 (nine of the 13 systems are within this range) (see Figure 6-11). Perhaps not surprisingly, the *ADA only* systems are more similar to each other on this measure than the *other* systems. Within the *ADA only* category, eight of the nine systems are within the $47 to $63 per revenue hour range.

The four representative systems in the *other* category show much greater variation on the measure, reflecting the varying objectives and characteristics of the transportation services that are provided.

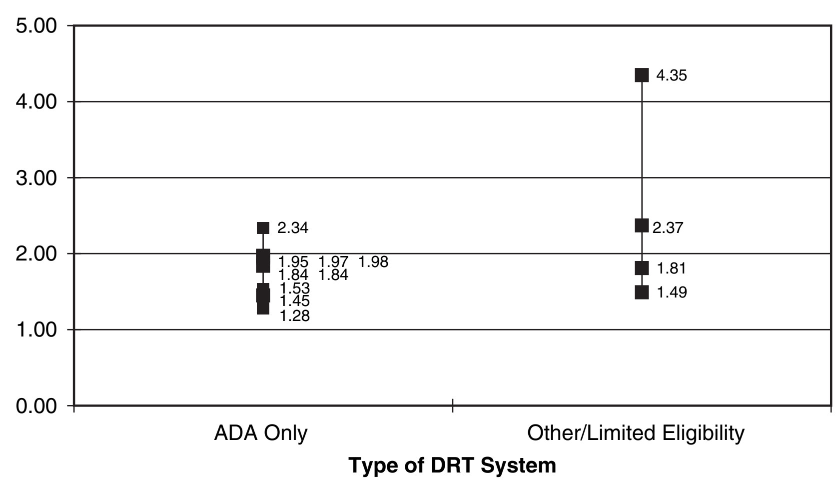


Figure 6-10. Largest urban DRT systems: passenger trips per revenue hour.

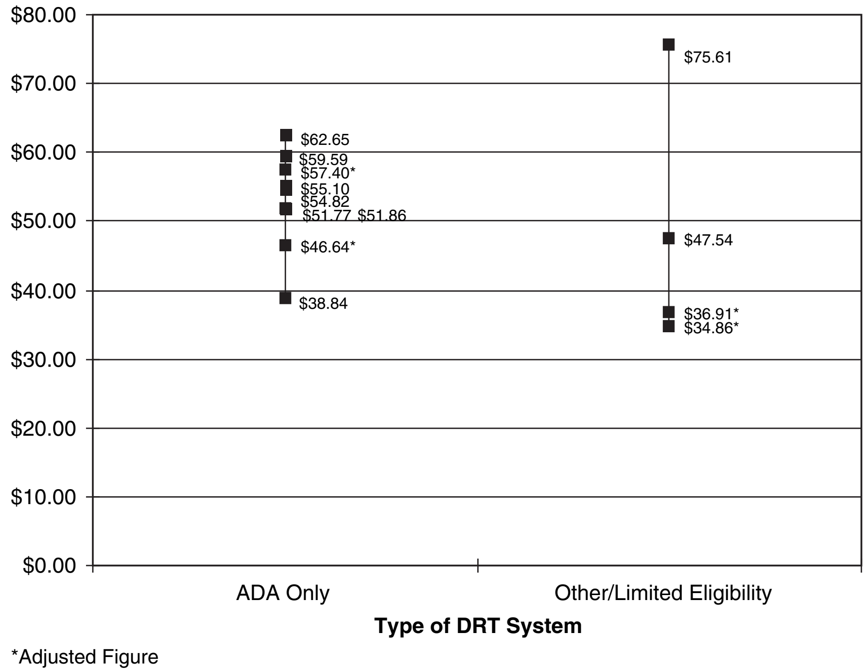


Figure 6-11. Largest urban DRT systems: operating cost per revenue hour.

Operating Cost per Passenger Trip

The largest urban systems range from $16 to $40 per passenger trip, with greater variability seen in the *ADA only* category than the *other* category (see Figure 6-12). Among the *ADA only* systems, while the operating cost per revenue hour clustered within a range from $47 to $63, the cost per passenger trip shows a broader range, from $21 to $40 per passenger trip. For the *other* systems, the range in cost per passenger trip was less, from $16 to $26.

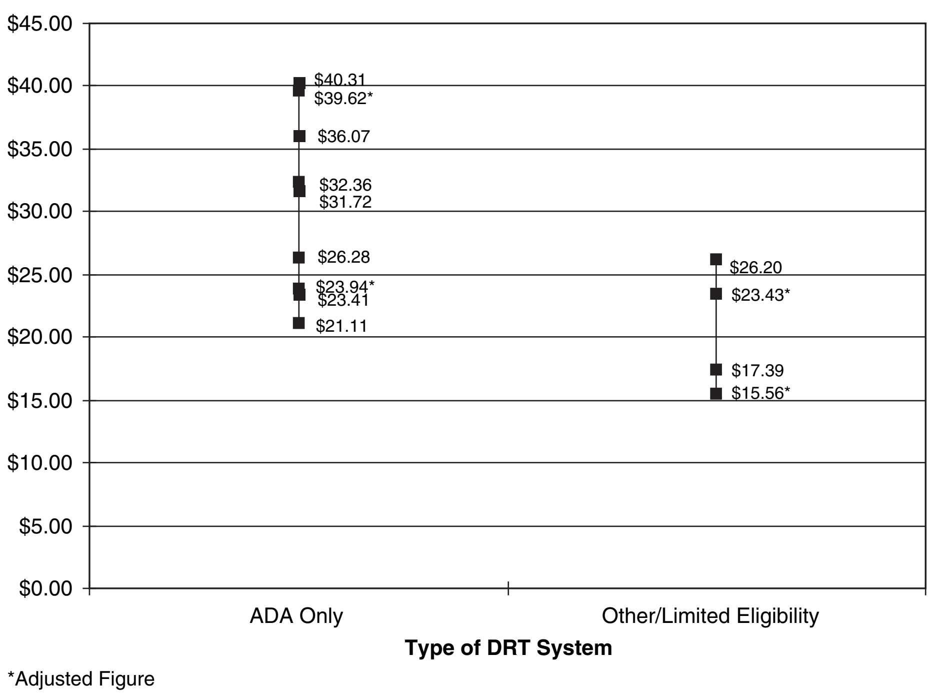


Figure 6-12. Largest urban DRT systems: operating cost per passenger trip.

Key to this performance measure is productivity. A DRT system may have a relatively high cost on a revenue hour basis, but can show a relatively low cost per passenger trip depending upon its productivity. Among the *ADA only* systems, the system with the highest cost per revenue hour exemplifies this. This system's cost per revenue hour is $62.65, the highest in its category. Yet since this system transports, on average, 1.98 passenger trips per revenue hour, its cost per passenger trip is $31.72, which is the mid point of the systems in the largest urban category on this measure.

On-Time Performance

Of systems in the largest urban category, OTP data were obtained from 11 systems. Six of these systems used MDTs and AVL to report on-time data as shown in Figure 6-13. One system uses a statistically valid sampling process to collect real-time OTP data, using operator and AVL information.

On-time windows for determining vehicle timeliness vary, though the most common, as with the small urban and large urban categories, is 30 min. It should be noted that the three systems that have windows longer than 30 min for determining OTP use a 30-min window for scheduling trips with their riders. That is, the rider is provided a 30-min window when the trip is scheduled, however, the systems' contractors have additional time beyond the 30 min before the vehicle is determined late for purposes of contractor performance. According to one of the DRT systems, this additional time gives schedulers more latitude to fit trips onto vehicle schedules, keeps operators from rushing to meet the on-time requirement, and provides reasonableness against the liquidated clauses in the provider contracts.

Summary Performance Data

Summary performance data from the representative DRT systems are shown in Table 6-2, within the categories of DRT systems. The key factors influencing the reported performance are also shown, as identified through the on-site visits and interviews with the participating DRT systems. Discussed in more detail in Chapter 7, some of these factors can be controlled or at least partially controlled by the DRT system, while other factors are not controllable.

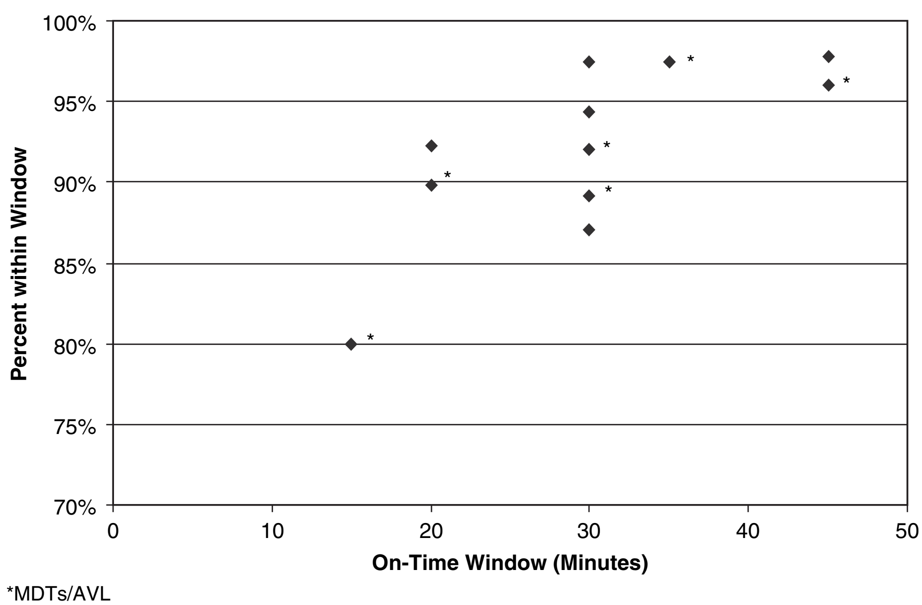


Figure 6-13. Largest urban DRT systems: on-time performance by on-time window.

Table 6-2. Range of performance data from representative DRT systems and factors influencing performance.

Representative DRT Systems by Category	Passenger Trips/Revenue Hr. *Effectiveness*	Operating Cost/Revenue Hr. *Cost-Efficiency*	Operating Cost/Passenger Trip *Cost-Effectiveness*	On-Time Performance *Service Quality*
Small Urban Systems • ADA Only (5 systems) • Limited Eligibility (6 systems) • General Public (3 systems)	1.77 - 3.84 1.76 - 4.04 2.92 - 4.70	$20.09 - $79.91 $28.98 - $50.31 $45.23 - $49.85	$11.36 - $20.80 $8.11 - $21.87 $9.79 - $17.09	15-min. window: 92% - 100% (2 systems) 20-min. window: 94.5% - 95.2% (2 systems) 30-min.window: 89% - 100% (6 systems)
Large Urban Systems • ADA Only (5 systems) • Other (5 systems)	1.83 – 2.68 1.79 – 3.55	$34.40 - $68.88 $32.24 - $77.20	$17.84 - $28.31 $14.99 - $35.69	30-min.window: 80.2% - 95% (7 systems) 40-min.window: 97.5% (1 system)
Largest Urban Systems • ADA Only (9 systems) • Other (4 systems)	1.28 – 2.34 1.49 – 4.35	$38.84 - $62.65 $34.86 - $75.61	$21.11 - $40.31 $15.56 - $26.20	15-min. window: 80% (1 system) 20-min. window: 89.8% -92.2% (2 systems) 30-min.window: 87% - 97.4% (5 systems) 35-min. window: 97.5% (1 system) 45-min. window: 96% - 97.8% (2 systems)
Factors Influencing Performance				
Controllable/Partially Controllable	- System focus on productivity - No-shows/late cancels - Dwell times - Scheduling/dispatch skills - Degree of group trips - Matching revenue hours to ridership demand - Use of local non-profits as supplemental providers	- Type of operator (e.g., private transit contractor, taxi co., city/county, transit authority) - Administrative/overhead costs - Costs for operator labor - Use of local non-profits as supplemental providers - Cooperative arrangements to purchase fuel, maintenance	- Type of operator - Administrative/overhead costs - Costs for operator labor - Matching revenue hours to ridership demand - Use of local non-profits as supplemental providers - Cooperative arrangements to purchase fuel, maintenance - Focusing on productivity - No-shows/late cancels - Dwell times - Scheduling/dispatch skills - Degree of group trips	- Use of MDTs and AVL - Use of CASD system - Scheduling/dispatch skills - Vehicle operator availability, i.e., fully staffed, under-staffed - System focus on on-time performance
Uncontrollable	- Type of ridership (e.g., ADA vs. non-ADA) - Trip length - Size of service area - Density of service area - Service area constraints, e.g., traffic congestion, bridges	- Location in higher/lower wage region of country - Increasing demand for service	- Type of ridership - Trip length - Size and density of service area - Service area constraints - Location in higher/lower wage region of country	- Size of service area - Service area constraints, e.g., traffic congestion, bridges

Passenger Trips per Revenue Hour

This measure of productivity showed a range of performance among the participating DRT systems, with the smaller systems generally achieving higher productivities than the larger systems.

Factors Influencing Performance

The key controllable and partially controllable factors that seem to affect DRT systems' ability to achieve a higher performance relative to the other representative systems include:

- A specific focus on increasing productivity, by increasing shared-riding, by developing new services that feature group trips (e.g., shopper shuttles), and in several cases, by including a productivity standard in the contract for the private operator;
- A low rate of no-shows and late cancellations;
- Short dwell times;
- The skills of scheduling and dispatch staff to create effective operator schedules;
- Reducing unproductive revenue time by better matching revenue hours to ridership demand; and
- Using community-based non-profit agencies as supplemental providers, which provide group trips at high levels of productivity.

The uncontrollable factors include:

- The type of ridership market that is served, in particular, whether the system is ADA only;
- Average trip lengths;
- The size of the service area, which impacts trip lengths;
- The density and development patterns of the service area; and
- Service area constraints, such as traffic congestion which is a serious constraint in large metropolitan areas, bridges, bodies of water or other features impacting travel within the service area.

Operating Cost Per Revenue Hour

On the performance measure *operating cost per revenue hour*, the representative systems ranged from a low of $20 to a high of $80. Interestingly, this range comes in the small urban category, reflecting the diversity of systems in this category as well as differences in cost allocation methods to DRT. The system operating at $20 per revenue hour is a city-based system, with minimal administrative and overhead costs for such ancillary functions such as accounting and planning, and day-to-day service is operated by a small, regional private provider with a competitive cost structure. The system operating at $80 per revenue hour is a full-scale transit entity, providing all functions necessary for transit operations, and using a cost-allocation procedure that allocates, among other costs, a share of all fixed facilities to DRT. This procedure contributes an estimated $20 per hour to the reported operating cost per hour figure.

Factors Influencing Performance

For this performance measure, the important controllable and partially controllable factors include:

- The type of DRT operator, that is, whether the service is operated by a private transit contractor, a local taxi company, a city or county, or a full-scale transit authority. This is a factor that might be considered only partially controllable, since decisions on the type of operator are often determined by the system's decision-making body, and not directly by the DRT manager.
- The administrative effort and cost for the DRT service. The representative systems with low operating costs per revenue hour typically have limited administrative and overhead costs allocated to the DRT service.

- Costs for vehicle operator labor, with several of the higher cost DRT systems indicating that their wage rates for operators were comparable to those for fixed-route operators.
- Use of community-based non-profit agencies as supplemental providers, which operate with lower and, in some cases, significantly lower operating costs than the DRT system.

The key uncontrollable factors influencing this measure include:

- Location of the system relative to higher or lower cost regions of the country. In particular, the DRT systems operating within the major urban/suburban regions on the east and west coasts are subject to higher wage pressures than those located outside such areas.
- Increasing demand for service, particularly for those systems that provide ADA paratransit, has required DRT systems to increasingly add service to ensure that capacity is available.

Operating Cost per Passenger Trip

Reflecting DRT systems' operating costs and productivity, this measure ranges from $8 to $40 per passenger trip for the representative systems. Among the 14 systems within the small urban category, performance clusters within two ranges, with seven systems ranging from $8 to $13 per passenger trip, and the other seven between $17 to $22 per passenger trip.

Within the large urban category, performance on this measure ranges from $15 to $36 per passenger trip, with six of the ten systems in the group falling between $24 and $28 per passenger trip.

Performance in the largest urban category shows somewhat higher costs per passenger trip, from $16 to $40. Among the 13 systems in this category, 11 range between $21 and $40 per passenger trip.

Factors Influencing Performance

The factors influencing performance on this measure are the same as those impacting the prior two measures, since operating cost per passenger trip relates productivity to cost per hour. What is important to recognize, however, is that a DRT system can have a relatively high operating cost per hour and still have a low cost per passenger trip if productivity is high.

On-Time Performance

Data obtained from the representative systems reflect different perspectives and definitions of "on-time." Among the smaller systems, four do not even measure OTP, given the small scale of their operations. The larger systems, particularly those that are ADA paratransit, focus considerable attention on this measure, given ADA regulations concerning capacity constraints.

Among the 29 systems providing data on the measure, the majority uses a 30-min on-time window. The other systems use windows of 15, 20, 35, 40, and 45 min for determining if the vehicle is late.

More than two-thirds of the systems with data for OTP reported on-time percentages at 90% or higher. Of the remaining systems, most were in the high 80% range.

Relative to OTP, one of the important issues raised by participating DRT systems was the use of AVL technology, with MDTs. System managers with this technology were very positive about its capabilities that allowed the systems to monitor vehicles in real-time and to make adjustments to improve timeliness.

Factors Influencing Performance

The primary controllable and partially controllable factors impacting DRT systems' performance on this measure include:

- Use of AVL/MDT technology, as indicated above. However, at least one small system reported that use of a CASD system, *without* AVL/MDTs, facilitated its improved OTP.

- Ability of systems' scheduling and dispatch staff to create effective and realistic schedules.
- Operator availability. Several systems noted issues related to having an inadequate number of vehicle operators, which can then impact OTP if scheduled vehicles are not assigned on the day of service because of operator shortages.
- A *focus* on OTP. Particularly for those DRT systems that are ADA paratransit, OTP is a key operational focus of DRT managers, given ADA regulations on capacity constraints.

The uncontrollable factors related to OTP, according to the representative DRT systems, include:

- Size of the service area and geographic constraints of the service area.
- Traffic congestion and the increasing unreliability of that traffic congestion. These were cited as particular factors by systems in major metropolitan areas. The unreliability factor is increasingly problematic, as recent research has found that the majority of congestion delays are caused not by recurring traffic but by unpredictable, non-recurring events such as crashes, bad weather, and vehicle breakdowns (*28*), which makes it more difficult to predict travel times. This in turn impacts DRT scheduling and OTP.

Safety Performance—Safety Incidents per 100,000 Vehicle Miles

Safety incidents per 100,000 vehicle miles is the last of the five key performance measures identified for the Guidebook. As discussed in Chapter 3, safety incidents are defined through the NTD reporting requirements and include both NTD's major and non-major safety incidents.

What became clear through the project's data collection efforts from the representative systems is that the NTD safety data are not the critical safety data that DRT systems monitor. The DRT systems have more stringent definitions of accidents and incidents than those used by NTD and such data are monitored closely. DRT systems that contract for service often include performance incentives and liquidated damages associated with accidents to ensure contractor attention to safety.

While not the key safety data from DRT managers' operational perspective, use of the NTD definition provides for a standardized definition of a safety-related incident. Those DRT systems that are NTD reporters provide the required data on safety with their NTD reports. The safety data are reported on a quarterly or monthly basis depending on the size of the transit agency.

The safety incident data, available from 30 of the representative systems, are shown in Figure 6-14. The experience of one small urban DRT system skews the data for the remaining systems. This system reported six safety incidents (all non-major) for the reporting year (FY05), and given its small size, traveled less than 400,000 annual vehicle miles. No other small urban DRT system participating in the research (and that are NTD reporters) reported any NTD safety incidents for that year.

Figure 6-15 shows the safety incident data without the small urban DRT systems. As can be seen, the range on this performance measure is 0.00 to 0.34 incidents per 100,000 vehicle miles. Within the large urban category, eight systems provided data, with four reporting no incidents. Within the largest urban category, ten systems provided safety incident data. All of these systems reported incidents, with three incidents as the least reported and more than 25 incidents as the most reported for the system.

What the safety data also demonstrate is that safety incidents are not very common relative to the transportation service that is provided. For example, within the largest urban category, two systems measured 0.10 incidents per 100,000 vehicle miles. The first system traveled almost five million vehicle miles, and the second system more than eight million miles in DRT service. Given the relative infrequency of safety incidents, a DRT system that wants to review peer data would likely need a data pool larger than what is available in this chapter.

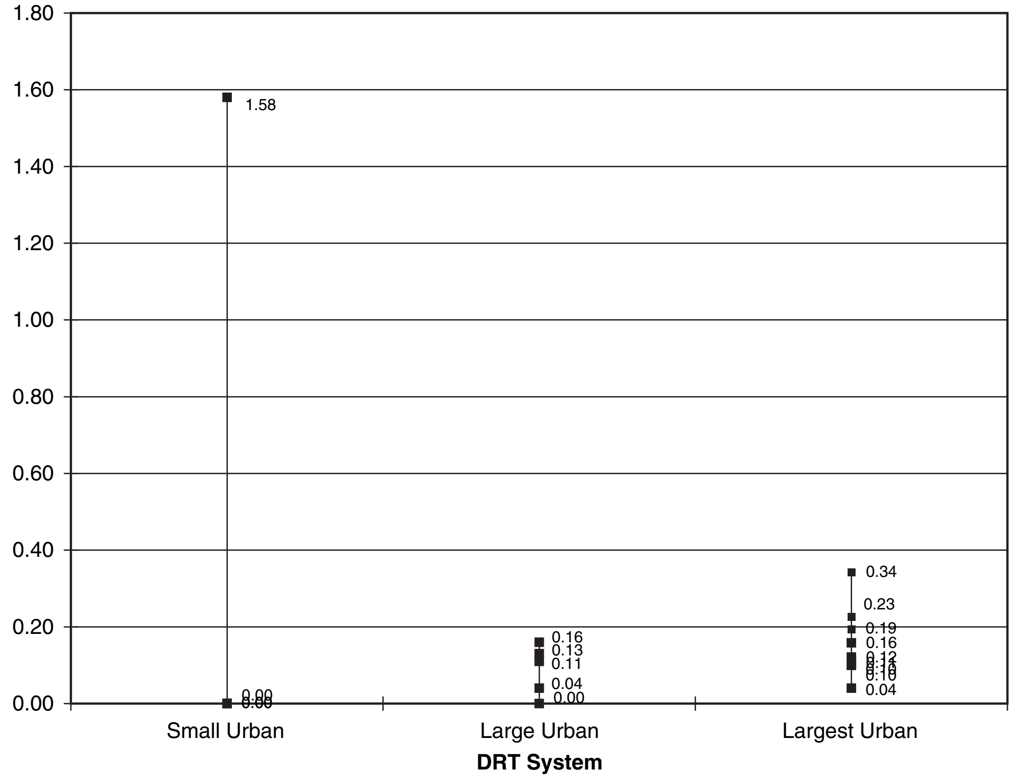


Figure 6-14. Safety incidents per 100,000 vehicle miles: small, large, and largest urban DRT.

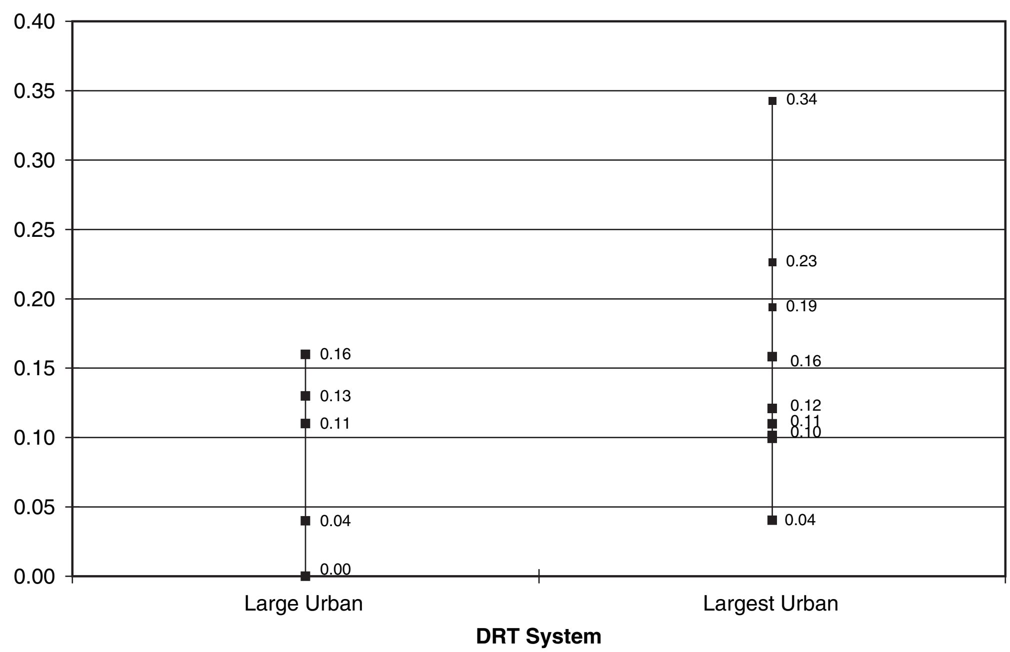


Figure 6-15. Safety incidents per 100,000 vehicle miles: large and largest urban DRT.

But significantly, in terms of monitoring safety, what is important is the trend shown *within* a system rather than comparisons between systems.

Attachment to Chapter 6

Performance Data of Representative DRT Systems: Additional Detail

This section provides additional detail about the performance of the representative DRT systems included in the research project, providing a context for the performance data. What are the factors and characteristics of a particular DRT system that enables it to achieve a higher productivity than others in its category? What factors impact the DRT system with the lowest reported productivity in the category? Such information may be useful to an individual DRT system reviewing the reported performance data in this Guidebook and may help the system synthesize what the reported results mean in relation to its own circumstances and operating environment.

For Figures 6-2 to 6-4, Figures 6-6 to 6-8, and Figures 6-10 to 6-12, there is a corresponding table in this attachment that provides information about the DRT systems with the highest and the lowest reported performance on the specific measure. The tables are labeled to show the corresponding figure so that the reader can refer back to the graphic presentation if desired.

Small Urban DRT Systems

Table 6A-1 (Figure 6-2)

Small Urban DRT: Passenger Trips per Revenue Hour (Productivity)

Characteristics of Systems Affecting Performance
ADA Paratransit Only DRT
Highest —3.84 passenger trips per revenue hour • The average trip length is relatively short, at 4.4 mi. • No-shows and late cancellations, defined as a cancellation made less than one hour before the scheduled pick-up time, are relatively infrequent, at 1.6% of scheduled trips. • Service is provided only within the ¾-mile corridors required by ADA. • Drivers are experienced, with an average tenure of 13 years. • Transit system is focused on improving performance, experimenting with different ways to serve demand. • The service is predominately directly operated by the transit system, with some contracted service. • DRT as well as fixed-route service is provided by the system, which is a public transit entity created by the local jurisdictions (the county and included cities) in accordance with state law, with the ability to levy dedicated transit funding.
Lowest —1.77 passenger trips per revenue hour • Trip lengths are long, at 10.7 mi. • The service is provided by a contractor, on a per trip basis. • The transit system is a department of a small city, which has negotiated an agreement with its larger county to provide ADA paratransit service throughout the county and in the main city. • Funding and local support for transit have been continual challenges. • City transit staff is very small, with an estimated less than 0.25 FTE (full-time equivalent) staff oversight for the DRT service.
Limited Eligibility DRT
Highest —4.04 passenger trips per revenue hour • Average trip length is very short, at 2.1 mi. • The service area is a compact and relatively developed university town. • The system manager reports that the population is relatively "young," and many of the ADA riders are young, mobile individuals, resulting in short dwell times. • Service is directly operated through the local transit district.
Lowest —1.76 passenger trips per revenue hour • Limited shared-riding, with service provided more as "taxi-type" service. • Service is provided by a contractor. • Productivity figure is impacted by an over-reporting of revenue hours, resulting in a lower productivity number. This was affected in part by the contract definition of revenue hours, which did not correspond to the NTD definition. • A correction to revenue hour reporting and a greater focus on shared riding resulted in a productivity improvement, to 2.2, the following fiscal year. • System is provided and administered through a city department. • Operating funds come from a portion of a local sales tax.

Small Urban DRT Systems (Continued)

Table 6A-1 (Figure 6-2)
General Public DRT
Highest —4.70 passenger trips per revenue hour • The average trip length is 5.3 mi. • Compact and developed service area. • DRT system is mature, having started in the 1970s; it has always been provided by a contractor. • High productivity achieved despite operation of a limited fixed route service in the same service area. • Productivity benefits from DRT service to school children during peak school travel periods. • The majority of riders are general public, with ADA passengers comprising 33% of total passenger trips. • Service is curb-to-curb, with only a 3-min wait time. • Service is provided through a city department.
Lowest —2.92 passenger trips per revenue hour • Ridership is predominately specialized, with ADA paratransit eligible and other disabled and senior riders comprising 86% of total ridership. • The system manager notes that there has been an increasing number of ADA paratransit, other disabled, and senior riders in recent years. • The service area has been expanding in recent years, as the city incorporates new developments at its periphery and as the city limits expand. • Service is provided through a city department and operated by a private contractor.

Table 6A-2(Figure 6-3)

Small Urban DRT: Operating Cost per Revenue Hour

Characteristics of Systems Affecting Performance

ADA Paratransit Only DRT

Lowest—$20.09 operating cost per revenue hour

- Service provided by contract on a cost per trip basis, with FY05 rate of $11.20 per trip; contractor retains the $1.80 fare, for a total per trip payment of $13.00.
- Contractor's costs are competitive; company has a centralized office and call center that is used to manage and schedule/dispatch trips for a number of paratransit contracts in the region, keeping overhead low.
- Operators keep vehicles at their homes overnight, decreasing deadhead time and costs.
- Very low city administrative burden on the contract, with limited city staff, estimated at less than 0.25 FTE staff.

Highest—$79.91 operating cost per revenue hour

- The service is directly operated by a full-scale transit entity, with all functions needed to provide service – planning, IT systems, marketing, maintenance.
- System allocates a share of all its fixed facilities (e.g., transfer center) to DRT, contributing approximately $20/revenue hour to the operating cost per revenue hour figure.
- DRT drivers are paid at same rate as fixed-route drivers.
- Drivers have an average tenure of 13 years, so many drivers are at the top of the pay range.
- System achieves the highest productivity of the five DRT systems in its category.

Limited Eligibility DRT

Lowest—$28.98 operating cost per revenue hour

- DRT service is operated on a contract basis by a local taxi company, which is a low cost provider.
- There is very limited administrative overhead and cost on the contractor, given the small scale of the service and strong confidence in the taxi contractor.
- System is provided through a city department.

Highest —$50.31 operating cost per revenue hour

- This is a directly operated service, by a full-scale regional transit entity, with a significant allocation of overhead on the DRT service.
- The system is located in a higher cost region of the country with unionized labor.
- DRT vehicle operators are paid at a rate almost comparable to that for fixed route operators, with a $1.00 per hour differential.
- The service area is relatively large, a region with eight towns.
- High levels of service are provided to meet objectives of participating towns with significant local funding available to support local transit.

General Public DRT

Lowest—$45.23 operating cost per revenue hour

- The service is operated on a contract basis by a large, national private contractor for a city sponsor.
- The contractor also operates the city's fixed-route service, so administrative costs are shared between the two modes, decreasing the contractor's DRT administrative costs.
- The city provides the maintenance and fuel for the contractor (costs are included in total operating costs), which are obtained through a cooperative arrangement with other city departments and the local school district, providing cost savings for both maintenance and fuel.

Highest—$49.85 operating cost per revenue hour

- Costs are not greatly dissimilar from the lowest cost general public DRT shown above of $45.23 (10% higher).
- This DRT system is similar to the lowest cost general public DRT system above in that it is operated on a contract basis by a large, national private contractor for a city sponsor.
- Some of the higher costs can be attributed to its location in a higher cost region of the country, with a higher wage scale.

Table 6A-3(Figure 6-4)
Small Urban DRT: Operating Cost per Passenger Trip

Characteristics of Systems Affecting Performance

ADA Paratransit Only DRT

Lowest —$11.36 operating cost per passenger trip

- This is the same system with the lowest operating cost per revenue hour among ADA paratransit only DRT systems, at $20.09 operating cost per revenue hour.
- Despite its having the lowest productivity in this category, the system has the lowest operating cost per passenger trip, given its cost structure.

Highest —$20.80 operating cost per passenger trip

- This is the same system with the operating cost per revenue hour of $79.91 (the higher cost per revenue hour of representative systems) and the productivity of 3.84 (the highest productivity of the representative systems).
- Despite its high productivity, with its higher operating cost per revenue hour, the cost per passenger trip is the highest of the five systems in the category.
- However, given its high productivity relative to the other systems in its category, the differences on this performance measure are not as large as they are on the measure operating cost per revenue hour.

Limited Eligibility DRT

Lowest —$8.11 operating cost per passenger trip

- This is the same system with the low operating cost per revenue hour of $28.98.
- The system has the second highest productivity of the DRT systems in its category, at 3.57 passenger trips per revenue hour, achieved in part with its small, concentrated service area and provision of senior center trips (the DRT service is coordinated with the senior center transportation program).
- With the low operating cost per revenue hour and relatively high productivity, this system has the lowest cost on operating cost per passenger trip.
- The cost of $8.11 per passenger trip is the lowest of the 14 DRT systems in the small urban category.

Highest —$21.87 operating cost per passenger trip

- This is the same system with the highest cost on the measure *operating cost per revenue hour*, at $50.31, in this category.
- With its productivity of 2.30, which is the third lowest productivity of the six systems in its category, this system shows the highest *operating cost per passenger trip*.
- Its productivity is impacted by the service area, which is regional in nature and includes eight small towns, an objective to meet all local specialized needs, and a high proportion (20%) of will-call trips.
- The cost of $21.87 is the highest cost per passenger trip of the 14 DRT systems in the small urban category.

General Public DRT

Lowest —$9.79 operating cost per passenger trip

- This system has the highest productivity of the three systems in the category—4.7—and with an operating cost per revenue hour of $46.05, it has the lowest cost per passenger trip.

Highest —$17.09 operating cost per passenger trip

- This system has the lowest productivity in this category—2.92—and given its operating cost per hour of $49.85 which is also the highest in its category, the result is the highest operating cost per passenger trip.

Large Urban DRT Systems

Table 6A-4(Figure 6-6)

Large Urban DRT: Passenger Trips per Revenue Hour (Productivity)

Characteristics of Systems Affecting Performance

ADA Paratransit Only DRT

Highest —2.68 passenger trips per revenue hour

- The DRT system focuses on productivity.
- Service provided by a private contractor, which has a productivity standard of 2.8 passengers per revenue hour included within contract incentives and liquidated damages. This level of productivity was promised by the contractor.
- 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.
- Average trip length is 6.2 miles, despite growing service area.
- The DRT service is provided by a legislatively created transportation entity, with service contracted to a private provider.

Lowest—1.83 passenger trips per revenue hour

- The service area spans one large county and part of a second county, with two major population centers separated by 18 miles of rural land uses. Additional small communities throughout the rural parts of the service area are also served.
- Average trip length is 10 miles.
- DRT service is provided by a joint city-county entity, with day-to-day service operated by a private contractor.

Other DRT

Highest—3.55 passenger trips per revenue hour

- The DRT service is directly operated by the transit entity, with a supplemental program that provides vehicles and support (maintenance, fuel, insurance) to local human service agencies for their own client transportation. Data for this supplemental program are included with NTD data.
- The directly operated service has a productivity of 3.0 and the supplemental program for human service agencies achieves a productivity of 8.6, increasing the DRT system's overall DRT productivity.
- For its directly operated service, the DRT system has a sophisticated CASD system but reports that is often over-rides the computer to manually schedule trips for "better" schedules.
- Scheduling/dispatch staff is experienced.
- The DRT system is a part of a larger transit entity created by the local jurisdictions (county and included cities) in accordance with state law, with the ability to levy dedicated transit funding.

Lowest—1.79 passenger trips per revenue hour

- The service area is large, at close to 800 square miles.
- The average trip length is 11 miles.
- The DRT system serves the largest population of the ten DRT systems in the large urban category, at close to 1 million population.
- System's no-show/late cancel rate is relatively high, at 8% in FY05, negatively impacting productivity.

Table 6A-5(Figure 6-7)

Large Urban DRT: Operating Cost per Revenue Hour

Characteristics of Systems Affecting Performance

ADA Paratransit Only DRT

Lowest —$34.40 operating cost per revenue hour

- The DRT system is provided on a contract basis, by a private contractor that bid a very competitive rate for the service.
- There is minimal allocation of city administrative or overhead cost on the contractor's cost.

Highest — $68.88 operating cost per revenue hour

- The DRT system is part of a full-scale transit entity, with all functions needed to operate public transit services.
- There is a relatively high allocation of costs to DRT administration.
- Comprehensive eligibility/certification process, requiring administrative effort and cost.
- Operates within an area with competition for lower wage employees.

Other DRT

Lowest—$ 32.24 operating cost per revenue hour

- The service is provided by and operated by a private non-profit agency.
- Administrative and overhead costs for the service are reduced through a cooperative arrangement with other local non-profit agencies in the community that partner together to share facilities and support services.
- There is no ADA paratransit service provided; service is provided to various specialized rider groups.

Highest —$77.20 operating cost per revenue hour

- The DRT service is directly operated by the city sponsor.
- DRT vehicle operators are paid at the same rate as fixed-route drivers.
- Operating costs include city payments to the regional transit provider for ADA trips that extend beyond the city boundaries.

Table 6A-6(Figure 6-8)

Large Urban DRT: Operating Cost per Passenger Trip

Characteristics of Systems Affecting Performance

ADA Paratransit Only DRT
Lowest —$17.84 operating cost per passenger trip • This is the same system with an operating cost per revenue hour of $34.40, the lowest operating cost per revenue hour of the systems in the category. • Given the operating cost per revenue hour and its productivity of 1.93, the system has the lowest operating cost per passenger trip in the category. • While the system's productivity is mid-range for its category, it could potentially be higher with a reduced rate of late cancellations and no-shows, and with a more experienced operator work force (retention is an issue).
Highest —$28.31 operating cost per passenger trip • This system has the second highest operating cost per revenue hour in its group, $51.93, and given its productivity of 1.83, the lowest in the category, it has the highest operating cost per passenger trip.
Other DRT
Lowest —$14.99 operating cost per passenger trip • This DRT system has the lowest operating cost per revenue hour of the systems in its category, of $32.24. • With a productivity of 2.15, which is the mid productivity in the category, the result is the lowest operating cost per passenger trip in the category.
Highest—$35.69 operating cost per passenger trip • The DRT system has the mid-point operating cost per revenue hour in its group, of $63.78. • Given its productivity of 1.79, which is the lowest in the category due in large part to the large service area and long trip lengths, the system has the highest operating cost per passenger trip.

Largest Urban DRT Systems

Table 6A-7(Figure 6-10)

Largest Urban DRT: Passenger Trips per Revenue Hour (Productivity)

Characteristics of Systems Affecting Performance

ADA Paratransit Only DRT

Highest —2.34 passenger trips per revenue hour

- DRT system's average trip length is 8.9 miles, which is the second shortest of the nine systems in the category.
- Service is provided only within the required ¾ mile corridors of fixed-route service.
- System management is proactive in managing the supply of revenue hours for its service contractors, "flexing" the start and end times of DRT routes the day before service—based on demand for the next day. This reduces unproductive revenue time.
- On-going rider education programs, on such topics as no-shows, calling to cancel unneeded trips, and boarding on time, to foster responsible use of the ADA service.

Lowest —1.28 passenger trips per revenue hour

- DRT system operates in very large area, over 2,000 square miles.
- The average trip length is 11.5 miles, which is among the four longest trip lengths of systems in the largest urban DRT category.
- With about 8% of total passenger trips provided by the system's same-day taxi program, which is structured to subsidize shorter trips particularly during peak travel times, the DRT system provides a larger proportion of riders' longer trips, impacting productivity.
- Suburbanization of the service area and in particular decentralization of medical complexes and hospitals are increasing passengers' trip distances, also negatively affecting productivity.

Other Limited Eligibility DRT

Highest—4.35 passenger trips per revenue hour

- More than 90% of the service is subscription service for human service agencies, with significant group riding.
- Service area is 400 square miles, smaller than the other DRT systems in the largest urban category, in some cases by significant amounts.
- 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%.
- There is no ADA service provided.

Lowest —1.49 passenger trips per revenue hour

- The system operates in a large service, composed of 3 counties and over 2,500 square miles.
- Average trip length is almost 13 miles.
- Medicaid non-emergency transportation is provided, comprising about 44% of total passenger trips, with a portion of trips traveling beyond the 3-county service area with one-way distances of over 50 miles. The system limits such trips to specific days and time periods in an attempt to create shared rides, but even with such efforts, the trips are very long and impact productivity.

Table 6A-8(Figure 6-11)

Largest Urban DRT: Operating Cost per Revenue Hour

Characteristics of Systems Affecting Performance

ADA Paratransit Only DRT

Lowest—$38.84 operating cost per revenue hour

- One of the DRT system's two service contractors is a taxi company; service is provided on a dedicated basis predominately using sedans. The operating cost per revenue hour for the taxi contractor is $29.78 (FY05) which includes the capital cost of the sedan. This can be compared to the operating cost per revenue hour for the second contractor, which uses vans, at $35.73 without capital. Subtracting the cost of capital for the taxi contractor would further improve the cost competitiveness of the taxi provider.
- Use of a taxi contractor puts competitive pressure on the van provider to manage its cost structure.
- Extensive use of part-time staff for reservations, scheduling and dispatch functions, reducing costs for wages and benefits.

Highest—$62.65 operating cost per revenue hour

- The DRT system has a comprehensive administrative and rider support structure, including a sophisticated eligibility/certification program with 100% in-person assessments, comprehensive no-show/late cancel policy requiring staff resources, travel training provided by staff, and a program that involves DRT staff working with riders with cognitive disabilities in group homes to ensure their understanding of the paratransit service.
- Service is provided 365 days a year, 24 hours per day.
- The service is provided on a contract basis by one contractor.
- System operates in a low unemployment region, creating competition for vehicle operators which impacts wages.
- Operating funds are local, from a portion of local sales tax.

Other Limited Eligibility DRT

Lowest—$34.86 operating cost per revenue hour

- The DRT system uses six service contractors. One is the primary contractor, and others are community based non-profit human service agencies with lower cost structures for transportation.
- The community-based agencies provided 18% of all passenger trips (FY05).
- Except for the primary service contractor, providers are paid on a per trip basis.
- ADA paratransit trips comprise approximately 43% of total passenger trips (FY05).

Highest — $75.61 operating cost per revenue hour

- This DRT system serves predominately agency-based subscription trips, with an aide traveling on the vehicles to assist riders. Costs for the aides contributed almost 10% to total operating costs (FY05).
- System operates in a higher wage, low unemployment region.

Table 6A-9 (Figure 6-12)

Largest Urban DRT: Operating Cost per Passenger Trip

Characteristics of Systems Affecting Performance

ADA Paratransit Only DRT

Lowest —$21.11 operating cost per passenger trip

- This DRT system has the lowest operating cost per revenue hour in its category, and with a productivity of 1.84 (the mid range for productivity in the category), achieves the lowest operating cost per passenger trip in the category.

Highest—$40.31 operating cost per passenger trip

- While this DRT system has the third lowest operating cost per revenue hour in the group ($51.77), it has the lowest productivity, resulting in the highest operating cost per passenger trip.

Other Limited Eligibility DRT

Lowest—$15.56 operating cost per passenger trip

- This system has a relatively low operating cost per revenue hour ($36.91) and with its productivity of 2.34 (the second highest in its category), it has the lowest operating cost per passenger trip.
- Its lower operating cost per revenue hour is impacted by the use of multiple, predominately local providers, with competition among the providers structured by the DRT system.
- The system stresses productivity, with productivity standards in their provider contracts. It is aggressive in pursuing business that provides group trips, such as shopper shuttle-type services and senior center services with group trips.

Highest—$26.20 operating cost per passenger trip

- This *limited eligibility* DRT system has the second highest operating cost per hour in its category ($47.54, which interestingly would be among the lowest in the *ADA paratransit only* category) and given its productivity of 1.81, the result is the highest operating cost per passenger trip in the category.
- While its productivity is not the lowest in the category, it is impacted by the service area, which is a major metropolitan area with significant congestion. It is likely that productivity would be lower except for the system's commingling its ADA riders with non-ADA riders. Management indicates that this works well, with ADA riders more concentrated during peak travel times and non-ADA riders more concentrated during off-peak times, with the two ridership types generally complementing each other relative to time of use.

CHAPTER 7

Improving Performance

Earlier chapters in this Guidebook have focused on measuring and assessing DRT performance. This chapter addresses the next step in the performance measurement process—*improving* performance.

The chapter includes the following:

- Discussion of the factors that influence DRT performance. Understanding these factors provides a useful perspective from which to consider improvement options.
- Identification of various policies, procedures, strategies, and practices—collectively referred to as *management actions*—that influence DRT performance.
- Management actions identified by the DRT systems participating in the research as actions they have taken to improve their performance. For some of these, DRT systems provided data quantifying the positive performance effects. For others, data were either limited or not available to quantitatively show change. Yet these latter management actions are included in the chapter as they may provide value to other DRT systems considering improvement options.

7.1 Factors Affecting DRT Performance

The discussion of factors affecting DRT performance is often approached with the notion that factors are either *controllable* or *uncontrollable*, that is, a factor is something that a DRT manager can "do something about" or not. While there are factors that fall into one of these two types, there are some that straddle the distinction and are more aptly described as *partially controllable*.

The demand for DRT service may be a good example of a factor that is partially controllable. Demand for DRT service is a factor that impacts the level or volume of passenger trips, one of the data elements in the measure *passenger trips per revenue vehicle hour*, or *productivity*. To increase the number of passenger trips, a DRT system can try to increase demand for its service by providing quality service, by establishing a fare structure that encourages usage, and through marketing and public information strategies that inform members of the community about the service. On the other hand, a DRT system such as one providing ADA paratransit may try to manage its demand by such actions as ensuring an effective eligibility certification process and providing travel training to support riders' use of fixed-route service when possible.

Whether these actions affect demand will depend on *more* than what the DRT system does. It will also depend on the demographics of the community, the level of need for transit service, and availability and cost of alternatives to DRT such as human service agency transportation and volunteer services. Thus, a DRT system has some ability to influence its demand, but not real control.

The ability to control a particular factor may also depend on the type of DRT system. For example, a DRT system that is not ADA paratransit has more latitude in terms of modifying service hours and even days in light of reduced demand, financial constraints, or other local issues. An ADA DRT system, however, does not have such latitude: it must provide service during the same hours and days that fixed-route service is provided.

Table 7-1 lists the major factors that affect DRT performance. This table also indicates the degree to which each factor can be "controlled" by the DRT system, and identifies the performance measures most impacted by each of the factors.

Table 7-1. Factors influencing DRT performance.

Factor	Control by DRT System?	Key DRT Performance Measures				
		Passenger Trips/ Rev. Hour	Operating Cost/ Rev. Hour	Operating Cost/ Passenger Trip	Safety Incidents/ 100,000 Veh. Miles	On-Time Performance
Operations						
Hiring practices and training for vehicle operators	**C**	✓	✓	✓	✓	✓
Operator wages and benefits	**C/P-C**	✓	✓	✓		✓
Timely pull-outs with back-up operator availability	**C**				✓	✓
Relationship of paid operator hours to revenue vehicle hours	**C**		✓	✓		
Wages and benefits for other operating staff	**C/P-C**		✓	✓	✓	✓
Scheduling/Dispatch						
Skills in creating effective manifests	**C**	✓		✓		✓
Ability to impact operations in real-time (e.g., MDTs, AVL)	**C**	✓		✓		✓
Matching revenue hours to demand	**C**	✓	✓	✓		
Service Policies Related to						
No-shows and late cancels	**C**	✓				✓
Length/structure of on-time window	**C**	✓				✓
Length of advance reservation window	**C**	✓				
Vehicles						
Vehicle type and mix	**C**		✓	✓	✓	
Vehicle condition and maintenance practices	**C**		✓	✓	✓	
Maintenance expenses	**C**		✓	✓		
Administration						
Staffing and expenses	**C**		✓	✓		
Safety						
Safety policies and procedures	**C**				✓	
System's "culture of safety"	**C**				✓	
Service Area Environment						
Service area size, density, street network, development, constraints (e.g., traffic, bridges)	**U-C**	✓	✓	✓	✓	✓
Strength of local economy/job market	**U-C**		✓	✓		
Weather and other "Acts of God"	**U-C**	✓		✓	✓	✓
Other						
Type of ridership (ADA only, limited eligibility, general public)	**U-C**	✓		✓		
Type of operator (private contractor, taxi co, city/county, transit authority)	**P-C**		✓	✓		
Demand for DRT service	**P-C**		✓	✓		
Rider no-shows and late cancels	**P-C**	✓		✓		✓
Dwell time	**P-C**	✓		✓		✓
Deadhead time and miles	**P-C**		✓	✓		
Average system speed	**P-C**	✓		✓	✓	

Legend : **C – Controllable** **U-C – Uncontrollable** **P-C – Partially Controllable**

Controllable Factors

The factors over which DRT management for all types of DRT systems have direct influence relate to:

- Vehicle operators:
  - hiring practices and training;
  - wages and benefits (though these are influenced by the local economy and compensation for similar types of jobs);
  - timely pull-outs with back-up availability;
  - practices impacting the ratio of paid operator hours to revenue vehicle hours (such as absenteeism and benefits related to vacation and other time off).
- Other operating staff—call-takers, scheduling and dispatch staff, operations supervisors:
  - Wages and benefits for these other operating staff.
- Scheduling/dispatch:
  - ability to create effective manifests for operators, use of CASD;
  - ability to impact real-time operations, e.g., does the system have technology such as MDTs and AVL, allowing dispatchers to move passenger trips from one operator to another, use capacity created by late cancellations and no-shows, and respond to service on the street; and
  - the extent to which scheduled revenue hours match ridership demand patterns.
- Operating policies related to:
  - no-shows and late cancels: effectiveness of the DRT system's policies and ability to monitor and manage rider infractions;
  - length and structure of the on-time window: the window provides some flexibility for getting to scheduled pick-up locations in a "timely" fashion with the changing nature of DRT service and idiosyncrasies of traffic; and
  - length of advance reservation window.
- Vehicles:
  - vehicle type and mix: this is controllable by many DRT systems though there are some systems that obtain vehicles through state procurement procedures, giving them limited control over this factor. Yet, even for systems with control over the selection and procurement of vehicles, it is not a factor that can be affected rapidly, given the lead times typical for vehicle procurement—as much as 18 months or longer in some cases;
  - vehicle condition and maintenance practices: while generally under the control of DRT systems, those with old fleets will need to expend more effort (and cost) to keep their vehicles in operative condition; and
  - maintenance expenses: costs are related to vehicle condition and maintenance practices, and are impacted by the age and type of vehicles, which some but not all DRT systems can control.
- Administrative expenses:
  - how efficiently can the system administer the service, particularly in the number of staff positions required for administration and costs for that administration.
- Safety:
  - policies and procedures related to safety; and
  - a management emphasis and commitment to safe operations can influence the DRT system's safety record.

Uncontrollable Factors

There are several factors over which DRT systems generally have no or very limited control:

- The type of DRT system—whether it is general public, specialized, or ADA (some DRT systems may be able to influence the service sponsor as to the ridership markets that are served, but this is not something that changes in the short-term).

- Service area environment—this is a critical factor, impacting all aspects of DRT service:
  - characteristics such as size, density, land use patterns, street network, and service area constraints such as significant traffic congestion and bridges that limit access through the service area, have strong impacts on DRT performance, influencing trip lengths, travel times, opportunities to group rides for improved productivity, and on-time performance;
  - strength of the local economy, which affects the unemployment rate and wage pressures; and
  - weather and other "Acts of God."

Partially Controllable Factors

Beyond controllable and non-controllable factors, there are factors impacting DRT service performance that can be considered *partially* controllable by the DRT system. Among these include:

- Type of operator—whether the DRT service is operated by a private contractor, a taxi company, a city or county, or a full-scale transit authority.
- Demand for DRT service—as discussed above, demand can be partially controlled by decisions and actions of the DRT system, but the responses by the community and target rider groups are not controllable.
- Operational issues:
  - Rider no-shows and late cancellations: While every DRT system will experience some level of no-shows and late cancellations, they can be partially controlled by policies that address their occurrence as well as performance levels that ensure service is reliable and timely.
  - Dwell time: This is influenced by DRT system policy (i.e., the wait time) but also by passengers, their mobility levels, the weather (snowy/icy sidewalks will slow riders' access to the vehicle) and the degree to which riders adhere to the policy; advanced technology can also be a factor, with features such as "call-outs" which automatically notify riders of the pending arrival of their vehicle.
  - Deadhead time and miles: This is impacted by the location of the garage in relation to the service area and the size of the service area, but can be influenced to some extent if the DRT system can establish satellite parking locations for the vehicles or even allow operators to take vehicles home with them at night to minimize deadhead the next service day; for contracted service, garage location can be influenced by contractual requirements.
  - Average system speed, which influences productivity as well as safety: This speed will depend on the type and environmental characteristics of the service area, scheduling/dispatch efforts as well as dwell times at individual pick-up and drop-off locations, vehicle operator experience, and general traffic and congestion in the community.

Controllability Depends on Type of DRT Service

Finally, as noted above, there are several factors for which "controllability" depends on whether the DRT system provides ADA paratransit. These include:

- Service span of the DRT system (days and hours of operation):
  - DRT systems that are ADA paratransit must provide service during the equivalent days and times that fixed-route service is provided; DRT that is not ADA paratransit has more latitude to change or reduce hours or even days that are very low ridership and therefore less productive, which may help improve performance.
- Service policies:
  - Policies related to advance notice, trip purpose, fare structure, and capacity constraints are regulated for those DRT systems that are ADA paratransit; other systems, however, can set such policies to meet system objectives, available funding, and other local conditions.

- Service area:
  - The DRT service area is generally not a controllable factor, but in the case of ADA paratransit, the service area may be set to meet the regulations, generally a ¾-mile corridor either side of fixed routes. In such case, the service area can be impacted by management action.

7.2 Management Actions Influencing DRT Performance

There are various actions that a DRT system can take to affect and improve its performance. For those controllable and partially controllable factors listed in Table 7-1, these actions include policies, procedures, strategies, and practices—called management actions in the Guidebook—that can affect DRT service positively in the shorter and longer term. In addition to such actions, there are broader-scale options relating to system structure (e.g., management/operations options such as directly operated vs. contracted service, use of centralized vs. decentralized operations, etc.) that can affect performance, but these have not been the focus of this research project.

Management actions influencing DRT performance are identified in Table 7-2, generated during the research project's early efforts. There are actions listed that may not be appropriate for all DRT systems (e.g., an ADA paratransit system has less latitude to use its fare structure to manage demand), and there are likely numerous actions not listed that DRT managers have successfully used at their own systems. From this list, a number of the actions were researched in depth as part of the project's later efforts, and these are described in the following section of this chapter.

The actions listed in Table 7-2 are also correlated to the five key performance measures selected for the Guidebook, with a checkmark (✓) indicating the *primary* measures that the action positively affects. Given the interrelationships between the performance measures, however, and the many variables that impact DRT performance, a management action selected for one specific attribute may also benefit other aspects of DRT operations. For example, *establish policies and procedures for bad weather operations* shown under "Policies and Procedures" as positively affecting the measure *safety incidents/100,000 vehicle miles* may also benefit both operating costs if accidents are reduced and on-time performance if trips—likely to run late because of the weather—are curtailed by policy.

In a related way, a management action included as having a positive affect on a particular performance measure may potentially have a less positive affect on another performance measure. This is true for the first management action listed—*set vehicle operator pay to encourage stability of operator staff*. Shown on Table 7-2 as having a positive influence on productivity (passenger trips per revenue hour) as well as several other measures, this management action may have a not-so-positive affect on the measure operating cost per revenue hour, depending on *costs saved* with the action (e.g., less cost for recruitment and training) versus *new costs incurred* for possible increased operator wages.

Navigating these interrelationships between actions affecting performance and their results is part of the challenge of managing a DRT system. And determining which actions to take to benefit performance may sometimes seem a balancing act between feasibility and funding, and policy and public input. While there is no one single action that by itself will transform a DRT system that needs improvement, the DRT systems that participated in the research project were able to identify a range of actions they had taken that benefited their performance. These actions identified by the participating DRT systems are the subject of the next part of this chapter.

7.3 Management Actions Identified by Participating DRT Systems

The DRT systems participating in this research project were asked about actions and strategies they had implemented to improve performance. The research project's objective was to

Table 7-2. Management actions influencing DRT performance.

Management Actions	Key DRT Performance Measures				
	Passenger Trips/ Revenue Hour	Operating Cost/ Revenue Hour	Operating Cost/ Passenger Trip	Safety Incidents/ 100,000 Vehicle Miles	On-Time Performance
Operations					
Set operator pay to encourage stability of staff	✓		✓	✓	✓
Establish effective operator hiring, training, and re-training procedures	✓			✓	✓
Align operator shifts to meet service demand	✓		✓		
Consider use of part time drivers		✓			
Use split shifts effectively		✓			
Reduce excess use of overtime		✓			
Reduce excess deadhead time and mileage		✓			
Provide on-street supervision to monitor operations				✓	✓
Provide back-up operator capability					✓
Scheduling/Dispatch					
Professionalize scheduling/dispatch function	✓		✓		✓
Maximize provision of subscription trips	✓		✓		
Regularly review, fine-tune, and tighten subscription trips	✓		✓		
Use "will calls" effectively and judiciously	✓		✓		
Seek operator input on schedules	✓		✓		
Match reservationist staff shifts with call patterns and call demand		✓			
Monitor system speed	✓		✓	✓	✓
Obtain correct information on riders' pick-up and drop-off locations					✓
Give "light" schedules to new operators					✓
Consider CASD system to improve scheduling/dispatch function	✓		✓		✓
Review CASD-created schedules	✓		✓		✓
Maximize use of CASD system functions	✓		✓		
Implement MDTs/AVL	✓		✓		✓
Consider use of automated "call-outs"	✓		✓		
Policies and Procedures					
Develop/enforce no-show/late cancel policy	✓		✓		
Implement and use advanced technology to address no-shows/late cancels	✓		✓		
Ensure appropriate on-time window length	✓		✓		✓
Educate riders on policies and procedures, e.g., wait time, on-time window, no-show/cancels	✓		✓		✓
Reduce the advance reservation period	✓		✓		
Decrease dwell time at rider pick-up locations	✓		✓		
Establish policies/procedures for bad weather operations				✓	
Ensure effective rider eligibility/certification		✓			
Demand Management					
Establish scheduled service to frequented destinations	✓		✓		
Use fare structure to manage demand (on DRT and fixed-route as appropriate)	✓		✓		
Increase demand for service during low usage times of service day	✓		✓		
Encourage shorter trips by subdividing large service area into smaller areas or zones	✓		✓		
Maintenance and Vehicles					
Ensure effective preventive maintenance practices		✓	✓	✓	✓
Add fleet capacity with non-dedicated service as supplement for peaks, difficult-to-serve trips		✓	✓		✓

Table 7-2. (Continued)

Management Actions	Key DRT Performance Measures				
	Passenger Trips/ Revenue Hour	Operating Cost/ Revenue Hour	Operating Cost/ Passenger Trip	Safety Incidents/ 100,000 Vehicle Miles	On-Time Performance
Safety					
Monitor accident trends				✓	
Involve operators in a safety committee				✓	
Reward safe operators				✓	
Service Span and Area					
Reduce underutilized revenue hours through service span adjustment	✓	✓	✓		
Adjust service area	✓	✓	✓		
Management					
Establish a "culture of safety"				✓	
Cross train staff		✓			
Contracted and Other Services					
Use incentives/penalties effectively, e.g., productivity, on-time performance	✓		✓		✓
Consider reducing "risk"/costs for contractors, e.g., fuel pass-through		✓	✓		
Introduce competition into the contracting process by adding an additional contractor to provide some service		✓	✓		
Subdivide a large service area and use more than one contractor		✓	✓		
Use per trip payment contracts judiciously					✓
Consider alternative service delivery options as appropriate (e.g., partnerships with community agencies, same-day taxi)		✓			

identify management actions successfully used by DRT systems as well as to measure the effects of those actions on performance.

The management actions identified by the DRT systems are presented in this section of Chapter 7, with quantitative data on performance impacts where managers were able to provide such data. Qualitative affects are also identified. Table 7-3 introduces the actions, organized by performance issue and indicates the specific page in this chapter where the management action is discussed, providing a guide for readers.

It is important to note that quantifying performance changes from specific strategies that have been taken by DRT systems is not always straightforward. It is not possible to completely isolate the specific performance impacts of a single strategy because of the many variables that affect DRT performance. However, performance improvements at the selected DRT systems seemed clear from a number of the management actions undertaken, based on before-and-after measures directly related to the strategy.

> Objective: To identify actions and strategies that DRT systems have taken to improve performance and measure that improvement.
>
> Challenge: Quantifying performance change is not always straightforward given the many variables and factors that affect DRT performance.

Table 7-3. Management actions taken by participating DRT systems to improve performance.

Performance Issue	Management Action	See Page
Improve productivity.	▪ Implement CASD.	84
	▪ Implement MDTs/AVL.	87
	▪ Adopt and enforce no-shows/late cancels policy.	94
	▪ Manage supply of revenue hours to match demand.	98
	▪ Reduce service area.	113
	▪ Rider education program.	117
	▪ Improve DRT operator compensation.	119
Improve on-time performance.	▪ Implement MDTs/AVL.	87
	▪ Implement CASD system.	84
	▪ Adopt and enforce policies for no-shows/late cancels.	94
	▪ Rider education program.	117
Reduce cancellations and no-shows.	▪ Adopt and enforce no-show/late cancel policy.	94
	▪ Shorten advance reservation window.	90
	▪ Rider education program.	117
Alternative service delivery options for potential cost-savings.	▪ Same-day taxi program.	100
	▪ General public DRT instead of traditional fixed-route service in low-density environment.	106
Provide passenger trips more cost-efficiently.	▪ Develop partnerships and coordinate with community agencies to meet specialized transportation needs.	109
	▪ Same-day taxi program.	100
Encourage use of fixed-route service: cost-savings when riders choose fixed-route over DRT.	▪ Provide reduced or free fares for use of fixed-route.	112
	▪ Refine ADA eligibility certification process for more accurate determinations.	114
	▪ Improve accessibility to fixed-route.	116
Effective strategies for working with contractors.	▪ Refinements to the contracting process including reducing risk and cost, purchasing capital equipment, providing direct provision of control room functions.	116
Improve customer service: accurate information for *"where's my ride"* and decrease in no-show complaints.	▪ Implement MDTs/AVL.	87
Improve DRT staff working environment: increase retention, increase understanding across functional areas, improve relationship with riders.	▪ Improve DRT operator compensation.	119
	▪ Cross training of staff.	121
	▪ Rider education program.	117

Implement Computer-Assisted Scheduling and Dispatch

While most of the DRT systems included in the research have been using CASD systems for some time, there were a few that had recent experience implementing a computer-assisted scheduling/dispatch system, and they indicated a number of performance improvements.

Performance Improvements

Cited improvements from several DRT systems participating in the research related to scheduling improvements and improved on-time performance with acquisition of scheduling/dispatch systems, included:

- **Scheduling is more accurate and realistic.** Prior to CASD, staff were apt to take all or most trip requests, particularly outside peak periods, sometimes without really knowing what was already scheduled and without knowing how the trip would fit with existing reservations. With the CASD system, staff can "see" immediately what is already booked and determine how a new trip request can fit into already booked trips. This can produce more realistic and accurate driver manifests.

Reported Performance Improvements with CASD Systems

- Scheduling is more accurate and realistic.
- More accurate manifests for vehicle operators.
- Improved on-time performance.
- "Tighter" manifests, as reported by vehicle operators.
- Potential for productivity improvement.

The ability of a CASD system to improve scheduling at a particular DRT system will depend on a variety of factors, and prior research indicates that systems have reported a range of results with their new CASD systems, with some reporting mixed results depending on the skill level of their staff in using the software and the ability to review computer-generated schedules to ensure they are rational (*19*).

- **Improved accuracy of operator manifests.** With CASD, staff no longer write down trip requests onto paper; requests are entered into the computer, aided by "drop down menus" and "trip history files" for routine and repeat trips. In areas with several brand name stores, or other common destinations with multiple locations, the CASD system has reduced errors on the manifests, with operators less likely to be scheduled to the wrong store for a pick-up. This benefits productivity and on-time performance.
- **Improved on-time performance.** One small DRT system manager said that the new CASD system enabled the system to improve its on-time performance. With the more accurate and realistic driver manifests, more trips were on-time. This DRT system showed an improvement in its on-time performance from 89% in FY05 to 91.1% in FY06. This is an improvement accomplished without MDTs or AVL.
- **Impact on productivity.** Two DRT system managers noted that their vehicle operators reported "tighter" driver manifests with the new CASD systems. It was too early in the implementation process at one system to determine whether "tighter" schedules improved productivity, but the other system, with a full year of the new CASD, showed a *decrease* in productivity of 15% from FY05 to FY06. It was not possible to assess all the factors that might have affected that DRT system's operation and resulting productivity. But possible explanatory factors could be an increase in average trip length of almost 20% from FY05 to 06 at this system, or the new CASD system's computation of revenue hours may be producing different numbers than the prior manual, spreadsheet system. At a third DRT system, while management seemed particularly interested in the on-time improvements that resulted with its new CASD, performance data showed a slight increase in productivity from 2.90 to 2.94.

Qualifications

While several of the DRT systems included in the research noted positive effects with implementation of CASD, there were other comments as well:

- **DRT systems do not always use their CASD systems to the fullest extent.** Similar to findings in earlier research (*18*), several of the DRT systems included in the research indicated that they do not use the full capabilities of their CASD systems. One small urban system uses its sophisticated CASD system only for a "first cut" at the schedules, with final schedules created by two highly experienced schedulers, each with more than 15 years of scheduling background. A large urban system implemented a newer version of a standard CASD system and still has not adapted to it, often over-riding the computer and its parameters. The manager of this system felt that the CASD was too focused on grouping trips, at the expense of longer travel times and less convenience for riders. At another system, scheduling staff have ignored and misused the software to the point that productivity and on-time performance have both declined.

Qualifications
• DRT systems do not always use their CASD systems to the fullest extent. • Some DRT systems believe their contractors do not use CASD and other technology to the fullest extent. • Implementation and transition period can be difficult. • CASD systems' computation of revenue hours may produce new or different numbers from previous methodology, impacting reported performance on measures using revenue hours. • Performance may decline with new CASD: during implementation, or because new performance data are more accurate than prior procedures, or both.

- **Some DRT systems believe that their contractors do not use CASD and other technology to the fullest extent.** Several of the small urban and large urban DRT systems that contract for service expressed the opinion that their private contractors do not appear to be using the full capabilities of the CASD system and in some cases the additional technology (MDTs and AVL), nor are they using the technology most effectively. It was not clear how they came to this opinion, but there was an implication that performance at several systems might be better if the contractor was using the technology fully and most effectively.
- **Implementation and transition period can be difficult.** As noted in earlier research on the use of CASD systems, the implementation period for new CASD can be difficult (*19*). Two large urban systems participating in the research said it took more than a full year from implementation of their new technology (CASD system, MDTs, and AVL) to become a relatively well-functioning state. Another large system reported "nightmarish" problems in the early months of CASD implementation, including schedules that did not make sense, but continuing efforts and additional experience were expected to soon bring performance back to pre-CASD levels and then bring improvements after that.
- **CASD systems' computation of revenue hours produces new or different numbers.** Several DRT systems noted that their CASD systems' method for computing revenue hours may be impacting reported productivity numbers. One of these DRT systems changed its CASD system, and two went from manual data collection and reporting to a new CASD system. In one case, it was clear that the former manual method of collecting and reporting revenue hours understated the data, which provided a higher but inaccurate productivity figure, while at the other two DRT systems, it appears that the new CASD system uses a somewhat different methodology for determining revenue hours, and that this impacted the lowered productivity figure rather than actual performance on the street.
- **Performance may decline with a new CASD system.** During implementation of new technology, performance may actually decline for a time period while staff adapt to the changes. And once implemented, the new technology may provide more accurate data than was available with previous manual or sampling procedures, which then may result in what appears to be lowered performance statistics. This is related to the qualification above regarding CASD systems' computation of revenue hours. Several DRT systems participating in the research found themselves with what appeared to be lowered performance with a new CASD system and realized that prior methods had errors and biases which provided overstated performance data. It is important that DRT systems annotate trend line data to clearly show when new technology is introduced and to note when such change impacts data and performance reporting. This will help ensure that such "declines" can be seen within their proper context.

Implement Mobile Data Terminals and Automatic Vehicle Location

Various performance improvements were cited by DRT system managers with implementation of MDTs and AVL.

Performance Improvements

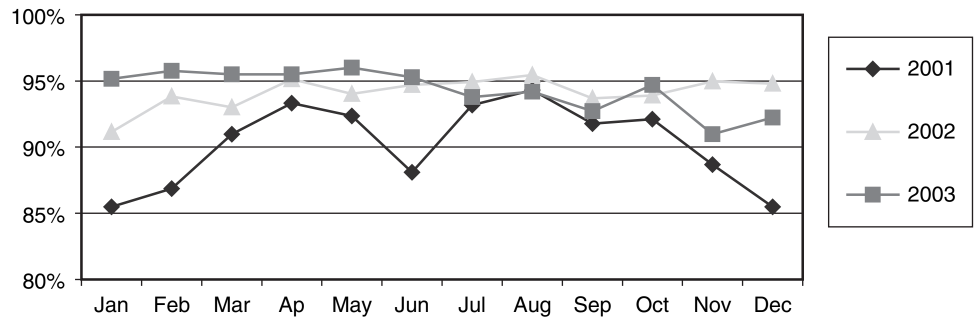
- **Increased on-time performance.** Six DRT systems specifically indicated that they were able to increase their on-time performance with MDTs and AVL. With the ability to "see" where the vehicles are on a real-time basis, dispatchers can respond to timeliness issues, making adjustments to improve on-time performance. Two systems provided data showing on-time performance improvements that the DRT manager specifically attributed to MDTs/AVL (see Table 7-4). The improvements at one of these systems are shown in Figure 7-1.

  Several of the systems commented that they were surprised to learn their "true" on-time performance once they implemented the MDT/AVL technology; apparently, the technology showed timeliness to be considerably lower than prior data indicated. Armed with the new and more accurate information, these systems were able to focus on timeliness and make improvements.
- **MDTs and AVL allow dispatchers to better manage trips in real-time.** With real-time knowledge of the vehicles' location and status, dispatchers can effectively insert new trips into an operator's schedule, move trips from one operator to another, and make other on-the-spot revisions to operators' manifests. This has been noted in earlier research (*15*). Among DRT systems participating in this research, eight specifically spoke to this benefit of MDT/AVL technology.

  This capability, which contributes to the system's ability to improve on-time performance, provides at least two advantages: it allows the "re-use" of capacity created on the day of service from same-day cancellations, including (sometimes) late cancellations, and it facilitates the same-day scheduling of trips that may have purposefully been "overbooked" the day before. Such capability also provides the potential for the DRT system to improve productivity, discussed below.
- **DRT staff can provide accurate information to riders who call and ask "where's my ride."** Using the AVL technology, DRT staff can determine where a particular vehicle is and when it should arrive at a scheduled location, so that staff can accurately inform a caller inquiring "where's my ride" when the vehicle should arrive. Prior to this technology, one DRT system said that riders complained that "the dispatcher always tells me the same thing when I call and ask about my ride—20 min!"

Table 7-4. Improving on-time performance with mobile data terminals (MDTS) and automatic vehicle location (AVL).

Performance Effects	Comments
Before MDTs/AVL OTP percentage - "in the 80's" *After MDTs/AVL* FY01 OTP = 90.2% FY02 OTP = 94.1% FY03 OTP = 94.3%	The DRT system implemented MDTs and AVL in late FY99 and FY00. The manager said it took about 1-½ years to have its MDTs/AVL technology stabilized and working smoothly. Now, with more than six years experience, DRT system is almost "paperless," though operators have a sheet to record vehicle and revenue time and mileage and to serve as back-up if "the computer goes down."
Before MDTs/AVL FY05 OTP percentage – "in the mid 90's" *After MDTs/AVL* FY06, first half OTP = 72.03% FY06, second half OTP = 88.4% FY07, first quarter OTP = 86.7%	With implementation of MDTs and AVL, the DRT system had accurate data to determine OTP. With the new data, it was clear that the prior method of "random" OTP checks was not complete. OTP improved by late FY06 with on-going experience with the new technology and ability to focus on timeliness with the real-time data provided by AVL.



Spokane Paratransit's Experience: MDTs/AVL implemented during 1999 and 2000, with the technology "working smoothly" by February 2001.

Figure 7-1. Improvements to on-time performance, use of MDTs/AVL.

- **Reservationists can take the "where's my ride" calls rather than dispatchers.** This is a more cost-efficient approach and allows the dispatchers to focus on their primary responsibilities. Two DRT systems specifically identified this as an advantage with the technology.

Reported Performance Improvements with MDTs/AVL
• Increased on-time performance. • Ability to manage trips in real-time, adjusting vehicle operators' manifests to insert new trips and move trips as needed. • The ability to provide accurate information to passengers calling to ask "where's my ride?" which improves customer service. • Significant decrease in no-show complaints. • Reservationists can handle "where's my ride?" calls, a more cost-efficient practice than having dispatchers handle that task. • Improved monitoring of vehicle operators and their performance. • Ability to improve productivity.

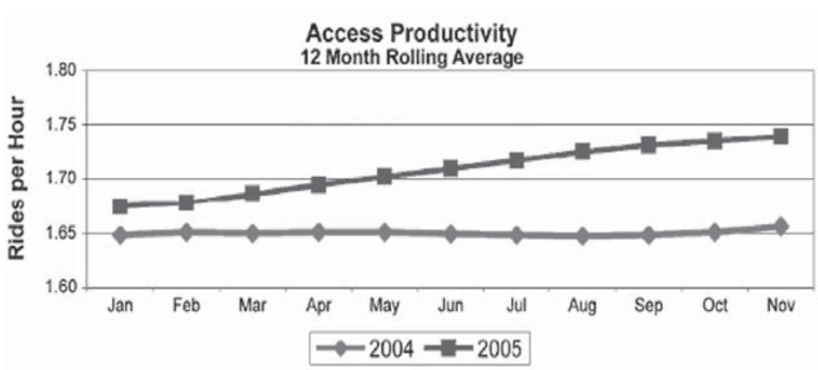
- **Decrease in no-show complaints.** With AVL technology, a DRT system can review stored data and determine a vehicle's location at a particular time. This allows the system to check reported no-shows and see if in fact the vehicle operator was actually at the scheduled location at the scheduled time. Several of the DRT systems included in the research reported a significant decrease in no-show complaints. One system manager referred to AVL as the "eyes in the sky" that "leave nothing to dispute," effectively eliminating arguments about whether a vehicle was, or was not, at a particular scheduled pick-up location at the scheduled time.
- **Improved monitoring of vehicle operators.** In addition to allowing systems to verify reported no-shows, DRT systems can use the AVL technology to better monitor operators and their performance. One of the DRT systems reported that it used its AVL to investigate an operator who routinely appeared to take excess time delivering a standing order trip. With the MDT/AVL records, it was determined that the operator purposefully delayed the reporting of a passenger drop-off on his MDT. Instead of "performing" the trip when he dropped off the passenger (e.g., reporting the drop-off via the MDT) he "performed" it after taking an unscheduled break at a nearby fast food restaurant.
- **Ability to improve productivity.** Among other benefits, MDTs and AVL have the potential to improve DRT productivity, with the ability for dispatchers to address real-time service issues and insert new trips into vehicle operators' schedules or re-arrange trips to improve efficiency. A TRB research report published in 2000 reports on the productivity improvements gained at Houston's demand response system with the use of AVL (*20*). While the researchers acknowledge that their review could not "control" for all variables that could

impact productivity, they conclude that the AVL in addition to the CASD appear to be the primary factors in the productivity increase of 10.3% from 1994 (pre-technology) to 1999 (post-technology).

Among the DRT systems participating in the research, improved productivity was not among the performance benefits commonly cited by managers whose DRT systems have MDT and AVL technology. Seattle METRO's DRT system, however, attributes the productivity increases to technology, in several ways. First, the AVL data has allowed system managers to scrutinize actual system speed by time of day, day of week, and trip distance within the service area. With this accurate data on speed, managers have refined the system speed in the CASD system, resulting in more accurate and realistic vehicle schedules which then translate to more efficient and often more productive schedules. Second, the MDTs provide real-time information on operations, with vehicle operators "performing" trips in real-time, so that dispatchers know the accurate status of the vehicles, for example, when a trip is "performed," the dispatcher knows when that specific passenger trip is completed. With this real-time information, dispatchers can better utilize available vehicle capacity. This information also shows "slack" time, and this knowledge can later be used to adjust schedules to minimize this unproductive time. The DRT system has reported that its productivity gain from 1.66 in 2004 to 1.74 in 2005 can be attributed in great part to the MDT/AVL technology (Figure 7-2).

But, as Seattle's DRT management said as caveat, productivity has been enhanced by other operational strategies as well, including:

- The mapping navigation software in the MDTs, which provides turn-by-turn instructions, so that operators rarely get "lost."
- State DOT traffic information is available via the MDT, so that operators can "see" real-time traffic conditions on the area's freeways and several main highways and determine if they should take the freeway or an alternate route for a particular trip, resulting in better schedule adherence.
- The DRT system's ability to adjust revenue hours on a daily basis. Management has conducted detailed analysis of past ridership and service data, providing realistic estimates of ridership demand levels by day of week, month and season, which then allows the system to determine, fairly accurately, the amount of service, or revenue hours, to schedule for the next day. If ridership demand for any given *next* day varies from what is predicted, management can adjust the revenue hours scheduled for the next day, informing the contractors to either reduce or add revenue hours. This provides a very realistic match of revenue hours to scheduled ridership, helping eliminate excess revenue time which will harm productivity.



Source: King County METRO's Access, from In Transit, January/February 2006 edition.

Figure 7-2. King County METRO's access productivity gain, 2004 to 2005.

- Using the CASD system, the schedulers "restrict" a pre-determined number of DRT vehicles to specific zones or sub-areas of the service area, concentrating passenger trips within that area onto the "zoned" vehicles to increase their productivity.

Qualifications

There were a few qualifications reported about MDTs/AVL by participating DRT systems.

- **Balancing technology with workforce realities.** One large DRT system that directly operates service reported that it did not push the full capabilities of its MDT/AVL technology because of labor issues. Given some contention between operators and management, the DRT manager decided it would not be prudent to aggressively use the technology, inserting new trips and continuously revising operators' manifests to maximize productivity and performance. When needed, this system was able to use back-up taxi service to address last minute changes. Another system noted that its dispatchers sometimes "get carried away" with their ability to continuously revise operators' schedules in real time.
- **Not using full capabilities of technology.** Two of the participating DRT systems noted that there remain technical issues with their MDTs/AVL and thus the technology is not used to its full potential. One of these two DRT systems reported that it uses its MDTs/AVL primarily for "fact finding," for example, responding to no-show complaints, rather than for dispatching trips in real-time.
- **Balancing on-time performance and productivity.** This was an issue heard from a number of DRT systems and has been reported in the literature (*19*). One of the DRT systems participating in the research called it a *seesaw*, a trade-off between efficiency and service quality. MDTs and AVL allow the DRT system to improve on-time performance, but sometimes this is at the expense of productivity. Finding the balance can be a challenge.

Shorten the Advance Reservation Window: Reduce Cancellations

By their nature, advance reservation DRT systems allow eligible riders to call in advance and reserve trips. Some of the trips scheduled in advance will be cancelled, as riders find that, over the advance reservation period, their plans change or they find alternative transportation. Cancellations, including *all* cancellations—advance and late—may account for 15 to 25% of total trips scheduled.

Reported rates of cancellations among DRT systems will depend not only on the system's actual experience but also on *what* cancellations are included in the calculation, for example, advance cancels only or all cancels including late cancellations. The reported rates will also depend on *how* the DRT system defines cancellations. For example, if a system counts only advance cancellations in its cancellation rate and if advance cancels are defined as cancellations made by 5:00 p.m. the day before service, this system will tend to have a lower cancellation rate, other things being equal, than another system which defines cancellations as all cancellations made before two hours before the trip.

Effects of Cancellations on DRT Performance

While cancellations are a reality of advance reservation DRT systems, they have an impact on DRT performance. Once trips are reserved and placed on schedules, they occupy capacity within the system. Subsequent requests for trips have to be placed around these trips, and this may impact the times scheduled for riders with those subsequent requests. When scheduled trips are cancelled, they become "holes" in the schedules, some of which can be filled as additional requests for service are made. The ability to fill these "holes," that is, re-use the capacity, will depend on when the cancellation occurs, and it will also depend on the technology used by the DRT system.

In addition to their impact on schedules, cancellations require staff time. They require staff time for the original trip scheduling and then staff time for their deletion from the schedule. While the time to accomplish this task for each reservation and cancellation is only minutes, the minutes add up with the cancellations made over the advance reservation window.

Because cancellations are made at different times, they have a tiered impact on service: the closer the cancellation is made to the time of trip pick-up, the more detrimental the impact. Cancellations made at the last minute are typically the functional equivalent of a no-show, as it is very difficult and for many systems not possible to re-use that newly created capacity. That is why most DRT systems group late cancellations with no-shows in their no-show policies.

DRT systems have long recognized the impacts of cancellations, and many have taken deliberate actions to mitigate their impact. Some systems accept same-day trips, knowing that they will have some capacity each service day created by same-day cancels. Will-calls are a similar approach to filling capacity created by same-day cancellations. A will-call is typically a return trip that is not placed on a manifest but rather the rider "will call" when ready to be picked up, and the DRT system fits that trip into the day's schedule.

Over-scheduling trips the day before so there are trips to insert in the capacity created by same-day cancels is another approach. One DRT system included in the research determined that its average same-day cancellation rate is 8%, and it over schedules trips to that amount, with those trips then used on the day of service to fill the capacity created by same-day cancellations.

Performance Improvements

Another approach to addressing cancellations is to shorten the advance reservation window: with more limited time in advance to schedule trips, riders should be more sure of their travel plans and less likely to cancel their trips. There may even be fewer no-shows as riders may be less likely to forget that they scheduled a trip with a shorter period between booking and taking the trip.

Shortening the advance reservation time period is a management action specifically identified by a number of DRT systems included in the research, and several have shortened the window at least twice since the ADA regulations were amended in 1996. These amendments, among other changes, allowed systems to shorten the originally required 14-day time period for advanced reservations. This management action has resulted in a lowered rate of cancellations.

For the DRT systems included in the research, Table 7-5 shows the number of systems by different advance reservation windows, categorized by size of DRT system. All but one of these systems serve ADA paratransit trips.

Table 7-5. Advance reservation windows.

Length of Advance Reservation Window	DRT Systems		
	Small Urban	Large Urban	Largest Urban
More than 14 days	1	1	
14 days	8	4	2
7 days	1	3	4
5 days		1	
4 days			1
3 days		1	3
Next-day only			1
Same-day			2 systems providing general public DRT
Mixed	2 systems specify 14 days in advance for ADA riders and 7 days for non-ADA riders		1 system: 2 days in advance Mon-Wed and 4 days in advance Thurs-Fri.

Note: Not included in the counts are two small urban systems that specified only that reservations must be made "at least the day before" and one very large system that is more than 90% subscription service.

Table 7-6. Shortening advance reservation window.

Change in Reservation Window	Performance Effects	Comments
14 to 7 days	Cancellations reduced from 22% to 18% of trip reservations.	Change implemented in 2005. Decrease in cancellations happened within first month. Result has been almost 1,300 fewer cancellations per month.
7 to 3 days	Cancellations reduced from 13.0% to 11.7% of total scheduled trips.	The window was changed at the start of FY05. Data measures advance cancellations; late cancellations are not included. The 13.0% rate is an average of FY02-04. The 11.7% rate is based on FY05.
7 to 3 days	Cancellations reduced from 12% of all reservations in 2003 to 8.5% in 2004, and to 8% by 2005.	The window was shortened in 2003. Data measures advanced cancellations only. While the impact of the change was predominately in advance cancellations, it was noted that there was also a small decrease in same-day and late cancellations over the same time period. No-shows remained at about the same level over the time period.
7 to 3 days	Cancellations reduced from 24.0% to 19.9% of trips provided. No-shows reduced from 4.1% to 3.1% of trips provided.	This change was implemented in May 2006. Effects based on two months of data in FY05 and same two months in FY06 after window was shortened.

Ten DRT systems indicated they had shortened their advance reservation windows. One system did so immediately following the 1996 amendments, at the suggestion of its riders advisory committee, moving from 14-days in advance to four. The other systems made the change later, typically to address high rates of cancellations and some mentioned that they also hoped to impact no-shows as well. Of the ten systems that shortened their reservation window, four provided data to measure the effect (see Table 7-6 and Figure 7-3).

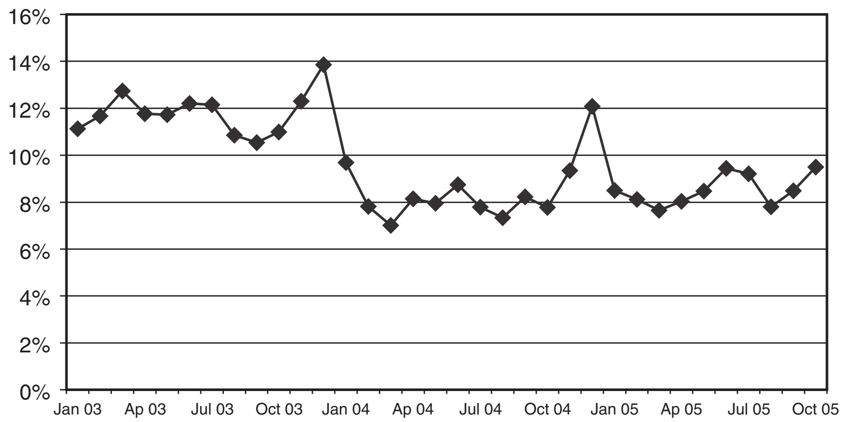
One very large urban system had reduced its original 14-day reservation period to 7 days, but still had high rates of cancellations. An analysis of cancellation patterns, which found that those riders that called 5 to 7 days out were more likely to cancel trips, led this system to further shorten the window to three days in 2005.

With the change to a 3-day reservation window, this system experienced a reduced cancellation rate—from 13.0% to 11.7% of advance cancellations—but also found a dramatic increase in reservation calls on the afternoon before the service day, impacting the reservations staff. Call volume is highest on Monday afternoons, as Tuesdays, Wednesdays, and Thursdays are the busiest days. The DRT system has had to remind its riders that it is open on weekends for reservations.

Reported Performance Improvements with Shorter Advance Reservation Window

- Fewer advance cancellations: riders more certain of their travel plans and less likely to cancel trips.
- Riders may be less likely to forget a scheduled trip with a shorter reservation period; *may* result in fewer no-shows.
- Reduced staff time devoted to scheduling and canceling trips that riders do not want.

Of other systems participating in the research project that shortened their advance reservation windows, while not able to provide measurable data, most noted that cancellations had decreased and that this was beneficial. One small DRT system manager explained that his sys-



Source: Experience of Denver RTD's Access-a-Ride: Window shortened at end of 2003.

Figure 7-3. Reduction in advance cancellation rate with reservation window change from 7 to 3 days.

tem reduced its advance reservation window because, in part, a number of riders would call at the very start of the reservation window, book a number of trips, and then call just prior to the service day to cancel some of those trips.

Several systems said that another benefit was fewer no-shows as "riders are less likely to forget that they made a reservation" with a shorter reservation period. However, there was little data to support this claim, with the exception of one system shown on Table 7-6. To effectively address no-shows, DRT systems have specifically tightened their no-show/late cancel policies, educated their riders, and enforced the policies. This management strategy is addressed next in this chapter.

Qualifications

There were few comments by DRT systems as to any unintended effects of shortening the window, with the exception of the one very large urban system that found a large shift in reservation calls made the afternoon before the service day, as discussed above. To some extent, this is a trend that occurs as systems have reached a zero denial environment essentially required for ADA paratransit services, as riders find that they do not need to call days ahead to get a trip.

This trend towards reservation calls made the afternoon on the day before service seems also to be impacted, in some cases, by riders "learning the system." Two DRT systems noted that some riders were purposefully calling late the afternoon before the service day to request a trip, because they had learned that doing so typically meant they received the exact time they requested, with no trip time negotiation. This occurred because the CASD system could not find space for the trip and it was placed on the "unscheduled list." Call-takers were telling these riders that "no solution was found" for their trips and then giving the riders the exact trip time they requested. Such unscheduled trips are later manually scheduled or placed on an overflow provider. However, when riders began asking for a "no solution found" trip, the DRT systems realized that they needed to adjust call-taker practices so that riders are not told if there is "no solution found," and so that all riders are treated in the same way in terms of the reservations and scheduling process.

It is also noted that two of the largest urban systems indicated limited effects from shortening their reservation windows. One system, which changed its original 14-day reservation period to 4 days some years ago, has a current cancellation rate of about 20%. The second system went from 7 to 3 days in 2001. Both of these systems specifically said there was very limited, if any, change to their cancellation rate with the shortening of the reservation window.

Adopt and Enforce No-Show and Late Cancel Policy

While some level of no-shows and late cancellations may be an accepted aspect of DRT operations, they are also recognized for their detrimental effect on performance. In an effort to minimize no-shows and late cancels, most DRT systems have developed and adopted policies to reduce their occurrence.

Effects of No-Shows and Late Cancellations on DRT Performance

No-shows have a clear negative impact on DRT performance. When a rider does not show up for a scheduled trip, or cancels the trip at the door, the DRT system has essentially wasted a passenger trip.

Excessive no-shows may also have an impact on on-time performance. To the extent that operators have to wait at scheduled pick-up locations for the full waiting time or longer while dispatch tries to locate a rider, no-shows may cause subsequent trips on the operators' schedules to be affected. And when riders are no-shows for their return trips back home, the DRT system may be required to send a second vehicle later to pick up the rider, requiring new trips to be inserted into vehicle schedules, which then may affect the timeliness of trips that follow.

No-shows also inconvenience other riders who might be on-board when a rider no-shows, affecting the service quality of their trips. These others riders have wasted their time traveling to and waiting for the no-show rider. Had the rider cancelled his trip with adequate notice rather than no-showing, the other riders on-board may have had a more direct trip, in less time.

Late cancellations are also typically detrimental to DRT performance. Depending on the DRT system's definition, a late cancellation may have the same impact as a no-show. If the system cannot re-use the capacity created by the late cancellation, it has the same negative affect as a no-show. As noted in Chapter 5, DRT research using simulated service has found that higher rates of late cancellations adversely impact productivity, with an approximate 4–5% decrease in productivity for every 10% increase in the cancellation rate.

Because they represent lost resources, no-shows and late cancellations have a price tag. One of the larger urban systems participating in the research estimated that during FY 2000, it scheduled over $1 million of service that was *not* used due to no-shows and late cancellations. Another large urban DRT system estimated its potential annual cost savings with reductions in its high rate of no-shows: the system estimated that if it could reduce the no-show/late cancellation rate from its then-level of 10% to a lowered rate of 7%, the DRT system would save approximately $350,000. If it could reduce the rate to an even lower 4%, this would represent an annual cost savings of over $695,000.

No-Show and Late Cancellation Policies Vary

To mitigate the impacts of no-shows and late cancellations, most DRT systems have established policies that both define *no-shows* and *late cancellations* and establish penalties for riders who accumulate excessive no-shows and late cancels. These policies vary considerably across DRT systems. Some systems use a fairly straightforward policy that counts the number of no-shows and late cancellations accumulated by an individual rider over a defined period of time, which then results in some level of service suspension once the number of no-shows/late cancellations exceeds the defined threshold.

Other DRT systems use fines or charge for scheduled but untaken trips as a way to address no-shows and late cancellations and this may be in conjunction with service suspension. Some larger DRT systems have established more sophisticated policies using a point scale, where points are assigned for each cancellation and no-show, and the number of points given for each cancellation or no-show depends upon when the rider notifies—or does not notify—the system. Once a certain level of points has been accumulated by an individual rider over a specified time period, the rider is suspended for a defined amount of time. Such policies may also have a reward component, so that riders who use the service responsibly, without no-shows or late cancellations over a defined time period, may be eligible for a free trip on the system.

It is noted that DRT systems that are ADA paratransit must also have an appeals process in place if the no-show/late cancel policy provides for service suspension for excessive no-show/late cancels.

A few of the smaller DRT systems included in the research indicated that they have few problems with no-shows and late cancels. Despite this, they still have a policy to address these situations.

Most of the DRT systems indicated that problems with no-shows and late cancels occur predominately with subscription riders. In fact, one DRT system implements its no-show/late cancel policy only for subscription riders. And often, DRT systems reported that it was a small number of riders who are habitual offenders of the no-show/late cancel policy.

One DRT system requires that riders who have more than three no-shows in a 30-day period call the system one-half hour before each trip to “confirm” that they are, in fact, taking the trip. Such riders stay on the “confirmation” program until they have achieved one month without a no-show. Moreover, if a rider on the confirmation program fails to call in for a scheduled trip, any remaining trips that rider has scheduled for the day are automatically cancelled. Subsequent infractions of the no-show policy may result in progressively longer service suspensions. A key aspect of this system’s policy is the personal touch—a DRT staff person contacts the offending rider to explain why no-shows are a problem and the consequences of continual no-shows.

Performance Improvements

The cited performance improvements with quantifiable data related predominately to reductions in no-shows and late cancels, and two systems pointed to productivity improvements as well.

- **Reduced no-show/late cancellations.** Among the DRT systems included in the research, seven provided data that quantified the reduction in no-shows and late cancels with implementation of their no-show/late cancel policies; see Table 7-7 and Figure 7-4. Interestingly, two of the systems provided data that showed how an education campaign, by itself, can reduce the no-show and late cancel rate. Another system, DART’s Paratransit program, quantified reductions from its revised policy (and consistent enforcement) separately for no-shows and late cancellations, the latter defined as a cancel made after 5:00 p.m. the day prior to the trip and up to 2 hours before the pick-up time. The system’s no-show rate declined from 5% to 3% and its late cancellations from 13% to 9%.
- **Improved productivity with reduced no-shows/late cancellations.** Among the DRT systems participating in the research, two systems, one small and the second in the largest urban category, reported that the reductions in no-shows and late cancels translated into improved productivity; see Table 7-8. Interestingly, it was a new performance standard that marshaled the efforts at the small DRT system to address no-shows and late cancels. Facing a new productivity standard of 2.8, the system’s contractor focused on reducing no-shows/late cancels by telephoning each night those riders on the next-day schedule with a history of no-shows/late cancels. The no-show/late cancel rate was reduced dramatically, from over 9% to less than 3%, and the productivity standard was achieved.

Qualifications

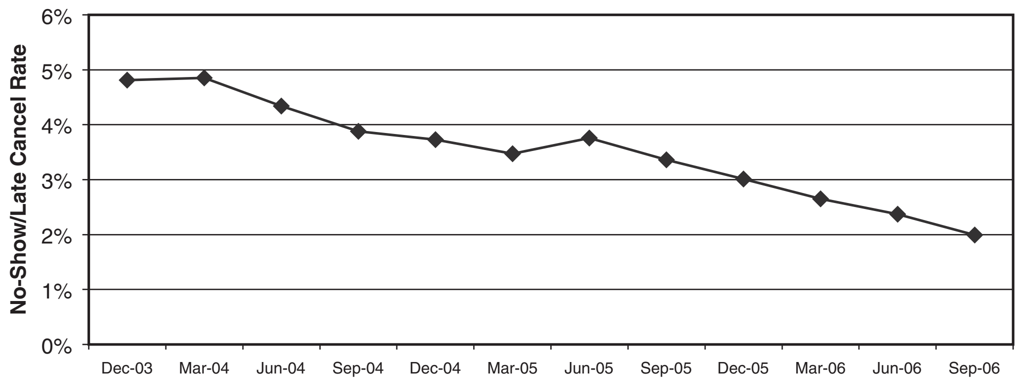
Tackling the problems of no-shows and late cancellations requires staff resources. Some of the DRT systems included in the research benefit from their sophisticated CASD systems capable of automatically generating letters when no-shows/late cancels occur. But even with such technology,

Table 7-7. Develop and enforce no show/late cancel policy.

No-Show/Late Cancel Policy	Performance Effects	Comments
Strict new policy implemented in 2003, by small urban DRT system. *Late cancel definition: cancellations less than one hour before trip considered no-shows.*	*Before* late cancellation/no-show rate • FY 2003 2.8% *After* late cancellation/no-show rate • FY 2004 2.0% • FY 2005 1.6%	The system's relatively low "before" no-show/late cancel rate reduced even further with new policy. Problems are with "habitual offenders," typically subscription riders whose trips are booked through an agency and riders traveling for dialysis.
The existing policy of a small urban DRT system was enforced more strongly by the contractor when its new contract stipulated new performance standards, including a productivity standard. Policy states: *no-shows and late cancellations, which are trips cancelled after 3 pm the day prior to service, may result in loss of riding privileges.*	*Before* late cancellation/no-show rate • FY 2005 9.4% *After* late cancellation/no-show rate • FY 2006 2.8%	The DRT system's contractor focused on reducing no-shows, which were significantly more problematic than late cancels. Contractor assigns one staff person each night to review next-day manifests and to call riders on schedule with history of no-shows/late cancels to remind them of their scheduled trips or to cancel the trip if not needed. Given small size of system, this involves roughly 30-50 phone calls per night.
The no-show/late cancel policy of a large urban system was not enforced, in part because the system was waiting for planned implementation of MDTs/AVL. Without enforcement, result was a high no-show rate. The system embarked on a rider education campaign to reduce no-shows/late cancels prior to implementation of MDTs/AVL. Policy states: *No-show occurs when no one answers door when driver knocks loudly or rings doorbell. Late cancellation, which is the same as a no-show, occurs if trip is cancelled less than 90 minutes prior to scheduled pick-up time.*	*Results from an education campaign* *Before* late cancellation/no-show rate • FY 2004 10% *After* late cancellation/no-show rate • FY 2005 8%	The DRT system indicated that many riders did not know about the no-show/late cancel policy and some were "very embarrassed" to learn they were taking trips from others by not showing. Education campaign included outreach, letters, and other direct mailings, including a focus on riders with no-show histories.
The existing no show/late cancel policy of a large urban DRT system was enforced beginning in early 2004. Efforts included outreach, education, and penalties as established.	*Before* no-show rate (cancels not included) • FY 2003 4.8% *After* no-show rate • FY 2004 3.7% • FY 2005 2.0%	Enforcement includes: daily listing of all no-shows/late cancel riders from previous day with notification letter automatically generated and mailed to rider. Staff also reviews obituaries in local newspapers to look for subscription riders who may have passed away with resulting no-shows incurring until the DRT system is notified.
Implementation and enforcement of no-show/late cancel policy began during FY 2002 at a large DRT system. *A late cancel is a trip not cancelled by 5 pm the day before service.* Implementation began with 4-month education campaign, then enforcement was initiated.	*Before* late cancellation/no-show rate • FY 2002, first 4 months: 10.3% *After* late cancellation/no-show rate • FY 2002, second 4 months, after education-only campaign 6.8% • FY 2002, after enforcement began 5.6% • FY 2003 5.6% • FY 2004 5.8% • FY 2005 5.8%	System mails out an auto-generated letter for every no-show/late cancel with specific details on each occurrence. Relatively few riders receive a suspension: on average, 42 suspensions each year over 2003-2005, compared to approximately 12,600 active riders. Reductions in late cancels/no-shows have come more from late cancellations. No-shows decreased from 2.9% of scheduled trips before the education and enforcement campaigns to 2.2% by FY 2003.

Table 7-7. (Continued)

No-Show/Late Cancel Policy	Performance Effects	Comments
Sophisticated no-show/late cancellation policy was developed and has evolved since its implementation in FY 2003, by a large DRT system. The policy uses "points," which a rider accumulates depending upon when the rider notifies, or does not notify, the system as to a cancellation/no-show. Penalties are imposed depending on the number of points accumulated over specified periods of time. Riders can also receive "rewards" for earning no points.	*Before* late cancellation/no-show rate • FY 2001 10% *After* late cancellation/no-show rate • FY 2002, first two months, implemented new policy 4.5% • FY 2003, revised policy to include "points" 2.4% • FY 2004, lengthened period for advance cancels to 10 pm day before 2.7% • FY 2006, reduced length of suspension 2.4%	The "points" based late cancellation/no-show policy has been very effective, allowing the DRT system to focus on education rather than suspensions. The system's advisory group was instrumental in developing the no-show/late cancel policy.
New, stricter no-show/late cancellation policy in 2002, by a large system using "points," where a different number of points are assessed for cancel/no-shows depending on when the rider notifies, or does not notify, the system. The closer the notification time is to the scheduled pick-up, the greater the number of points assessed. The policy has gone through 3 iterations. The current version has an incentive program for riders who accumulate no points.	*Before* late cancellation/no-show rate • 2001 est. 20% *After* late cancellation/no-show rate • 2003 11% • 2006 7%	Before implementing the stricter no-show/late cancel policy, the system tried to address the high rate of no-shows by reducing the advance reservation window from 14 to 3 days in advance. Reportedly, this did not have much impact on no-show/late cancels. Current policy is considered very successful, though it was reported that there are issues with chronic offenders who repeatedly are faced with the longest suspension of 6 months.



Experience of ACCESS LYNX, Orlando, Florida.

Figure 7-4. Enforcing no-show policy.

staff resources are needed. One of the larger DRT systems with a points system for no-shows/late cancellations reports that up to 1.75 full-time staff are assigned to enforce its policy.

It is also noted that one system indicated that there is an upside to some level of no-shows and late cancellations. This system, operating in a large metropolitan region, reported that no-shows/late cancels can be useful at times, providing short pockets of time that operators can use to get back on schedule when running late.

Manage Supply of Revenue Hours to Match Demand

DRT performance can be improved by ensuring that the supply of service, as measured by revenue hours, matches expected demand for service, as measured by passenger trips. This management action requires that the DRT system understand its ridership patterns by day of week, by month, and by season. Once patterns are understood, the system can then schedule its service to match expected ridership patterns. In this way, the system can reduce less productive hours and increase its productivity.

Table 7-8. Reduce no-shows/late cancels to improve productivity.

No-Show/Late Cancel Reductions	Effect on Productivity	
To help meet a new productivity standard in the contract, the small urban system and its contractor focused on reducing no-shows/late cancels. Contractor assigns one staff person each night to review next-day manifests, then calls riders on schedules who have a history of no-shows/late cancels to remind them of trips or to cancel the trip if not needed.	*Before* late cancellation/no-show rate • FY 2005 9.4% *After* late cancellation/no-show rate: • FY 2006 2.8%	*Before* productivity: • FY 2005 2.6 passenger trips/revenue hour *After* productivity: • FY 2006 2.8 passenger trips/revenue hour
Several strategies implemented in 2002 by a large system to address increasing costs and demand. Among them, implementing a strict "point"-based no-show/late cancel policy was considered very effective, reducing no-show/late cancels by almost half over 2 years.	*Before* late cancellation/no-show rate: • 2001 est. 20% *After* late cancellation/no-show rate • 2003 11%	*Before* productivity: • FY 2001 1.89 passenger trips/revenue hour *After* productivity: • FY 2003 1.97 passenger trips/revenue hour

Performance Improvements

Several of the DRT systems participating in the research identified the management of their revenue hours to match expected ridership as a strategy employed to improve productivity; see Table 7-9. These are systems that use private contractors to provide their DRT service, and the contractual relationship provides for the adjustment of revenue hours. Since contractors enter into agreements based on an understanding of the service they will provide and for a cost that depends on that understanding, it is important that the mechanism for adjusting revenue hours and the extent to which adjustments will be made are explained. The contractor is then responsible for operationalizing the adjustments, including changing operator schedules to match the revenue hours.

For this strategy to be effective, the system must understand its expected demand so it can then provide the appropriate amount of service on the street. For a larger system, such adjustments may be an action taken each day, so that the next-day's pull-out may be reduced or certain vehicle schedules revised based on passenger trips that are requested for the next day.

A variation on this strategy is the adjustment of revenue hours on the day of service. One of the DRT systems in the research is proactive in monitoring the vehicle schedules out on the street. If a particular vehicle schedule shows a number of same-day cancellations towards the end of the operator's shift with only one or two trips remaining, for example, those trips may be moved to another vehicle and the vehicle pulled in to end its schedule. This practice helps to minimize unproductive revenue time.

For a smaller system, the adjustment of revenue hours to match demand may be an action taken less frequently. One of the systems shown on Table 7-9 negotiated its contracted service to be provided on an "on-call" basis during weekday nights and weekend days, time periods that system

Table 7-9. Manage supply of revenue hours to meet demand.

Strategy	Performance Effects	Comments
The start and end times of DRT routes operated by the contractors are "flexed" from their original schedules by the sponsoring very large urban DRT system to match trips scheduled for the next day. Initially, this strategy was aggressively pursued, but then revised so that the "flex" was limited to 30 to 60 minutes from the original schedules.	Productivity of 2.34 passenger trips per revenue hour achieved in 2005, with the "flexing" given much credit for the productivity achievement. Once the "flexing" was more limited, productivity decreased the following year, to 2.26.	The DRT routes subject to "flexing" start and end times are identified to the contractors, so that contractors can inform their vehicle operators which routes may be "flexed" before routes are chosen. Routes that are flexed are those serving demand trips and that tend to fluctuate day-to-day; routes anchored by subscription trips, the large majority of routes, are not flexed. When initially implemented, the amount of flexing was not popular with vehicle operators, and this led to more limited flexing.
"On-call" revenue hours are provided during weekday nights and weekend days by the contractor to meet the limited demand experienced by the small urban DRT. Beginning in 2005, during the defined low demand hours, the system is charged for revenue hours only when a trip is scheduled. The contractor is a private non-profit.	With "on call" revenue hours, productivity reached 3.08 during 2005. Prior year, with service directly operated by the city, productivity was 2.72.	With the change from direct city operation to contracted service, the city negotiated the arrangement whereby the contractor is on-call during the low demand periods of weekday nights and weekend days. It was estimated that for the six-hour period each weekday night, which computes to 30 hours of potential service during a week, the city pays for only 2 to 4 trips (therefore hours) in a typical week.
Actively managing the contractor's revenue hours to match the demand for service is among the strategies employed by a very large DRT system to improve productivity. The DRT system implemented a number of strategies at the start of FY06, including limiting the service area to ¾ mile corridors and increasing the on-time window from 20 to 30 minutes.	Productivity on the contracted service improved in FY06 to 1.97, an increase from 1.93 in the prior year, FY05.	This increase was the result of the various strategies put in place, but ensuring that the provision of revenue hours by the contractor match changing patterns of demand and use is a key management action used by the DRT system to maximize productivity.

managers knew were very low demand, so that the system is charged for revenue time only when a passenger trip is provided. This has been a very effective management action, saving more than 25 revenue hours on a weekly basis. When annualized, this is a savings of more than 1,000 revenue hours, which saves not only unproductive revenue hours, but operating costs as well.

One technique used by a contract operator to check the *efficiency* of the next-day's schedule involves a fairly straightforward calculation. On the afternoon before next-day's service, the following is done: determine the number of passenger trips requested, adjusting that for anticipated no-shows and late cancels, and divide that number by the target productivity figure. According to the contractor, this provides an estimate of the number of revenue hours needed for the next day, which can then be used to schedule the appropriate amount of service for the next day. If the system has an average of eight hours per day per operator, for example, the estimated number of revenue hours is then divided by that average, eight in this example, providing an estimate of the number of operators needed. With this information, the manager can begin to adjust the number of operators for the next day to maximize efficiency. If these calculations are done over time, with the actual day's data then added to compare to the estimates, the manager can monitor trends and understand the patterns, fine-tuning the ability to match revenue hours to demand for service.

Qualifications

To be effective, a DRT system must work closely with its service contractor when adjusting revenue hours, particularly when this is done on a daily and ongoing basis. While such adjustments have the potential to improve productivity, the strategy must be workable from the contractor's perspective. During economic times when DRT systems and their contractors are experiencing vehicle operator shortages, such adjustments requiring the cancellation of two vehicle schedules out of 100 for the next day, for example, might work out well for the contractor. But changing vehicle schedules is clearly not universally popular among operators, many of who need some stability in their work schedules and pay checks. Given the pivotal role that operators play in the provision of DRT service, this strategy of adjusting vehicle schedules on a continual basis must be implemented to the benefit of both the DRT system and its service providers.

Consider Same Day Taxi Program

Several of the DRT systems participating in the research project have implemented same-day taxi programs. While this may not be considered a management action that leads to direct performance improvements in the same way as those discussed earlier, such programs have been implemented by a number of DRT systems that are ADA paratransit, facilitating use by ADA-eligible riders of taxi trips that are less costly than ADA paratransit trips, and are considered effective by the DRT systems.

The DRT systems that provide such same-day taxi programs as supplemental to their ADA paratransit service claim a number of benefits, including cost savings to the extent that riders choose the taxi service rather than the ADA service for their trips, and increased flexibility for the ADA riders given the taxi program's same-day attribute. The cost-savings accrue as the subsidy level for the taxi trips is typically substantially less than the subsidy for the next-day ADA paratransit trips. Even if the taxi program generates new demand, which is an issue for such programs, given the difference in trip subsidy levels, the same-day taxi programs may still represent cost savings for the ADA paratransit program.

Characteristics of Same-Day Taxi Programs

The same-day taxi programs allow ADA-eligible riders to reserve and take trips with participating taxi companies on the day of travel, as opposed to the next-day, advance reservation nature of ADA paratransit service. The taxi programs typically have restrictions on use, for example, limits on the amount of subsidy per taxi trip and a cap on the number of taxi trips that can be taken through the program during defined periods of time, for example, per day or per month. Such restrictions serve as budgetary controls on the programs.

Typically, the DRT system subsidizes a trip up to a maximum amount on the taximeter, with the rider paying a pre-determined fare at the start of the trip. If the rider's taxi trip exceeds that maximum amount on the meter, the rider is responsible for paying the amount over the maximum. For example, one of the same-day taxi programs reviewed in this research allows an ADA-eligible rider to take a trip up to $10 on the meter for a fare of $2.25. A $10 taxi trip is approximately two to three miles. If the taxi trip exceeds $10 on the meter, the rider must pay the additional amount, as well as the initial fare of $2.25.

Objectives of Same-Day Taxi Programs

While the specific objectives of the DRT systems' same-day taxi programs vary, one objective is typically cost savings. If some of the ADA riders shift trips to the less expensive taxi service, the DRT system may achieve some cost savings. Table 7-10 shows summary characteristics of five same-day taxi programs that are provided as supplemental, premium service for the ADA paratransit service provided by DRT systems participating in the research.

The programs shown on Table 7-10 are provided by DRT systems in the largest urban DRT category. However, same-day taxi programs have been implemented at small systems as well. One of the small systems participating in the research, Champaign-Urbana MTD, developed a half-fare taxi program as part of its approach to meet increasing demand and costs for its ADA paratransit service. Through this program, eligible ADA riders as well as others with disabilities and senior members of the community can take a pre-determined number of taxi trips each month for half the meter cost, with the other half subsidized by the DRT system. This program gives ADA eligible riders an option for same-day trips, and also provides discounted taxi transportation for others in the community with specialized needs. System management credits this program, along with other strategies, for helping improve the performance of the city's ADA paratransit service.

A lingering issue regarding same-day programs is the extent to which they induce *new* trip-making because the riders do not have to book trips one day in advance. If significant new trips are created over what would have been taken on the next-day ADA service, the cost savings to the DRT system will be reduced.

Early research conducted for the FTA when the ADA regulations were being written in 1989 and 1990 looked at the issue of same-day versus next-day service. According to the model that was used in that research, changing from a 24-hour advance reservation to a same-day service could, other things being equal, increase demand by up to 90% (*29*).

This research project has looked in detail at three same-day taxi programs including changing trip patterns with implementation of the taxi program.[1] The findings are discussed below.

Same-Day Taxi Program Use

For the three taxi programs reviewed, use of the same-day program was assessed in two ways. First, riders' use of the taxi program was reviewed for a sampled period of time and compared

[1] Data on the same-day taxi programs were requested from three of the DRT systems participating in the research. Data reviewed: for the first program, all taxi program ridership over a 20-month time period after the program was introduced in 2005 was assessed; for the second program, all taxi program ridership was assessed for a 3-month time period in 2006; for the third program, a random sample of 150 taxi program users was assessed for a 3-month time period in 2005.

Table 7-10. Summary characteristics of same-day taxi programs provided as supplemental to ADA paratransit services.

	Program 1	Program 2	Program 3	Program 4	Program 5
Program Objectives	Program initiated in FY04 at the request of a legislator to provide more spontaneous travel opportunities for ADA riders.	Program initiated in FY06 to: • Mitigate possible negative effects of reducing service area to ¾ -mile ADA corridors and of eliminating same-day medical back-up service provided through dedicated van service. Expected that program might help reduce late cancels/no-shows.	Program initiated at start of FY05 to address service performance issues experienced at that time and to provide alternative service options while transit agency implemented major revision of service structure.	Program was implemented in the 1990's to address ADA paratransit denials being experienced at that time and to provide a more cost-effective alternative to dedicated van service. There had been a particular interest in shifting the shorter trips to taxi during peak hours to free up capacity on the dedicated service.	Program has been in operation for many years and was implemented to provide opportunity for more spontaneous travel than provided through the agency's traditional advance reservation paratransit service.
Program Parameters	Eligible rider pays $7.00 for a taxi trip up to $20 on meter. Beyond $20 meter fare, rider is responsible. $20 taxi trip is approx. a 10-mile trip. ADA fare is $3.50 peak, $2.50 off peak.	Eligible rider pays $2.25 for taxi trip up to $10 on meter. Beyond $10 meter fare, rider is responsible. $10 taxi trip is approx. 2-3 miles. ADA fare is $2.25, the same as the taxi fare.	For first year, eligible rider paid $3.00 for taxi trip of any length. After program's first year, this was revised so that $3 fare provided trip up to $50 on meter, with cap of 4 one-way trips per day per rider. Rider responsible for fare over $50 on meter. ADA fare is $1.85.	Eligible rider pays $2.00 for a taxi trip up to $9.00 on meter. Beyond $9 on the meter, the rider is responsible. ADA fare is $3.00.	Eligible rider pays $1.00 for taxi trip up to $9 on meter. Beyond $9 meter fare, rider is responsible. $9 taxi trip is approx. 3 miles. ADA fare is $1.15.
Program Controls	Program operated as pilot for period of time. DRT system developed electronic notification procedure so that requested taxi trips, which are scheduled in the CASD system as riders contact the ADA system first, are uploaded at the participating taxi companies. When eligible rider calls taxi company of choice, the taxi company can verify the request and then provide the trip.	Program initiated in FY06 as a pilot. Same-day trips capped at 50 per day. However, since weekend usage has been lower than the cap, DRT system allows weekday trips to somewhat exceed cap when needed.	New controls implemented in FY06, as described above. Program still labeled pilot. DRT system uses a private firm for comprehensive management of taxi program. Eligible riders use an electronic swipe card that collects comprehensive trip information. Participating taxi companies have meters that read the swipe card. Management firm monitors use closely, providing detailed data on use and watching for any unusual activity/fraud.	Same-day taxi trips capped at 600 per day and a rider can request up to 4 one-way trips per day. Program usage has not reached the current cap. Usage is about 180-210 taxi trips per day, a ridership level that has been relatively consistent for a number of years.	DRT system issues limited number of "blank" vouchers each month to participating cab companies. Blank vouchers then provided to drivers. DRT system also gives each taxi co. a list of randomly generated numbers each month. When an eligible rider requests a trip, the taxi co. dispatcher gives the next random number to the driver, to fill in on the blank voucher, helping prevent unauthorized completion of vouchers. The requested trip and voucher number are also entered electronically. Data on the completed voucher and electronic file must match for taxi company to be paid.
Program Use and Cost	Passenger trips, FY 05 • ADA paratransit 1,104,879 • same-day taxi est. 2,660 (< 1% of ADA paratransit trips) Cost per passenger trip • ADA paratransit $23.94 • same-day taxi $13	Passenger trips, FY 06 • ADA paratransit 1,235,836 • same-day taxi 11,681 (1% of ADA paratransit trips) Cost per passenger trip • ADA paratransit $26.55 • same-day taxi $7.75	Passenger trips, FY 05 • ADA paratransit 620,989 • same-day taxi 169,710 (27% of ADA paratransit trips) Cost per passenger trip • ADA paratransit $31.16 • same-day taxi $25.48	Passenger trips, FY 05 • ADA paratransit 551,000 • same-day taxi 49,700 (9% of ADA paratransit trips) Cost per passenger trip • ADA paratransit $40.31 • same-day taxi $7.00	Passenger trips, FY 06 • ADA paratransit 1,365,949 • same-day taxi 120,143 (9% of ADA paratransit trips) Cost per passenger trip • ADA paratransit $20.91 • same-day taxi $5.18

to the same riders' use of the ADA service during the same sample time period. Second, to review how trip patterns changed on the ADA service with introduction of the same-day taxi program, riders' use of the taxi program was reviewed and compared to the same riders' use of the ADA service both before and after the taxi program began. This second assessment focused on riders who were eligible for the ADA service during both the *before* and *after* time periods.

Given the different scales of the taxi programs—two of the programs provide a very small percentage of passenger trips compared to ridership on the ADA service, while the third program provided a substantially larger share—and with different taxi program parameters, the results of the programs are quite different. With the first two programs, the majority of the taxi program users appear to be infrequent users, with less than one taxi trip per month. Correspondingly, small portions of the taxi program users are frequent users, defined as taking one or more taxi trips per week. The first program shows that less than 2% of taxi program users are frequent users, and they accounted for about one-third of the taxi trips during the sampled time period. The second program shows that 10% of the taxi program users are frequent users, with one or more taxi trips per week, and they accounted for about half the taxi trips. The "frequent" taxi program users at both the first and second DRT system averaged nine taxi trips per month, in addition to their ADA paratransit trips.

With the third program, which provides a considerably larger subsidy and initially few limitations for taxi trips, the trends of the first two programs are reversed, with the majority of taxi program riders defined as frequent riders; and these riders take on average 17 taxi trips per month, almost twice the level of taxi trip-making as the first two systems. Table 7-11 provides this summary information.

Changing Trip Patterns

The changes in trip patterns with introduction of the same-day taxi program vary by the three DRT systems and whether the taxi program users are *frequent* or less frequent taxi users. For the first two programs, the infrequent taxi program users appear, based on ridership data during the sampled time period, to use taxi trips as supplemental trips, with either the same or somewhat greater ridership levels on the ADA service during the *before taxi program* time period and the *after taxi program* time period.

The frequent users of the taxi program, however, appear to be shifting trips from the ADA service to the taxi program and, with two of the programs, increasing their overall trip-making (taxi trips plus ADA paratransit service trips) by significant amounts. With the second program, the small group of frequent taxi program users decreased their ADA trips, on average, by about four trips per month and added nine new taxi trips per month. With the third program, the frequent taxi program users, accounting for about two-thirds of the users based on sampled data, decreased their ADA trips, on average, by 5.4 trips per month, and added 17 new taxi trips per month. For this latter program, this represents an increase in overall trip-making (on both the ADA service and taxi program) of over 90% once the taxi program was introduced.[2]

Performance Effects

Because the taxi program parameters were considerably different across the three DRT programs reviewed, few generalizations can be made. The program parameters are clearly important in determining use of the program. Not surprisingly, the taxi programs that provide a greater

[2] It may be tempting to relate this finding to the research findings noted earlier in this section on increased demand when a 24-hour paratransit system converts to same-day service. But the experience of the same-day taxi program related here was not conversion of the service from next-day to same-day, it is a supplemental same-day program that does not hold all other things equal. Furthermore, the increase in demand of 90+% comes from trips on both the next-day ADA service and the same-day taxi service.

Table 7-11. Use of same-day taxi programs by ADA-eligible riders at three systems.

	Program 1	Program 2	Program 3
ADA-Eligible Riders Who Use Same-Day Taxi Program	Total Passenger trips, FY 05 • ADA paratransit 1,104,879 • same-day taxi est. 2,660	Total Passenger trips, FY 06 • ADA paratransit 1,235,836 • same-day taxi 11,681	Total Passenger trips, FY 05 • ADA paratransit 620,989 • same-day taxi 169,710
Increase in total trips made by taxi program users, measured from year *before* taxi program to year *after* taxi program initiated.	41%	37%	67%
Composition of new trips by taxi program users: • **ADA paratransit** • **Same-day taxi**	• 84% ADA trips • 16% taxi trips	• 37% ADA trips • 63% taxi trips	• 41% ADA trips • 59% taxi trips
Users of taxi program:			
• **Infrequent – less than once per month**	91%	57%	9%
• **Somewhat frequent – once per month and more**	9%, accounting for 65% of taxi trips	43%, accounting for 86.5% of taxi trips	91%, accounting for 99% of taxi trips
• **Frequent – once per week and more**	1.5%, accounting for 34% of taxi trips; average of 9.3 taxi trips per month	9.7%, accounting for 51.4% of taxi trips; average of 9.1 taxi trips per month	65%, accounting for 95% of taxi trips; average of 17.1 taxi trips per month
• **Very frequent – once per day and more**	<0.2%, accounting for 14% of taxi trips	<0.5%, accounting for 8.2% of taxi trips	11%, accounting for 39% of taxi trips
Changing trip patterns once taxi program began:			
• **Infrequent users – less than one taxi trip per month**	Average of 7.0 ADA trips/month *prior to* taxi program. Increase to 9.1 ADA trips/month *after* taxi program. These users appear to use taxis for supplemental trips.	Average of just under 9.0 ADA trips/month *prior to* taxi program. Average of 9.0 ADA trips/month *after* taxi program. These users appear to use taxis for supplemental trips.	Small portion of taxi users, with average of 6.8 ADA trips *prior to* taxi program. Average of 5.5 ADA trips *after* taxi program.
• **Somewhat frequent users - one or more taxi trips per month**	Average of 10.5 ADA trips/ month *prior to* taxi program. Very slight increase to 10.6 ADA trips/ month *after* taxi program. Additional 3.1 taxi trips per month on average.	Average of 11.1 ADA trips/month *prior to* taxi program. Decrease to 10.1 ADA trips/month *after* taxi program. Additional 3.7 taxi trips per month on average.	Average of 12.4 ADA trips/month *prior to* taxi program. Decrease to 8.3 ADA trips/month *after* taxi program. Additional 12.9 taxi trips per month on average.
• **Frequent users – one or more taxi trips per week**	Very small group of taxi riders, *decreased* ADA trips from 21 ADA trips per month to 9 ADA trips per month, with *additional* 9 taxi trips per month on average.	Relatively small group of taxi riders, *decreased* ADA trips from 13.2 to 9.5 ADA trips per month, with *additional* 9.1 taxi trips per month on average.	Two-thirds of taxi riders, *decreased* ADA trips from 12.9 to 7.5 ADA trips per month, with *additional* 17.1 taxi trips per month.

subsidy per same-day taxi trip are more heavily used. Additionally, as noted on Table 7-10, the taxi programs can be designed so that riders are encouraged to take shorter trips. One of the DRT systems specifically wanted its ADA riders to use the same-day taxi program for shorter trips, particularly during peak times to free up capacity on the dedicated vehicles.

It can also be said that, based on the three same-day taxi programs reviewed, with the availability of a same-day taxi program, there seem to be a portion of ADA eligible riders who gravitate to the taxi program and use it extensively, with a significant decrease in trips on the ADA service. Some discontinue use of the ADA service altogether. The size of this portion of ADA riders varied considerably among the three programs reviewed. At the first program, this group of frequent riders was less than ten individuals. At the second program, it was about 60 individuals. At the third program, data were not available to show the size of this portion of taxi program users, but based on sampled riders, it appears that the frequent riders are about two-thirds of the users of the taxi program. This latter program provides a substantially greater subsidy for each taxi trip and, during the program's first year, few limitations on its use.

Moreover, for all three programs, it seems that those ADA eligible riders who become frequent users of the taxi program were more active riders of the ADA service before the start of the taxi program compared to other taxi program users. This review did not compare the frequent taxi program users to those riders who use only the ADA service, so it is not known to what extent the taxi users' trip-making compares to those who do not use it. But experience in the industry and the review described here suggest that the riders who became frequent users of the taxi program are already relatively mobile compared to other paratransit riders.

To the extent that eligible riders who are frequent riders of the ADA paratransit service can be encouraged to shift trip-making to a taxi program where per trip costs are significantly less than the ADA service, same-day taxi programs may be cost-effective if properly controlled. Assuming DRT budgets are constrained, however, it is important to ensure that a taxi program is designed such that the per trip taxi cost and the new trip-making that will be induced do not incur additional, new operating costs.

Qualifications

If same-day taxi service is being considered, several issues should be addressed, and generally, these will arise with the use of taxis in any non-dedicated fashion for DRT service. First, the DRT system should consider whether local taxi companies have any accessible taxi vehicles. The ADA regulations do not require taxi companies to have accessible taxi sedans[3] but a growing number of communities across the country are requiring their local taxi industry to provide some level of accessible vehicles. Even in communities without such local regulations, there are some taxi companies that acquire accessible cabs to serve customers who need a lift or ramp to board. At least two of the taxi programs reviewed in this research operate in cities which have, or had when the program originated, no accessible taxis. But this means that the same-day program, while a premium service beyond what the ADA requires, is not available to ADA-eligible riders who require accessible equipment.

Another issue relates to the potential for unauthorized use of the program. With the use of paper vouchers or similar media and the participation of companies that typically have limited control over their independent contractor drivers, taxi-based programs have experienced fraud. The DRT system needs to ensure that taxi-based programs are designed with procedures in place to closely monitor ridership and ensure appropriate use. This requires an investment of time and resources. One of the same-day programs reviewed is managed by a

[3] ADA regulations, 49 CFR §37.29 (b) *Private entities providing taxi service.*

private entity for the sponsoring DRT system, with sophisticated systems and procedures in place, including swipe cards for the riders and in-vehicle card readers, providing comprehensive management and control over the same-day program, including detailed monitoring to ensure proper use.

The issue of FTA drug and alcohol testing is another facet that deserves mention when considering use of taxi services. When taxis are used in same-day programs, such as those described here, so that eligible users can choose among taxi companies for service, the federal drug and alcohol testing rules do not apply. However, if the taxi company is under contract to a public transit agency to provide taxi service as part of the public transit service, the federal testing rules do apply.[4]

Substitute General Public DRT for Fixed-Route Service in Low Density Areas

General public DRT, sometimes called *dial-a-ride*, is one of several flexible transit solutions applied around the country in low density areas where traditional fixed-route services cannot operate efficiently.[5] Such service is a strategy that can be employed by a transit system that is considering service options for lower density environments. As such, DRT itself becomes a management action for the transit agency, and thus this strategy differs from others discussed in the Guidebook which focuses on management actions taken by the DRT system to improve its own performance.

Description

General public demand-response or dial-a-ride services (referred to as DAR to distinguish it from DRT service discussed elsewhere in the Guidebook) are used in a variety of ways, most commonly providing circulation in low density areas, or providing feeder services to fixed-route bus and rail services or both. More recently, DAR services are being integrated with ADA paratransit services in an attempt to improve the efficiency and cost-effectiveness of these services by sharing vehicles and increasing overall ridership productivity.

DAR services specifically provide curb-to-curb pick-up and drop-off within a designated service area, they are available to the general public, and generally they operate throughout the day. Advance notice requirements vary from system to system, with minimum notice times as little as one hour and up to one day. Standing orders are accepted for trips. Transfers are encouraged to the regional fixed-route network, often at designated transfer locations and at designated times, and transfers are generally free.

Applicability

DAR is generally applied in areas of low to moderate density where the number of transit trips and size of the area would likely be barriers to the justification of fixed-route services. DAR is intended to provide greater area coverage with fewer vehicle resources than a fixed-route service

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[4] "Implementation Guidelines for Drug and Alcohol Regulations in Mass Transit," prepared by RLS & Associates, Inc., for the US Department of Transportation, Federal Transit Administration, Office of Safety and Security, under contract to US Department of Transportation, Research and Special Programs Administration, John A. Volpe National Transportation Systems Center, August 2002, page 2-5.

[5] Other flexible services, not a part of this discussion, include flex routes, route deviation, and point deviation services, all of which combine aspects of fixed routes or fixed stops with the ability to provide, upon request, deviations to accommodate riders not served directly by the route.

in comparable areas, at the same time providing a premium, personalized service that transit systems and their planners hope to translate into higher ridership among choice riders.

The most frequent application of general public DAR is for the provision of rural transit services. There have been, however, many applications of general public DAR going back several years in a range of urban settings. Some examples from the literature follow:

- In San Diego, DAR services were initiated in several communities to overcome problems of dispersed trip-making and low-density suburban development patterns accompanied by discontinuous road networks and cul-de-sacs that limited fixed-route bus opportunities. DAR provides both inter-community services as well as feeder services to the region's light rail system.
- Hamilton (OH) replaced several of its fixed-route services with vans and minibuses operating DAR services as circulators within designated zones and as feeders to arterial fixed-route buses.
- Orange County (CA) created a similar program of DAR services that provide door-to-door service within each zone or connections to fixed-route services for zone-to-zone travel.
- Charlottesville Transit (VA) replaced one of its poor performing routes with a demand response zone with a timed connection to the rest of the fixed-route network.
- Victor Valley Transit in Victorville (CA) is planning to implement general public DAR services to replace fixed-route services in several established low density neighborhoods, as well as to expand into rapidly developing neighborhoods that cannot be served by fixed routes due to development constraints and unfriendly roadway networks.
- Several transit systems have expanded their service areas, reaching into low density neighborhoods and suburbs with DAR. Examples of these programs can be found in Dallas (TX), Tidewater (VA), Denver (CO), Austin (TX), and Portland (OR), among others.

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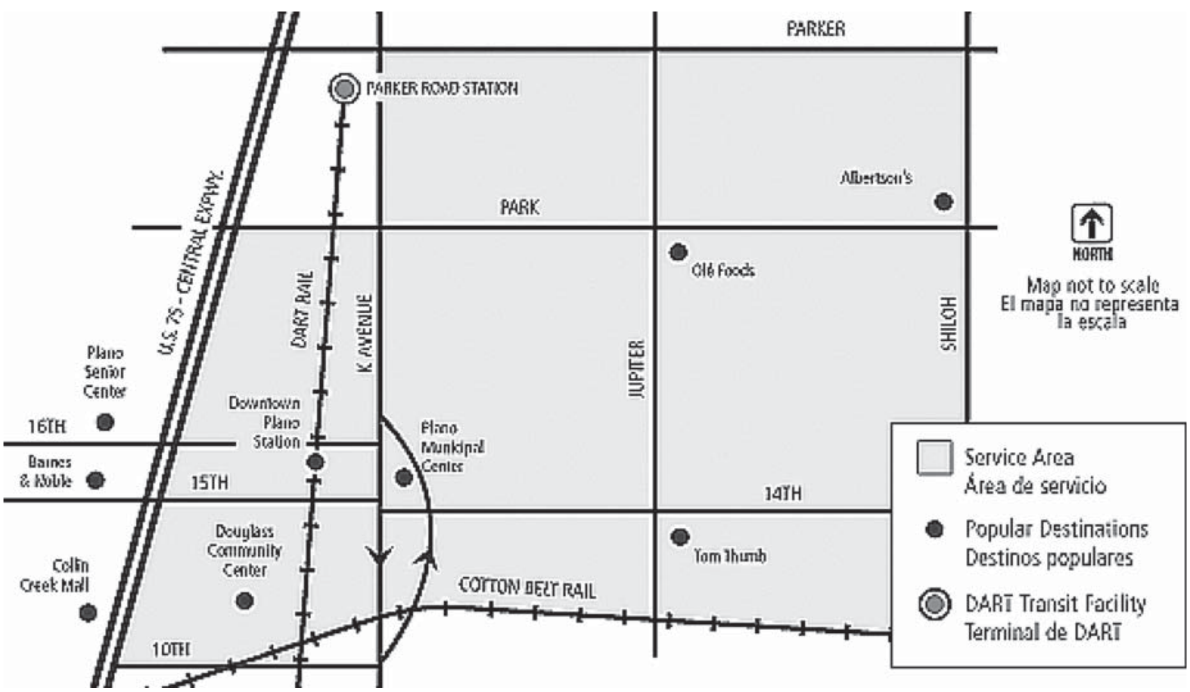

Performance Data

Performance data on general public DAR services was gathered from three previous reports (*30,31,32*) and primary data collected from site studies conducted for this project. The data were developed only for systems that were solely general public DAR programs and do not include hybrids such as flex routes or route deviation, nor services that operated a combination of DAR and fixed-route or flexible services. General public demand response programs reviewed as part of this project included those in Denver, Dallas, and Lubbock, Texas.

The range of performance on three key performance measures—passenger trips per revenue hour, operating cost per revenue hour, and operating cost per passenger trip—was rather similar across the programs (see Table 7-12).

- **Passenger Trips per Revenue Hour—**The range of experience on this measure was from 1.2 to 4.5 among the six systems for which this data was available. The general consensus is that 3.0 to 4.0 passengers per hour is considered to be "good" for a pure DAR program. Since the comparable fixed-route programs in the same locations operate well in excess of 20 passengers per hour, the expectations for a DAR service must be developed considering a range of factors to be discussed later in this section.
- **Operating Cost per Revenue Hour—**The range of operating cost per revenue hour was from approximately $26.50 to $55.00, with clustering around $40.00 to $50.00. A key determinant of this measure is whether the transit system can use a different cost structure than used for the fixed-route program, either using differential wage rates, part-time drivers, or private contractors for the service.
- **Operating Cost per Passenger Trip—**The operating cost per passenger trip ranged from approximately $9.60 to $27.80, with the most effective programs clustered in the $10.00 range. Comparable fixed-route programs in these areas typically had operating costs per passenger trip in the range of $2.00 to $3.00.

Applicability and Findings

It is clear from the performance data that DAR services do not perform to the standards of fixed-route services, when the entire fixed-route program is taken into account. However, DAR service substitution for fixed-route service in low density areas, or the implementation of DAR service in a previously unserved low density market, when compared to either the performance of the existing fixed-route being replaced or to anticipated fixed-route performance in new areas, can be cost-effective for a transit system.

- General public DAR as a substitute for an existing fixed-route service is generally implemented to maintain mobility at a more reasonable cost to the agency. The total cost to provide DAR in a specific area may be lower than the cost of providing adequate fixed-route services for the same area. These savings may accrue because of the number of hours being used to serve the area, or because of a significant differential in the operating cost per hour. The flexibility of a

Table 7-12. Performance of general public DRT as substitute for fixed-route in low density area or previously unserved low density market.

Measure	*Range of Performance*
Passenger Trips/Revenue Hour	1.2–4.5
Operating Cost/Revenue Hour	$26.50–$55.00
Operating Cost/Passenger Trip	$9.60–$27.80

DAR service may allow the transit system to reduce fixed-route hours on one or more local routes while still providing the same level of coverage.

- While DAR does not have the potential to carry as many riders per vehicle hour as fixed-route service, local transit systems need to study the productivity of the specific segments being replaced and not the productivity of the entire route when determining service effectiveness. Transit systems often have fixed routes which extend into low density neighborhoods where performance is poor; replacement of these segments may be effective if the productivity of these segments is compared to the productivity of the new service.
- Many transit systems are asked by local officials to extend service into new neighborhoods and commercial strips, which are generally not friendly to transit, having low densities, difficult circulation patterns, and deep setbacks, among other issues. Using DAR for a start-up in these areas may be as or more effective as extending an existing fixed-route, particularly if the DAR can serve local circulation and can also feed the fixed-route network using timed transfers.
- An opportunity exists to significantly improve the operating performance of a general public DAR, which is to integrate it with the ADA complementary paratransit service in the same service zone. Full integration of the services can result in reduced vehicle hours of service to serve the two markets, and thus the appropriate measure of effectiveness is to compare the performance of the general public DAR to the combined performance of both the fixed-route and ADA services currently provided in the same area. This is one of the more powerful arguments in favor of implementing and then maintaining general public DAR in low density areas of a community.
- While not addressed in this research, the effectiveness of general public DAR systems often can be improved by developing hybrid alternatives—for example, route deviation, flex routes, and point deviation services—which have characteristics of a fixed-route service that encourages greater productivity; or by implementation of DAR by time of day for a selected fixed-route, for example, fixed-route service during peak commuter hours and DAR in off-peak and evening hours. In these cases, the literature suggests that productivities reaching as high as eight passengers per hour can be reached, significantly higher than those for pure demand-response service.

In terms of performance, measuring the effectiveness of DAR requires careful consideration of the objectives of the transit system and local officials, particularly since the productivity and the cost per passenger trip, regardless of any operating cost per hour savings using differential labor rates or a contractor, is generally significantly higher than for fixed-route services, which is generally the first point of comparison. Yet general public DAR can be a useful and cost-effective strategy for serving lower density environments as a substitute for traditional fixed-route service and its required complementary ADA paratransit.

Develop Partnerships—Coordinate—with Community Agencies to Meet Specialized Transportation Needs

Coordination is a strategy that DRT systems can use to improve performance, where the DRT system partners with local agencies that provide trips to their clients with specialized needs at a more cost-efficient rate than the DRT system. This strategy can also improve overall, system wide productivity if the agencies are providing significant group trips.

The research found a number of DRT systems that have developed partnerships with community-based agencies, serving individuals with specialized needs, which allow these agencies to transport their own clients. The specific objectives of these partnerships may vary by individual DRT system, but generally there are several overall purposes. First, the arrangements allow the DRT system to provide the trips to those riders in a more cost-efficient manner, since the agencies can provide the transportation at a lower cost per passenger trip than can the DRT system. Second, the partnerships support the community agencies' ability to provide their own transportation to their clients. And third, the arrangements expand mobility options for the community-based agencies, by providing them resources so that they have transportation options and mobility beyond that which the public DRT system can provide.

The specific parameters of the partnerships differ across DRT systems: some involve the provision of vehicles and additional support in the way of maintenance, fuel, and driver training. Others involve provision of operating funds to support the agencies' specialized transportation service. The community agencies become contractors to the DRT system. For NTD reporting purposes, these agencies are listed as contract service providers and their data included with the system's operating data.

While this may not seem the typical coordination model that has been espoused for the past 25 years, it is a coordination model that recognizes that the public DRT system cannot serve all specialized transportation needs within the community and that the community agencies may be better suited in some cases to transport their clients with the proper support and resources. In this way, the DRT system and local agencies share, in a coordinated manner, the responsibility for serving specialized transportation needs in the community. The agencies benefit in that they have new or additional resources to transport their clients, and at the times and in the manner they deem appropriate. This can be attractive for these agencies which otherwise would have to rely on the public DRT system and adapt to its established policies and practices, or find other ways to transport their clients. The DRT system also benefits in several ways: the community agencies serve their individual clients whose needs may be more specialized than appropriate for transport on public transit; these agencies are able to provide transportation at a lower cost per passenger trip; and given that the trips are often group trips during peak travel times, the DRT system has decreased its needs for capacity during peak periods, which reduces operating and in some cases capital costs as well.

Performance Improvements

Of the DRT systems included in the research, four provided data that quantified the effects of their partnerships with the community agencies; see Table 7-13. In each case, the DRT systems have established formal agreements with several different agencies in their communities that spell out the arrangement and cost structure. The agreement includes requirements that the agency report basic operating data on the transportation that they provide in exchange for the vehicles and other resources. The DRT systems include the data within their NTD reports, and the operating data on passenger trips, revenue miles and hours, are included with the DRT system's overall data for purposes of federal reporting requirements.

Performance Improvements with Community Partnerships

- Specialized transportation trips are provided by the community agencies at a lower per trip cost than by the public DRT system.
- If the community agencies provide trips during peak hours, it may decrease the need for the DRT system to increase its service during peak time, saving operating and possibly capital costs as well.
- System wide productivity may improve, if the agencies provide significant group trips.
- Where the DRT system provides vehicles and other resources to the community agencies in exchange for service provision, the agencies have equipment that gives them more flexibility to meet their own agency and client transportation needs, instead of relying solely on the public DRT system.

Table 7-13. Partnerships with community agencies.

Coordination Arrangement	Resources Provided By DRT System	Performance Results
Four community non-profit agencies, which serve individuals with disabilities, are under contract to a small urban DRT system.	• Vehicles and maintenance. • Additional monthly operating subsidy if community agency provides specified level of ADA eligible trips each month.	The four community agencies provided more than 21,000 passenger trips in FY05, 22% of the system's total annual DRT passenger trips. The operating cost per passenger trip was **$4.92**, based on the four agencies combined. Systemwide DRT operating cost per passenger trip was **$20.80** in FY05.
Large urban DRT system contracts with a number of community-based human service agencies serving individuals with disabilities through the DRT system's partnership program. More then 20 vehicles are provided through the program to the participating human service agencies.	• Vehicles, fuel, maintenance, insurance, and driver orientation.	Participating community agencies served almost 107,000 passenger trips in FY05, 24% of the system's total annual DRT passenger trips. DRT system estimated an operating cost per passenger trip of **$1.75** through its partnership program. This cost does not include overhead costs of DRT system. System wide DRT operating cost per passenger trip was **$19.03** in FY05.
Two human service agencies serving individuals with disabilities who are ADA eligible have contracts with the county-based DRT system that is ADA paratransit only.	• Operating subsidy provided annually to support trips for ADA eligible riders. One of the two agencies contracts for service with a taxi company. The second agency directly operates transportation service.	The two community agencies served more than 55,000 passenger trips in FY06, 4.5% of the system's total annual DRT passenger trips. Average operating cost per passenger trip to the DRT system for passenger trips provided by the two agencies was **$4.38** in FY06. System wide DRT operating cost per passenger trip was **$27.81** in FY06.
Limited eligibility DRT system has contracts with five community non-profit agencies serving individuals with disabilities. Four of the five agencies provide group trips. Fifth agency provides trips in outlying part of service area.	• Four of the five community agencies paid on a negotiated payment per trip basis. • Fifth agency paid on per mile basis.	Agencies served 107,628 passenger trips in FY05, 18% of the system's total annual DRT passenger trips. Average operating cost per passenger trip to the DRT system for passenger trips provided by the five agencies was **$17.20** in FY05. Costs ranged from $14.58 per trip to $24.75 per trip for the agency paid on mileage basis. System wide DRT operating cost per passenger trip was **$25.62** in FY05.

In one of the examples of this coordination strategy, the DRT system developed the partnerships with community-based agencies some years ago, prior to the ADA. Reportedly, there had been some behavioral issues of riders of some of the agencies, and it was determined that the agencies were in a better position to transport their own riders if they had the requisite resources. The current arrangement has the DRT system provide vans to a number of different non-profit agencies in the community. The DRT system provides the vehicles as well as maintenance, fuel, insurance, and driver orientation. In return, the agencies transport their clients and provide monthly operations data to the DRT system. The program, with experience gained for more than 15 years, reportedly works well. The cost per passenger for the DRT system is $19.03 (FY05 data) and the cost per passenger trip through the community partnership program is estimated at approximately $1.75, without DRT system overhead costs.

Qualifications

One of the DRT systems indicated a disadvantage of its partnership program with various community agencies: since these agencies provide group trips to their clients, this siphons off group trips from the public DRT system, so that the productivity of the DRT system alone is less than what it could be. The DRT system, which directly operates service, has a productivity of 2.98 passenger trips per revenue hour, while the productivity of its community-based partnership program is 8.62. When calculated on a system wide basis, however, the overall productivity is 3.55, with the group trips of the partnership program boosting the systemwide figure.

Consider Strategies to Address ADA Paratransit Services

While the subject of the research project behind this Guidebook was DRT, many such systems function as ADA paratransit service, complementing their transit agency's fixed-route service.

Given this, a number of the management actions identified by the DRT systems participating in the project as those taken to address performance issues are more specific to ADA paratransit. Among these are reduced or free fares for use of fixed-route service, changes to the service area, refinements to the eligibility/certification process, travel training, and improvements to stops and pathways for better accessibility for persons with disabilities.

A number of these strategies focus on fixed-route, which has become increasingly more accessible to riders with disabilities since the ADA. Focusing on accessible fixed-route service may improve transit options for ADA-eligible riders, assist DRT systems to meet the requirements for ADA complementary paratransit, and provide performance benefits. Moreover, access to regular, fixed-route transit service is the primary goal of the transportation provisions of the ADA.

Provide Reduced or Free Fares to ADA Riders When Using Fixed-Route

Among the common strategies that ADA paratransit systems have employed to encourage use of fixed-route service is to provide free or heavily discounted fares for use of fixed-route. The objective is to encourage ADA-eligible riders to use fixed-route to the extent that they are able with a financial incentive. Survey research on the preferences and abilities of riders with disabilities with respect to use of fixed-route service found that *low fares* is the first of the four most highly ranked features that can make fixed-route service attractive to riders with specialized needs (*33*).

Performance Effects

Several of the DRT systems participating in the project provided information related to their free or reduced fare programs for fixed-route service. OCTA Access in Southern California provides a reduced fare card to all ADA-eligible riders, which gives them half off the already-discounted senior/disabled fare on fixed-route. Over the first year of this program (FY06), approximately 700 cards were issued and almost 49,000 passenger trips taken on fixed-route. The DRT system estimates that this strategy may have potentially deferred more than $1 million in ADA paratransit costs, assuming these trips would otherwise have been taken on the ADA paratransit service (*34*).

A second DRT system, Utah Transit Authority's (UTA) Flextrans, has taken this strategy further. When an individual is determined eligible for ADA paratransit, the DRT system sends that person a description of the fixed-route service, free passes to ride fixed-route, and an instructional video on how to ride the bus. Additionally, the newly eligible individual may request that a "buddy" ride along on the bus to provide hands-on assistance. The free-fare program, which is not advertised, was started as a temporary measure and remained so for a number of years, and because the DRT system considers it highly successful, it is anticipated that the program will continue.

An impetus for this DRT system's free fare program was the achievement of full accessibility on the fixed-route system, in 2002. At this milestone, the DRT system, with the backing of its advisory committee, focused strongly on encouraging riders with disabilities to use fixed-route to the extent possible. The fixed-route drivers were re-trained, to ensure their compliance with the ADA regulations and their understanding of the DRT system's approach. This training and emphasis to the fixed-route drivers on the importance of assisting riders with disabilities with an inclusive attitude are a specific strategy of the system. Drivers are also told that fixed-route services (and driver positions) may be subject to cutbacks if growth in ADA paratransit services and its costs jeopardize the transit agency's budget. The eligibility/certification process supports the emphasis on fixed-route service as well, with a comprehensive process that conducts functional assessments of all applicants. The eligibility categories, including *conditional* for those determined able to use fixed-route for some trips and *transitional* for those determined able to learn to use fixed-route service, are fully imposed by the DRT system.

With its focus on accessible fixed-route through the free fare program as well as fixed-route driver education and its eligibility/certification program, Flextrans has seen its ADA paratransit ridership decrease, beginning in 2002 with the start of the free fare program. From 2001 through 2005, ADA paratransit ridership decreased 10.3%.

Smaller DRT systems also have taken proactive steps to focus on accessible fixed-route service. One of the small systems participating in the project, Champaign-Urbana MTD, uses a special pass that is provided to seniors and persons with disabilities, entitling the holder to specific fare discounts on and access to the community's transit services. If the pass holder has been certified as ADA eligible, the individual can use the fixed-route system for free. The pass is also available to all seniors, which enables them to use the fixed-route system for free as well. Non-ADA eligible holders of the pass may also use the ADA paratransit service, but at a fare more than three times that for an ADA eligible person and with a limit of 12 trips per month. All pass holders also have access to a half-fare cab program, which provides a limited amount of taxi service within a defined time period. To provide transit service to its community, this small system has created a layered program of services, with the *pass* as the entry key. The free fares on fixed-route, one of the layers, was introduced as a strategy to encourage greater use of fixed-route when the demand for ADA paratransit and the cab program was experiencing significant growth.

Qualifications

To be effective for riders with specialized needs, transit systems should do more than just provide free-fares on fixed-route. Through their eligibility certification programs, they should work to identify applicants who may be able to use fixed-route services for some trips or at some times, granting conditional eligibility and providing information to those riders on the fixed-route system. Riders may also need support and training to gain familiarity and confidence in using fixed-route service. Travel training programs can be effective in this regard, particularly those that provide one-on-one or small group training that involves trainees taking actual bus trips.

Reduce Service Area to ADA-Required ¾ Mi Corridors

The ADA regulations require that ADA complementary paratransit services be provided in corridors ¾ mi on either side of fixed routes, as well as the areas around the ends of routes and around rail stations. When implementing ADA paratransit services in the 1990s, some transit agencies exceeded these requirements, providing service in areas without fixed-route service, often serving all of a city or county.

Over time, some of these systems, in an effort to address increasing demand and costs for ADA paratransit, have revised their service area boundaries, reconfiguring the service area to that required by the ADA.

Performance Effects

Two DRT systems in the largest urban category that participated in the research made such a change to their service area, after reviewing the trips and riders that might be impacted as well as programs that could provide alternative transportation. The performance effects relate to reducing long trips and providing the opportunity to improve productivity.

The first system, OCTA Access, used mapping software to determine that 2% of the system's total daily passenger trips would be affected with a reduction in the service area, affecting about 315 eligible riders (1.2% of approximately 26,000 registered riders). Many of these individuals were provided individualized assistance in finding other transportation options. Additionally, the transit system implemented a new same-day taxi program for its ADA eligible riders, and one of the objectives of this new program was to mitigate possible negative impacts of the service area reduction. While the specific performance impact of this action on the DRT service was not measured, this management action was one of a number of strategies implemented in 2005 that have resulted in productivity improvement and a slowing of the rate of growth in ADA passenger trips and revenue hours needed for the service.

The second system, RTD's Access-a-Ride, changed its service area boundary during FY04–05. Similarly to the first system, this system analyzed potential effects of the change, estimating that 114 riders would be affected (0.9% of the system's 12,500 active riders). To help mitigate possible impacts on riders affected by the system's service area reduction, this system has in place a same-day taxi program, which has been operating for a number of years, and this was available to help meet the needs of riders affected. With the tightening of the service area, the system estimates that its scheduled productivity increased from 1.3–1.5 passenger trips per revenue hour, with about 2% trip denials, to 1.45–1.52 scheduled productivity and no trip denials.

Qualifications

Both of the DRT systems discussed above indicated that the reduction in the service area was the most criticized policy change of several that each system made to their ADA paratransit service. In each case, the DRT system had researched the number of riders and trips that would be affected and had an alternate program that could help meet the affected riders' trip needs. In both cases, the change helped reduce long trip lengths that have a negative impact on productivity.

Important in the consideration of changes to a DRT service area, whether ADA paratransit or otherwise, is assessment of the impacts on riders who may lose their current access to the service and consideration of alternatives that could serve such riders. Some DRT systems have implemented two-tier service areas, with the first tier being the required area that meets ADA regulations and the second tier serving areas beyond the ¾-mile corridors, with service available during more limited hours, at a higher fare, and/or with limited capacity.

While a DRT system may not be in a position to directly provide alternative services if considering a reduction in its service area, other options may be available in the community, and there may be ways to improve access to such alternatives, for example, subsidies for taxi service.

Refine Eligibility and Certification Process for More Accurate Determinations

The ADA requires that transit agencies establish a process for determining ADA paratransit eligibility. Transit systems have used a variety of approaches in this regard, and there has been increasing interest among transit systems to ensure that the process is thorough and as precise as possible. Towards this end, many systems have refined their eligibility process and procedures with an objective of giving more accurate eligibility determinations.

Seven DRT systems participating in the research specifically indicated that a revised eligibility/certification process was an action taken to address performance issues. It should be noted, however, that revising an eligibility process is not a management action that directly relates to DRT performance in the same way, for example, that more effective scheduling of passenger trips will lead to improved productivity.

Revisions to an eligibility/certification process are typically done so that the DRT system can ensure that its ADA paratransit service is targeted to those defined in the regulations as eligible, and that those individuals who can use fixed-route service for all or some of their trips are referred to fixed-route as appropriate. In this way, DRT systems that are ADA paratransit can better manage their resources, which may lead to improved performance.

Effects

A small urban DRT system indicated that its revised eligibility process led to reductions in the numbers of applications received each month, as the application materials provided a more detailed explanation of ADA paratransit. With its revised process that began in 2004, this system contracted with a vocational rehab counselor to assist with eligibility determinations and then a community action agency which had an existing mobility management program. Both of these contractors provided travel training and the second contractor conducts in-person assessments when this is needed. The system manager estimates that the more thorough process with functional assessments as needed results in half as many completed applications per month, from roughly up to 50 per month down to about 25. Decreasing numbers of new applicants also slowed the rate of growth in annual ridership. From an annual ridership increase of over 16% from 2002 to 2003, the annual growth rate was 7% the following year (2003 to 2004) with the new eligibility process in place and 4% the next year (2004 to 2005).

One of the DRT systems in the largest urban category instituted a 100% in-person eligibility assessment process in 2005, which was a change from a process where in-person assessments had been done on an as-needed basis. The DRT system was receiving more than 500 applications per month, with 70% new applications and 30% recertifications. With the new process, the number of applications received monthly decreased by about 13%. And of the applicants who start the process, approximately 20% do not complete it, which is an increase from the prior year where about 10% did not complete the process. The DRT system reported that the rate of growth in the number of eligible riders increased at a lower rate with the new process, from an annual average of 12% in prior years to 2% the year following the revised eligibility/certification process (*34*).

Another of the largest systems brought its eligibility process in-house beginning in 2001, instituting other changes as well. Starting in FY03, functional assessments were conducted on bus and rail services rather than using a "mock-up" environment. The functions of eligibility certification and travel training were combined, with staff cross trained and serving both functions. Applicants are also now required to have a telephone interview at the start of the process. As a result, with the additional information provided about ADA paratransit during the telephone interview, a portion of the individuals decide not to continue. The rate of growth in the number of certified riders, shown to the right, reflects lowered rates particularly in the earlier years of the changes.

Year	Certified Riders	% Increase
2001	6,938	
2002	7,287	5.03%
2003	7,598	4.27%
2004	7,670	0.95%
2005	8,657	12.87%
2006	9,353	8.04%

Qualifications

Significant changes to the eligibility/certification process for an ADA paratransit service should be done in consultation with the local community and advisory groups. The ADA requires that persons with disabilities be involved in the development of ADA paratransit services on an ongoing basis. One of the systems in the largest urban category, the Utah Transit Authority's Flextrans, which has developed a sophisticated eligibility process with 100% in-person determinations and with functional assessments conducted in the community, reported that involvement of the disabled community has been key. The system's process has undergone several changes over the years, and some of these have been initiated by the advisory group.

Improve Accessibility to Fixed-Route Service

In addition to improving the accessibility *of* fixed-route service, a number of transit systems are improving accessibility *to* fixed-route service. Such improvements focus on ensuring the accessibility of stops, particularly those with higher use, and of pathways connecting stops to major destinations. For example, a suburban county in the Washington, D.C. region that provides extensive fixed-route service contracted for an assessment of all its 5,400 stops, which included an evaluation of each stop's ADA accessibility. Following completion of the study, the county is now installing specific improvements at the higher usage stops, ensuring that each new stop meets or exceeds ADA requirements. A small urban provider in Texas has conducted a similar study of its 1,400 bus stops, which also included an assessment of pathway accessibility from selected stops that serve major activity centers to the final destination buildings. This pathway analysis was done on a segment-by-segment basis, allowing the provider to better plan improvements. Each segment is a defined "piece" of the path from the stop to the final destination. For example, the first segment might be the path from the stop to the first street crossing, the second segment would be the actual street crossing, and the third and last segment begins after the street crossing and extends down the block to the front entrance of the destination building. With the analysis divided into defined pieces, the provider could better plan the specific improvements that were needed to ensure accessibility.

Performance Effects

Improving accessibility to fixed-route service facilitates the use of fixed-route by riders with disabilities, which provides cost saving if riders can take fixed-route trips rather than more costly DRT service.

One of the large systems participating in the research, ACCESS LYNX in Orlando, FL, reports that it is working with the jurisdictions in its service area to improve pathway accessibility, including installation of curb cuts near stops. Jurisdictions in the service area have provided funding for the improvements to the transit system which then oversees the work.

A small system, LinkPlus in Wenatchee, Washington, reported that it is using its own funding to install curb cuts on sidewalks near a large medical facility in its service area, which improves access to the facility for riders using wheelchairs and other mobility devices. Such improvements facilitate use of fixed-route service to that medical destination for some riders now using ADA paratransit.

Refine the Contracting Process

A variety of changes and improvements to the contracting process that led to performance benefits were identified by DRT systems that contract for service, identified below.

Increased Participation and Control Over Contracted Service

Increased participation and control over contracted services were identified by eight DRT systems participating in the research, both small and large systems, providing a variety of reported performance benefits. These included cost savings, increased competition, and improved management of service operations. The changes have been operationalized in various ways:

- Purchasing fuel for the contractor: This can provide cost savings in a number of ways. The public agency may purchase the fuel, in bulk and with exemption from certain fuel taxes, or the contractor may be reimbursed for its fuel purchases on a pass-through basis. This relieves the contractor from dealing with the cost uncertainty of fuel and may provide cost savings to the DRT system to the extent that contractors may over-estimate fuel costs to cover increases over the term of the contract.

- Purchasing the capital equipment needed for service, including vehicles and the scheduling/dispatch software: While the purchase of vehicles for contracted operators is a practice that some larger DRT systems have done for a number of years, several of the smaller DRT systems participating in the research noted that they now provide the major capital assets to their contractors, providing the systems increased management control over the service. Several of the DRT systems also reported that they now own the software that is used by the contractor, a change that provides the public agency sponsor better access to the system and its data.
- Use of more than one service contractor: Three of the larger DRT systems reported benefits with changing to multi-contractor arrangements, as the DRT system spreads service responsibility over several providers and is not reliant just on one.
- The DRT system brings in-house the reservations, scheduling, and dispatch functions for direct provision: Four of the largest DRT systems that use contractors have changed their service structure in recent years, taking over the trip reservations, scheduling and, for three systems, dispatch functions for direct provision. According to the managers, this has given these systems increased management control over day-to-day service. In one case, UTA's Flextrans reported that this allowed the system to better impose the conditions of eligibility on the riders; in the prior arrangement, with the contractors responsible for all the functions and paid on an hourly basis, the contractors did not have an incentive to ensure that riders' trip requests fit their eligibility determination. This new capability, coupled with the increased control over vehicle schedules and the revenue hours operated by the contractors, saved the DRT system a reported $1.5 million over 18 months. In another example, the DRT system noted that the change solved much of staff turnover issues, allowing the system to focus on customer service rather than staffing. With the prior arrangement where the service providers were responsible for reservations, scheduling and dispatch, turnover in the three control room functions was about 35% to 40%. While the trip reservations function is still out-sourced, bringing the scheduling and dispatch functions in-house has reduced turnover in those two functions to 10% to 15%.

Change from Meter Rate to Flat Rate for Contracted Taxi Service

One of the small DRT systems, C.A.T. Paratransit in Grand Forks, North Dakota, contracts with a local taxi company for its DRT service and changed its reimbursement from a meter rate to a flat rate. When bidding the service, the DRT system provided the last ten years of trip data to prospective bidders so that they had requisite information with which to base their proposed costs. This change, implemented in 2006, resulted in a cost savings of 14% on a per passenger trip basis.

Educate Riders

Educating DRT riders, on an ongoing basis, on how to use the DRT service can be a strategy that helps riders use the DRT system more effectively and responsibly. While DRT systems typically have training and re-training programs for their staff, systems may neglect this function for their riders and the agencies that serve them. Riders who are well educated and knowledgeable about the policies and procedures of the system can contribute significantly to a well-functioning system. Such education programs can be targeted to all riders or to specific groups of riders, for example, subscription riders or riders traveling for certain trip purposes such as dialysis, as well as to the various human service and other agencies that serve riders.

Rider education programs also benefit vehicle operators and other DRT operating staff as well. If riders understand and follow established DRT system policies and procedures, the jobs of the operators and other staff are facilitated given the interdependency between riders and operators, particularly, but also between riders and other operating staff.

Performance Effects

Several of the participating DRT systems indicated that rider education programs have been effective.

- Portland's LIFT paratransit program planned and implemented a full-fledged education campaign, which targeted not only riders, but included vehicle operators and other staff as well. The campaign, which stretched over much of 2005, recognized that the riders' actions have significant impacts on their own transit experience, the broader experience of other riders, and the performance of the entire program. The philosophy of the campaign was to educate and reinforce positive behavior, as opposed to a punitive approach (e.g., service is suspended after three no-shows during a specified time period, etc.) that is often used with riders.

The DRT system, working with both the vehicle operators and advisory committee, identified areas where rider behavior was an issue. Using this information, LIFT targeted several specific areas with its education program, known as "Customers Count," including:

- Paying the fare;
- Canceling unneeded rides in advance;
- Being ready to board at the start of the on-time pick-up window; and
- Choosing fixed-route, whenever possible.

For each of the focus areas, LIFT developed educational information and materials, which were distributed to riders via various media, including letter and handout flyers. Operators were

LIFT customers count

You make a difference when you are ready to leave at the time your pickup window begins

Being on time is very important to LIFT customers, and to the LIFT program. LIFT does its best to make pickups within the 30-minute pickup window that is set when the trip is scheduled.

Being prepared to leave at the starting time of the pickup window helps LIFT stay on schedule. Customers who are ready to leave promptly when the driver comes to the door save valuable minutes that help keep their trip and others on-time.

Tips on "being ready:"

- When reserving a trip, write down the trip date and the times the pickup window begins and ends
- Before the pickup window time, gather together items you will be taking with you
- At locations other than home, wait near the door where the LIFT operator will be able to see you and ask for you by name

LIFT understands that, on occasion, a customer may be delayed in coming out the door after the LIFT operator has arrived. If a customer is unexpectedly delayed, the LIFT operator will wait up to five minutes. The five minutes is not meant to be extra time for a customer to use on every pickup.

You make a difference when you're ready! Thank you.

TRIMET
See where it takes you.

also given “pocket card” information, which complemented the information given to riders so that operators knew what was expected of them and of the riders.

Each focus area was introduced with the phrase “you make a difference when. . .,” so that the focus on *being ready at the start of the window*, for example, was articulated in the educational materials as “you make a difference when you are ready to leave at the time your pickup window begins.”

LIFT measured the impact of the Customer Counts program and found performance improvements. For the campaign focus on improving rider compliance with fare payment, a before-and-after analysis found increased compliance with fare payment, and the average cash fare payment per rider increased more than 15% over a 4-month period after the campaign. Similarly, an analysis of rider delays found a decrease in such delays after the campaign focused on being ready at the start of the window, as riders better understood the importance of being ready for their own trip and the impacts that their individual actions had on other riders.

In addition to improving specific aspects of service, LIFT’s education campaign highlighted the interdependency of riders and vehicle operators, acknowledging that cooperation and mutual understanding among the two benefit both groups and also contribute to improved service performance.

- With a significant portion of service provided for dialysis purposes, JTA Connexion in Florida has focused on working with the dialysis centers to improve service and increase mutual understanding between the centers and the DRT system. This has involved significant outreach by the DRT system to staff at the centers, including meetings on-site at the various centers and a workshop. This was a time-consuming effort, but resulted in improved service for riders traveling for dialysis purposes and fewer complaints from the dialysis centers about DRT service.

Improve DRT Operators’ Compensation

The wages and benefits for DRT vehicle operators have gained considerable attention in recent years, particularly in relation to competitively procured DRT contracts. For some DRT systems, particularly in wealthy regions of the country and during strong economic times with low unemployment, it has been difficult to find adequate numbers of qualified vehicle operators, and then, once operators are hired and trained, retention becomes another issue.

Shortages of operators and excessive turnover impact DRT operations and performance in a number of ways. Without an adequate roster of operators, DRT systems may not have enough staff to cover vehicle schedules. With annual turnover of up to 30% to 50%, DRT systems expend continuous funds on recruitment and training, and operators leave their positions before they become *experienced* operators. It is generally recognized that experienced DRT operators—who are familiar with the service area, understand their riders’ trip patterns, are knowledgeable about the system’s policies and procedures, and competent with in-vehicle technology—can contribute to improved performance, particularly productivity and service quality, such as on-time performance.

To address such issues, DRT systems have taken steps. Some systems that directly operate services have increased pay for DRT operators so it is more comparable to that for fixed-route operators. Increasingly, DRT systems that contract for DRT operations define minimum levels of pay for operators in their procurement documents. This is one way to ensure bidders’ attention to the important role of vehicle operators and helps ensure a base level of quality through the procurement process.

The state of California passed legislation in 2003 that addresses the issue of retention of operators and other operating staff for competitively procured public transit contracts in its state. The legislation, now included in the state’s labor code, states in its preamble that “. . . it serves an important social purpose to establish incentives for contractors who bid public transit services contracts to retain qualified employees of the prior contractor to perform the same or similar work."[6] This legislation establishes that an entity that awards a public transit service contract in the state is to provide a ten percent preference to any bidder who agrees to retain the employees of the prior contractor for a specified period of time. TCRP has funded research that will investigate the issues of operator recruitment and retention as they relate to the performance of ADA paratransit services.

Clearly, the pay for DRT operators is an issue of interest for service performance.

Performance Effects

Three DRT systems participating in the research, all directly operated by the transit agency, noted the fact that their DRT operators receive pay that is equal to or commensurate with the pay for fixed-route operators and that this has a positive performance effect.

One of these, a small urban system, LinkPlus in Washington State, established parity of compensation for its fixed-route and paratransit drivers in 1995, though for reasons not directly related to operator performance. Operators receive training for both fixed-route and DRT service and may switch between the two modes. With an average tenure of more than ten years, the operators are experienced. System management believes that this experience contributes to improved DRT performance, especially productivity.

Another participating small DRT system, located in the higher wage northeast section of the country, noted that its DRT operators are paid at almost the same rate as its fixed-route operators ($1/hour less). This system reports that turnover is not a problem. Its operators, similarly to the system above, also switch between DRT and fixed-route service. Should an operator move to fixed-route from DRT, he or she will lose one year of seniority on the roster, but despite this, the majority of the switches go from fixed-route to DRT. Additionally, the transit system is able to schedule some of the DRT operators to drive early morning and late afternoon shifts on the fixed-route shuttles, so that its operator staff is effectively utilized.

Two of these three systems achieve high productivities relative to other systems in their categories, and the third recognizes that it could be more efficient, but for various reasons—a service area that includes eight towns and the region in between, an objective of meeting all the needs of its specialized ridership, and up to 20% of its trips provided as will-call—its productivity is only mid-range for its category.

Two DRT systems that contract for service also raised the issue of operator pay, with both identifying problems with operator turnover impacted by the pay levels and indicating that this resulted in negative impacts on service quality. One of the systems addressed this problem by setting minimum wage levels in the RFP during the next procurement cycle and also required a solid benefits package as well for the operators. The second system noted that its contractor was having problems retaining qualified operators and that this seemed to be an issue of operator wages.

Qualifications

When vehicle operator wages are increased, for whatever reason—to improve recruitment and reduce turnover, to provide parity with fixed-route drivers, or to meet a particular state's requirements related to retaining employees from a prior contract—there will be an impact on total operating costs. Labor costs are the largest single component of transit operating costs, with operators comprising the largest category of employees, and increases in their pay will impact the DRT system's total operating costs. However, depending on the strength of the relationship between operator wages and DRT performance, there may be a net benefit to improving opera-

[6] California Labor Code, Section 1070-1074, 2003.

tor wages as measured by productivity, operating cost per passenger trip, and service quality measures such as on-time performance.

Cross Train Staff

Well-trained staff members contribute to the effective functioning of a DRT service. Given the interdependency of many of the functions of a DRT service, for example, the relationship between dispatch and those out on the street providing service (vehicle operators and field supervisors), a mutual understanding of each other's roles and responsibilities can contribute to a better working relationship among the staff and provide performance benefits through increased knowledge of service issues. Additionally, cross training gives DRT management greater flexibility in deploying staff as needed.

Performance Effects

While difficult to quantify its effects, DART Paratransit in Dallas takes a strong approach to cross training its staff. Those who are involved with the eligibility and certification process are cross trained with the staff responsible for travel training. In this way, staff members who make eligibility determinations have a grounded understanding of what is involved for a person with a disability to learn how to use fixed-route service. And this understanding provides a more complete perspective from which to make eligibility determinations.

This DRT system also cross trains its dispatchers and field supervisors. This provides the dispatchers with a better understanding of the issues that operators face on a daily basis when transporting riders, and field supervisors learn of the complexities involved in managing 40 to 50 vehicle runs. With this mutual understanding, dispatchers are more realistic in their expectations of the operators, and field supervisors better understand the importance of ensuring that dispatchers have real-time information on service on the street and the role they can play in supporting the scheduling decisions made by the dispatchers. Further, the knowledge and skills gained in the field by a dispatcher can be used to improve service and provide a realistic picture of most issues that dispatchers typically hear about but otherwise do not see. DRT management also believes this enhances the dispatchers' credibility with vehicle operators.

Cross training additionally provides staffing flexibility to management, so that management can pull from both field supervisors and dispatch staff in the event of a staff shortage. This can reduce the number of dispatch and supervisor positions that are needed.

And finally, this DRT system includes fixed-route operators in some of the training provided to paratransit operators. The objective of this is not to cross train operators but rather to give the fixed-route operators greater understanding of the needs of persons with disabilities and improve their ability to meet the needs of riders with disabilities when riding transit.

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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
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
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