TCRP
REPORT 76

TRANSIT
COOPERATIVE
RESEARCH
PROGRAM

Sponsored by
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Guidebook for Selecting Appropriate Technology Systems for Small Urban and Rural Public Transportation Operators

TRANSPORTATION RESEARCH BOARD

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TRANSIT COOPERATIVE RESEARCH PROGRAM

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Guidebook for Selecting Appropriate Technology Systems for Small Urban and Rural Public Transportation Operators

INSTITUTE FOR TRANSPORTATION RESEARCH AND EDUCATION
North Carolina State University
Raleigh, NC

In Association With:

KFH GROUP
Bethesda, MD

and

TRANSCORE
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SUBJECT AREAS
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TRANSIT COOPERATIVE RESEARCH PROGRAM

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

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

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

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

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

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

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

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NOTICE

The project that is the subject of this report was a part of the Transit Cooperative Research Program conducted by the Transportation Research Board with the approval of the Governing Board of the National Research Council. Such approval reflects the Governing Board's judgment that the project concerned is appropriate with respect to both the purposes and resources of the National Research Council.

The members of the technical advisory panel selected to monitor this project and to review this report were chosen for recognized scholarly competence and with due consideration for the balance of disciplines appropriate to the project. The opinions and conclusions expressed or implied are those of the research agency that performed the research, and while they have been accepted as appropriate by the technical panel, they are not necessarily those of the Transportation Research Board, the National Research Council, the Transit Development Corporation, or the Federal Transit Administration of the U.S. Department of Transportation.

Each report is reviewed and accepted for publication by the technical panel according to procedures established and monitored by the Transportation Research Board Executive Committee and the Governing Board of the National Research Council.

To save time and money in disseminating the research findings, the report is essentially the original text as submitted by the research agency. This report has not been edited by TRB.

Special Notice

The Transportation Research Board, the National Research Council, the Transit Development Corporation, and the Federal Transit Administration (sponsor of the Transit Cooperative Research Program) do not endorse products or manufacturers. Trade or manufacturers' names appear herein solely because they are considered essential to the clarity and completeness of the project reporting.

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FOREWORD

By Staff
Transportation Research Board

TCRP REPORT 76, "Guide for Selecting Technology for Rural and Small Urban Public Transportation Systems," provides guidance to public transportation managers and other professionals in the selection of technology that is appropriate for the needs, size, and type of their operations. Though the focus is on rural and small urban operations, study findings also have some application to larger urban transit operations. The guidebook can be useful in the procurement of technologies, such as off-the-shelf (OTS) computer software, as well as systems, such as automatic vehicle location (AVL) systems.

The companion document to the guidebook is a report that focuses on the Advanced Public Transportation Systems (APTS) applications implemented at small urban and rural transit operations and includes both advanced and basic technologies. The principal guidance tool is a taxonomy—a series of tables that provide important "technology-screening" information to transit professionals based on the characteristics of their transit systems that are most important in determining technology efficacy. The report also presents the basis for the taxonomy including: information gathered during six case-study site visits, an examination of the current status of ongoing APTS sites, measures used to evaluate the effectiveness of APTS technologies, and APTS financing issues. This report is published as *TCRP Web Document 20*, available at: www4.trb.org/trb/crp.nsf.

During the past 10 years, there has been steady growth in the use of custom advanced communications and information technology systems in public transportation operations. These systems have been used primarily to automate manual processes, increase the amount and quality of operations data collected, increase system efficiencies, and enhance operating productivity. While technologies have been demonstrated successfully in many larger transit environments, rural and small urban public transportation operations have not yet taken full advantage of transit technology systems.

The Institute for Transportation Research and Education (ITRE) at North Carolina State University with assistance from SAIC/TransCore and the KFH Group, Inc. prepared the guidebook and final report for TCRP Project B-17. To achieve the project's objectives of producing a set of guidelines and a report that may be used to assist in the selection of appropriate technology, the research team performed a literature review, conducted telephone interviews, and performed case studies.

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The **Transportation Research Board** is a unit of the National Research Council, which serves the National Academy of Sciences and the National Academy of Engineering. The Board's mission is to promote innovation and progress in transportation by stimulating and conducting research, facilitating the dissemination of information, and encouraging the implementation of research results. The Board's varied activities annually draw on approximately 4,000 engineers, scientists, and other transportation researchers and practitioners from the public and private sectors and academia, all of whom contribute their expertise in the public interest. The program is supported by state transportation departments, federal agencies including the component administrations of the U.S. Department of Transportation, and other organizations and individuals interested in the development of transportation.

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

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The National Research Council was organized by the National Academy of Sciences in 1916 to associate the broad community of science and technology with the Academy's purpose of furthering knowledge and advising the federal government. Functioning in accordance with general policies determined by the Academy, the Council has become the principal operating agency of both the National Academy of Sciences and the National Academy of Engineering in providing services to the government, the public, and the scientific and engineering communities. The Council is administered jointly by both the Academies and the Institute of Medicine. Dr. Bruce M. Alberts and Dr. William A. Wulf are chairman and vice chairman, respectively, of the National Research Council.

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The preparation of this Guidance document was conducted under Transit Cooperative Research Program contract Project B-17 entitled *Advanced Public Transportation Systems for Rural Areas: Where Do We Start? How Far Should We Go?* by the Institute for Transportation Research and Education (ITRE) at North Carolina State University (NCSU), with assistance from TransCore and the KFH Group.

The project Principal Investigator was Anna M. Nalevanko, Director, Transit Operations Group, ITRE. Ms. Nalevanko, along with Andrew Henry, ITRE Research Associate, were the primary authors of the Guidance document. Other project team members included John Sajovec, TransCore; Kenneth Hosen, KFH Group; Dr. John Stone, Civil Engineering Department, North Carolina State University; and Thomas Cook, ITRE. They contributed to concept development and written content. Bill Walker and Sherry McIntrye, ITRE communications staff, made significant contributions though their editing and design efforts, which have resulted in a visually appealing, easy-to-use document.

Many transit managers and professionals also generously contributed their time and knowledge to this report by hosting visits to case study sites, participating in detailed telephone interviews, and providing valuable written materials related to transit technology selection, planning, and implementation. The authors are also appreciative of the time and advice that the TCRP Topic Panel earnestly contributed. The willingness to contribute to this research demonstrates a positive spirit among those in the transit community to kindly share their resources and knowledge.

Preface: Navigating the Guidebook

Conducting a Self-Assessm nt

Matching Needs and Technologies

Investigating Functionality and Costs

Financing Technology Systems

Implementing Technologies

Summary

Appendices

Purpose

This Guidebook is intended to support public transportation professionals in identifying and implementing appropriate technologies for their transit systems. It can be useful in the procurement of low-tech solutions, such as off-the-shelf computer software, as well as high-tech systems, such as automatic vehicle location (AVL) systems.

Who Should Use this Guidebook

The intended audience for this Guidebook includes transit operators managing rural and small urban transit systems of varying size. It is appropriate for multi-modal and single-mode service providers, as well as for more broadly coordinated service providers. Larger urban transit operators, even those with considerable technical expertise, will also benefit from the many recommendations, tips, and references that can add to their extensive knowledge of transit technologies.

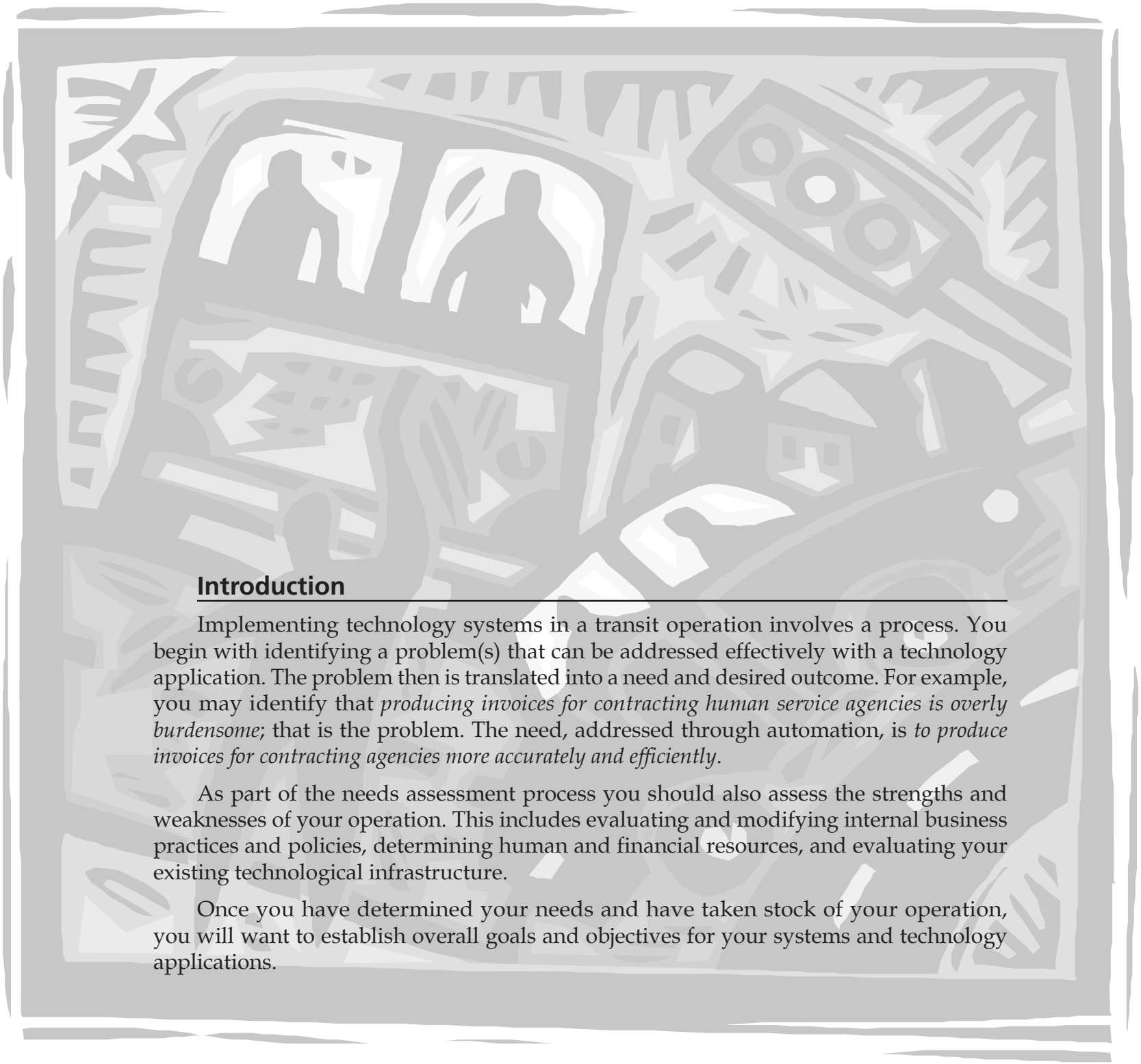
How to Use the Guidebook

This document presents a comprehensive, orderly process for acquiring transit technology. It provides information to help determine your transit system needs, identify potential technologies to meet those needs, and implement the selected technology system.

Not all chapters in this document will apply to every public transportation operation. Operations are unique and at different stages of development concerning technology, service, and management. As a result, this Guidebook allows you to start at the beginning or scan the table of contents to pick and choose from those chapters most relevant to your needs for implementing technology. Furthermore, you may proceed directly to the many valuable tables and references to support any stage of technology acquisition or implementation.

Overview of Contents

This Guidebook begins with the most basic steps. It helps you to better understand the services, character, and environment of your transit system in order to develop an effective set of system needs. Chapters 2 and 3 help you to identify transit technologies appropriate to your system size and needs and to educate you about these potential technology applications. As you learn more about these technologies, Chapter 4 answers the question, "Which grants and revenue sources can help us pay for these technologies?" Finally, the Guidebook offers recommendations that are particular to transit systems for developing an implementation plan, conducting the procurement process, and installing the new technology system. Throughout the Guidebook you will also learn through insightful case study examples how other transit systems have approached selection, procurement, financing, and implementation. The appendices provide some solid definitions of technical terms and references to help you along in your process.



Introduction

Implementing technology systems in a transit operation involves a process. You begin with identifying a problem(s) that can be addressed effectively with a technology application. The problem then is translated into a need and desired outcome. For example, you may identify that *producing invoices for contracting human service agencies is overly burdensome*; that is the problem. The need, addressed through automation, is *to produce invoices for contracting agencies more accurately and efficiently*.

As part of the needs assessment process you should also assess the strengths and weaknesses of your operation. This includes evaluating and modifying internal business practices and policies, determining human and financial resources, and evaluating your existing technological infrastructure.

Once you have determined your needs and have taken stock of your operation, you will want to establish overall goals and objectives for your systems and technology applications.

Forming a Technology Review Team

You will want to form a broad-based team to help in the technology selection and acquisition process no matter how simple or complex the process may be. The transit manager can call on this experienced group to ably provide input into any of the many required tasks.

Make sure the team is composed of people with a variety of professional skills and transit system perspectives, including:

- transit system management and operations staff;
- professionals from related departments, such as procurement and information systems;
- leaders from human service agencies that currently, or may in the future, purchase service from your system; and
- board members, local government managers, or other individuals whose support is critical to procuring new technology.

These persons will serve as champions who will help to ensure a smoother selection and implementation process.

Problem Definition

It is very likely that you have already given much thought to problems in your operation that can be effectively addressed though automation of some sort. You may already be utilizing spreadsheets and database systems to organize customer data and to initiate reports and invoices to contracted agencies, as well as local and state funding sources.

An examination of system performance statistics, as well as current and historical data, is a good framework with which to begin identifying problems. Performance statistics including trips per hour, cost per vehicle hour, percentage of late trips and the extent to which your service is accomplishing common goals related to efficiency, cost, and service quality may be examined. Once you have defined operational functions that require improved support, you are ready to further explore your needs and match the appropriate technology to support these needs.

Needs Assessment

This assessment simply identifies the most important system functions, such as reservations, routing, and billing, and highlights those that require improvements. These problems translate into the system needs. The needs assessment provides a solid base for effectively completing subsequent steps in your technology search and installation. It will keep you on track, focusing your technology search on products that support the system's most critical needs. A needs assessment will frame a transit system's needs, simplify the development of product specifications, and facilitate evaluation of vendors' proposals. In addition, a needs assessment will enable vendors to offer feasible solutions to your transit system's technology needs.

The time requirement and complexity of a needs assessment will increase with the system size, number of different services and modes, number of agencies served, and level of desired details. The technology matrices in Chapter 2, that match technologies with system needs, are organized around the 12 system needs listed in Figure 1.1. You can refer to this list when defining and prioritizing your transit system's needs.

There are various proven processes for conducting a needs assessment. These processes commonly define goals, evaluate how these goals are being achieved, and define any unmet goal as a problem or need. No matter which process you employ, make sure to observe these key factors in your process:

Figure 1.1 System Needs

1. More accurate, easier reporting and record keeping
2. More efficient service coordination
3. Safer, more accurate cash handling
4. Improved operations staff performance and productivity
5. More effective maintenance tracking
6. Clearer communications
7. More effective dispatching
8. Faster, more efficient trip request processing
9. Improved scheduling productivity
10. Improved service quality
11. Greater safety
12. More accessible, more useful customer information

- Involve appropriate staff in your needs assessment.
- Use a set of goals, objectives, or vision statement as the basis for your assessment.
- Formally define needs and frequently refer to these needs definitions throughout the technology acquisition process to keep you properly focused on real, effective solutions. This focus is especially important during the technology investigation and specification development steps.

Taking Stock of Your Operation

What existing business practices can be streamlined? What policies need to be modified? You will not achieve desired outcomes from a technology application unless you evaluate policies and procedures and make modifications as needed. Do not look at the technology implementation as causing you to change the way you do business, but instead as an opportunity to change some outdated policies and inefficient procedures.

In addition, you will want to examine your financial and human resources and your existing technological infrastructure. This assessment should help identify the environmental constraints, such as the lack of technical skills among staff, or lack of radio or cellular communication services that proposed solutions will come up against. This assessment will also identify problems that need to be addressed in order to meet your system's goals and objectives.

Such environmental factors will impact the effectiveness of the proposed technological solutions. For example, a transit system whose service area terrain results in poor radio service will not want to consider installing an AVL (automatic vehicle location) system that requires consistent radio service to send vehicle location data to the dispatch center. Likewise, it is unwise to install automated DRT software if your staff has limited technical backgrounds and inadequate training in the use of even basic software applications.

As you evaluate technology options for your transit system, keep these environmental factors in the forefront.

System

- System goals and objectives
- Funding availability

Staff

- Willingness to change current procedures
- "Champion" to lead effort
- Experience and skills using computers and other technologies

Services

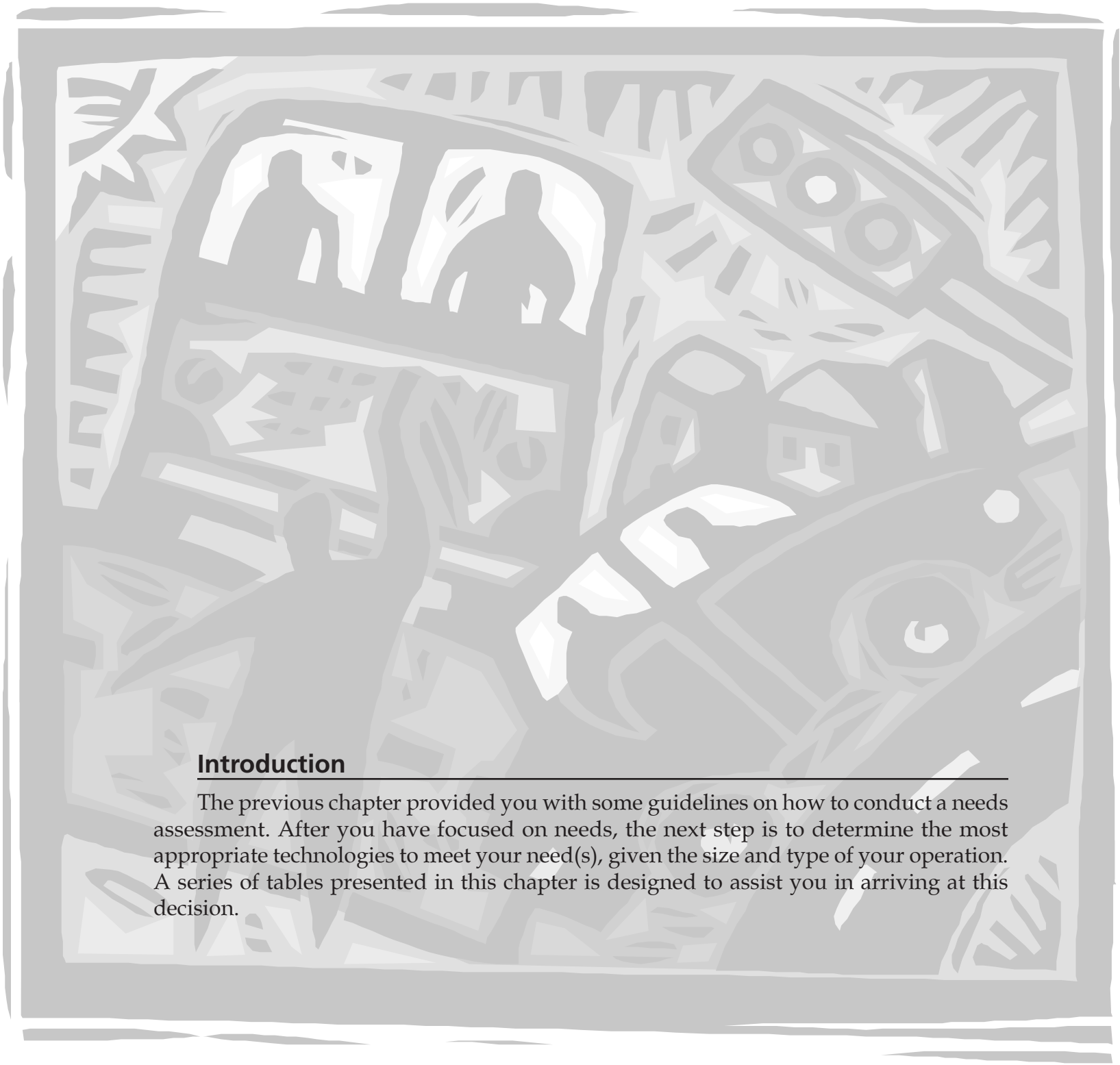
- Current and planned transit modes
- Current and planned service levels for each mode
- Types of passengers
- Size, demographics, and topography of service area

Dedicated Manager

Technology development and implementation needs a dedicated staff person to take the lead. Community Transit of Delaware County, Pennsylvania, initially assigned their DRT software and MDT installation to several staff members. The project planning and installation suffered as staff focused on their usual transit service duties, and struggled with juggling these day-to-day duties with installation testing and training. In great contrast, the projects began to move forward swiftly once a dedicated manager was assigned.

Technology and Communications

- Current use of computer hardware and software
- Quality, coverage, type (analog or digital), and availability of radio, cellular, and other wireless communication services
- Quality, type, and availability of communication services to connect to the Internet and public data networks
- Quality and availability of local technical support for computer and communication systems



Introduction

The previous chapter provided you with some guidelines on how to conduct a needs assessment. After you have focused on needs, the next step is to determine the most appropriate technologies to meet your need(s), given the size and type of your operation. A series of tables presented in this chapter is designed to assist you in arriving at this decision.

Technology Descriptions

Before using the technology tables, it is important that you have a basic understanding of each technology option. Therefore, you will want to review the brief technology descriptions in figure 2.0. The appendices also provide definitions for each technology identified in the tables.

Applying the Technology Tables

Each of the 12 tables presented in this chapter represents a particular need (as described in Chapter 1) and identifies one or more technologies that can address that given need.

In using these tables, refer first to the table(s) that corresponds to your need(s). For example, through the needs assessment process you might identify two needs — more efficient service coordination (Need #2) and improved operations, staff performance, and productivity (Need #4). To review possible technology solutions, you would then turn to pages 21 and 23 to review Figures 2.2 and 2.4.

In each technology table, a single row presents a possible technology solution and a more detailed description of how the technology can be applied. A check mark (☑) indicates that a technology is recommended for a particular system size.

The system size is based on the number of vehicles operated — small (< 10 vehicles), medium (10 to 30 vehicles), and large (> 30 vehicles). In identifying system size, the projected future size should be considered in systems that anticipate substantial growth.

Factors other than system size, such as service type (fixed-route, demand-responsive), volume and type of daily ridership (number of total riders, demand-responsive riders, and agency clients), and size of service area can be important. The impact of these other factors is discussed in the application column.

Finally, the technologies are divided into two broad categories — basic and advanced technologies. The basic technologies tend to be those having the potential to help solve problems for even the smallest or least complex of rural and small urban transit systems. In some cases, basic technologies can be built upon with more advanced technologies as a transit system grows. The advanced technologies tend to be applicable only to medium and large systems or systems with a high degree of service complexity.

Figure 2.0 Technology Descriptions

Technology	Acronym	Use	Description/Purpose
Accounting Software	none	Fixed-Route & Demand-Responsive	Electronically processes, stores, tracks, and reports standard accounting data and processes.
Automatic Passenger Counter	APC	Fixed-Route	Counts number of passengers boarding and alighting vehicle at each stop. Easily downloads data to computers for reporting and planning tasks.
Automatic Vehicle Location	AVL	Fixed-Route & Demand-Responsive	Determines vehicle location using navigation sensors (usually GPS), commonly sending position data to base station via radio or other communication link.
Communications	none	Fixed-Route & Demand-Responsive	Provides voice and/or data communication among vehicles and from vehicles to base station. Radio uses variety of private and commercial systems, frequency bands, and technologies. Cellular offers several commercial providers.
Customized Spreadsheets & Databases	none	Fixed-Route & Demand-Responsive	Allows user to develop a computer application to store, manipulate, and report on any desired set of data relating to clients, schedules, trips, and billing.
Demand-Responsive Transit Software — Automated	DRT	Demand-Responsive	Expedites call taking; automatically schedules trips and routes vehicles; collects and maintains client, service, and vehicle data; and generates standard and customized reports.
Demand-Responsive Transit Software — Computer-Assisted	DRT	Demand-Responsive	Expedites call taking; prepares driver manifests; collects and maintains client, service, and vehicle data; offers a visual display of schedule timeblocks; and generates standard and customized reports.
En-Route Customer Information	none	Fixed-Route	Provides real-time travel information to transit passengers and transit vehicle operators while traveling (e.g., variable message signs).
Fare Media: Bar Code Smart Card Magnetic Stripe Card	none	Fixed-Route & Demand-Responsive	Allows easy identification of passenger or payment of fare without using cash. Magnetic stripe card deducts fare from card. Smart card deducts fare from cash value stored on embedded microchip.

Figure 2.0 Technology Descriptions (continued)

Technology	Acronym	Use	Description/Purpose
Geographic Information Systems	GIS	Fixed-Route & Demand-Responsive	Computer mapping application that displays and analyzes the spatial relationship between different data such as vehicle routes, trip pick-up and drop-off points, bus stops, streets, and landmarks.
Internet Web Site	none	Fixed-Route & Demand-Responsive	Allows personal computer users to easily exchange or display transit service information such as trip requests and route schedules and maps.
Maintenance Software	none	Fixed-Route & Demand-Responsive	Electronically processes, stores, tracks, and reports detailed vehicle maintenance and repair data, including parts and supplies inventory.
Mayday System	none	Fixed-Route & Demand-Responsive	Allows vehicle operator to trip an inconspicuous on-board switch to alert base station of an accident, crime, medical, or other emergency.
Mobile Data Terminal	MDT	Fixed-Route & Demand-Responsive	Serves as information link between control center and driver to relay relevant information, such as dispatch, trip, route, and rider data.
Palmtop Electronic Manifest Device	none	Demand-Responsive	Electronically stores and updates the vehicle schedule (e.g., driver manifests) and provides capabilities similar to MDTs.
Personnel Software	none	Fixed-Route & Demand-Responsive	Electronically processes, stores, tracks, and reports detailed payroll, benefits, hours worked, and personnel actions information.
Pre-Trip Traveler Information	none	Fixed-Route	Provides travel information to potential users at home, work, malls, public buildings, or tourist attractions prior to making their trip.
Stop Annunciators	none	Fixed-Route	Provides audible and visible announcements of next stop, stop requested, etc.
Telephone Systems	none	Fixed-Route & Demand-Responsive	Interactively routes telephone calls, stores messages (voice mail), notifies recipients of new messages, and provides integrated voice response capabilities to provide information to callers on system schedules, fares, and current service status.

Figure 2.1 Technology Solutions by User Need

Need #1 More Accurate, Easier Reporting and Record Keeping

Basic Technologies	Small System <10 vehicles	Medium System 10-30 vehicles	Large System >30 vehicles	Application
Customized Spreadsheets & Databases	☑			Easier collection, organization, and reporting of any data. Especially for small, fixed-route or demand-responsive systems that want low-cost or low-technical alternative to manual tracking and reporting. User must develop database and application.
Accounting Software	☑	☑	☑	Easier collection, organization, and reporting of financial data. Especially for systems without services of city or county government finance department. Database and application system already developed.
Personnel Software	☑	☑	☑	Easier collection, organization, and reporting of wage, hour, and other personnel data. Especially for systems without services of city or county human resources personnel department. Database and application system already developed.
Fare Media: Bar Code	☑	☑	☑	Automatically identifies passengers and funding agency for billing purposes.
Palmtop Electronic Manifest Device	☑	☑		Assists in collecting, merging, and storing vehicle, passenger, and trip data. Especially for small systems not needing real-time communication features of MDTs.
Advanced Technologies				
Geographic Information Systems		☑	☑	Automatically displays location information for routing/service management. Most useful for systems with more than 100 DRT trips/day, or with both fixed-route and demand-responsive, or with several human service agency clients.
Demand-Responsive Transit Software — Computer–Assisted		☑	☑	Assists reservations, dispatching, and routing, and automates billing. Especially for systems with more than 100 DRT trips/day or serving several human service agencies.
Demand-Responsive Transit Software — Automated		☑	☑	Assists reservations; automatically dispatches and routes using GIS; automates billing; and interfaces with MDTs and AVL. Most useful for systems with more than 300 DRT trips/day.
Fare Media: Smart Card & Magnetic Stripe Card		☑	☑	Automatically identifies passenger, and processes and stores trip data. Most useful for systems with more than 200 DRT trips/day or serving several human service agencies.
Mobile Data Terminals			☑	Automatically collects, merges, and stores vehicle, passenger, and trip data. Especially for systems with more than 300 DRT trips/day and needing automated, real-time dispatching capability.

Figure 2.2 Technology Solutions by User Need

Need #2 More Efficient Service Coordination

Basic Technologies	Small System <10 vehicles	Medium System 10-30 vehicles	Large System >30 vehicles	Application
Customized Spreadsheets & Databases	☑			Easier collection and reporting of client and trip data to support coordination and analysis of routes, modes, and service. Especially for small systems that want low-cost or low-technical support. User must design database and spreadsheet structures.
Communications	☑	☑	☑	New radio technology and arrangements, such as shared system or spectrum (e.g., trunking), FM Subcarrier, and spread spectrum, offer affordable radio service. Commercial cellular offers services with relatively small equipment investment.
Fare Media: Bar Code	☑	☑	☑	Automatically identifies passengers and funding agency for billing and eligibility purposes.
Palmtop Electronic Manifest Device	☑	☑		Assists in collecting, merging, and storing vehicle, passenger, and trip data. Especially for small systems not needing real-time trip communication features of MDTs.
Advanced Technologies				
Geographic Information Systems		☑	☑	Automatically displays and reports trip location information for routing/service coordination analysis. Most useful for systems with more than 100 DRT trips/day, serving several human service agencies, or using multiple modes to manage client mobility needs.
Demand–Responsive Transit Software — Computer–Assisted		☑	☑	Provides several mode, vehicle, or route choices to meet particular trip demand. Generates performance data to support coordination analysis and automatically invoices. Especially for systems with more than 100 DRT trips/day, serving many human service agencies, or using multiple modes to manage client mobility needs.
Demand–Responsive Transit Software — Automated		☑	☑	Same as computer-assisted DRT except provides automated scheduling/routing and real-time dispatching to MDTs. For systems with more than 300 DRT trips/day.
Automatic Passenger Counter		☑	☑	Automatically collects passenger boarding and alighting data by stop, providing more precise information to support coordination decisions. For fixed-route with 10 or more vehicles.
Fare Media: Smart Card & Magnetic Stripe Card		☑	☑	Automatically identifies passengers, and processes and stores trip data. Most useful for systems with more than 200 DRT trips/day and multiple service modes.
Mobile Data Terminals			☑	Automatically collects, merges, and stores vehicle, passenger and trip data. Especially for systems with more than 300 DRT trips/day and needing automated, real-time dispatching capability.
Automatic Vehicle Location			☑	Displays vehicle location for real-time dispatching and management of passenger transfers.

Figure 2.3 Technology Solutions by User Need

Need #3 Safer, More Accurate Cash Handling

Basic Technologies	Small System <10 vehicles	Medium System 10-30 vehicles	Large System >30 vehicles	Application
Customized Spreadsheets & Databases	☑			Easier collection, comparison, and reporting of trip and cash receipt data. Especially for small systems that want a low-cost or low-technical alternative to manual collection, counting, and tracking. User must design database and spreadsheet structures.
Fare Media: Bar Code	☑	☑	☑	Automatically identifies passengers and funding agency for billing purposes.
Palmtop Electronic Manifest Device	☑	☑		Assists in collecting vehicle, passenger, and trip data for billing (reducing/eliminating cash handling), and possible interface with credit, magnetic stripe or smart card reader. Especially for small systems not needing real-time communication features of MDTs.
Advanced Technologies				
Fare Media: Smart Card & Magnetic Stripe Card		☑	☑	Automatically identifies passenger and deducts fare from card balance or collects needed billing data (reducing/eliminating cash handling). Most useful for systems with more than 200 DRT trips/day, multiple service modes, or serving several human service agencies.
Mobile Data Terminals			☑	Automatically collects vehicle, passenger, and trip data for billing (reducing/ eliminating cash handling), and uses credit, magnetic stripe, and smart cards. Especially for systems with more than 300 DRT trips/day, and needing automated, real-time dispatching capability.

Figure 2.4 Technology Solutions by User Need

Need #4 Improved Operations, Staff Performance, and Productivity

Basic Technologies	Small System <10 vehicles	Medium System 10-30 vehicles	Large System >30 vehicles	Application
Customized Spreadsheets & Databases	☑			Easier collection, organizing, reporting, and analysis of operations data to support staff functions. Especially for small, fixed-route, or demand-responsive systems that want low-cost or low-technical alternative to manual system. User must design database and spreadsheet structures.
Palmtop Electronic Manifest Device	☑	☑	☑	Streamlines vehicle, passenger, fare, and trip data collection. Reduces data collection and pick up/drop off errors. Especially for small systems not needing real-time communication features of MDTs.
Advanced Technologies				
Geographic Information Systems		☑	☑	Automatically displays and analyzes location information for greater dispatching and routing efficiency and better service coordination. Most useful for systems with more than 100 DRT trips/day, or with both fixed-route and demand-responsive, or with several human service agency clients.
Demand-Responsive Transit Software — Computer-Assisted		☑	☑	Helps manage trip demand into more efficient dispatching and routing choices. Streamlines collection and integration of client, vehicle, and trip data into databases for analysis. Especially for systems with more than 100 DRT trips/day.
Demand-Responsive Transit Software — Automated		☑	☑	Automatically dispatches trips and routes vehicles. Collects and integrates client, vehicle, and trip data into databases for analysis. Most useful for systems with more than 300 DRT trips/day.
Mobile Data Terminals			☑	Automatically dispatches trips. Streamlines vehicle, passenger, and trip data collection. Especially for systems with more than 300 DRT trips/day, and needing automated, real-time dispatching capability.
Automatic Vehicle Location			☑	Automatically locates vehicle for more efficient real-time dispatching and routing. Supports automated dispatching.

Figure 2.5 Technology Solutions by User Need

Need #5 More Effective Maintenance Tracking

Basic Technologies	Small System <10 vehicles	Medium System 10-30 vehicles	Large System >30 vehicles	Application
Customized Spreadsheets & Databases	☑			Easier collection, organization, analysis, and reporting of maintenance data, and integration with operations data (e.g., vehicle fuel efficiency). Especially for small, fixed-route, or demand-responsive systems that want low-cost or low-technology system. User must design database and spreadsheet structures.
Maintenance Software	☑	☑	☑	Easier collection, organization, analysis, and reporting of maintenance data. High-end software products can integrate with operations, parts inventory, and accounting systems. Variety of software suitable to different sizes and types of transit systems. Database and system already developed.
Advanced Technologies				
Mobile Data Terminals			☑	MDTs function as collection and communication point for AVM (automatic vehicle monitoring) system that automatically collects engine readings and vehicle operations data and transmits to base station. Especially for systems with more than 300 DRT trips/day, and needing automated, real-time dispatching capability.

Figure 2.6 Technology Solutions by User Need

Need #6 Clearer Communications

Basic Technologies	Small System <10 vehicles	Medium System 10-30 vehicles	Large System >30 vehicles	Application
Telephone System		☑	☑	Interactive Voice Response and Automated Call Distribution increases capacity to handle telephone inquiries by automatically providing route and service information to riders and routing calls. Especially for 300 DRT trips/day or 5 fixed-routes.
Communications	☑	☑	☑	New radio technology and arrangements, such as shared system or spectrum (e.g., trunking), FM Subcarrier, and spread spectrum, offer affordable radio service. Commercial cellular systems offer services with relatively small equipment investment.
Palmtop Electronic Manifest Device	☑	☑		Displays client address and maps (with integrated GIS) for drivers. Especially for small systems not needing full features of MDTs.
Advanced Technologies				
Mobile Data Terminals			☑	Automatically communicates trip, vehicle, and emergency data between driver and dispatcher, reducing radio needs and trip information errors. Especially for systems with more than 300 DRT trips/day.
Automatic Vehicle Location			☑	Automatically locates vehicle without need for driver/dispatcher voice communication.
Mayday System			☑	Sends distress signal to base station. Most effective if integrated with AVL.

Figure 2.7 Technology Solutions by User Need

Need #7 More Effective Dispatching

Basic Technologies	Small System <10 vehicles	Medium System 10-30 vehicles	Large System >30 vehicles	Application
Customized Spreadsheets & Databases	☑			Easier real-time trip tracking and data collection. Especially for small systems that don't need advanced functions of more expensive DRT software. User must design database and spreadsheet structures.
Communications	☑	☑	☑	New radio technology and arrangements, such as shared system or spectrum (e.g., trunking), FM Subcarrier, and spread spectrum, offer affordable radio service. Commercial cellular systems offer services with relatively small equipment investment.
Palmtop Electronic Manifest Device	☑	☑		Palmtop client database and map display reduces amount of information that dispatcher needs to communicate to driver. Especially for small systems not needing advanced features of more expensive MDTs.
Advanced Technologies				
Demand-Responsive Transit Software — Computer-Assisted		☑	☑	Provides real-time trip and vehicle status information to simplify tracking and support dispatch decision and vehicle management. Especially for systems with more than 100 DRT trips/day.
Demand-Responsive Transit Software — Automated		☑	☑	Provides real-time trip and vehicle status information to simplify tracking and support dispatch decision and vehicle management. Automatically dispatches trips. Most useful for systems with more than 300 DRT trips/day.
Mobile Data Terminals			☑	Automatically communicates and displays trip data between driver and dispatcher, reducing need for voice radio communication and trip data clarification. Especially for systems with more than 300 DRT trips/day.
Automatic Vehicle Location			☑	Automatically locates vehicle to support real-time trip dispatch decision and reduce need for driver/dispatcher voice communication. Most useful for systems with more than 300 DRT trips/day.

Figure 2.8 Technology Solutions by User Need

Need #8 Faster, More Efficient Trip Request Processing

Basic Technologies	Small System <10 vehicles	Medium System 10-30 vehicles	Large System >30 vehicles	Application
Customized Spreadsheets & Databases	☑			Faster reservation and eligibility check using client database. Quicker vehicle availability check and trip assignment with vehicle database. Especially for small systems that don't need more expensive full feature DRT software. User must design database and spreadsheet structures.
Telephone System		☑	☑	Automatically schedule or cancel trips using telephone system, sort and direct calls to appropriate staff person, and integrate Caller ID with database for automatic client lookup. Most useful to systems with at least 300 DRT trips/day or 5 fixed-routes.
Internet Web Site		☑	☑	Rider or human service agency uses Internet to request or cancel service.
Advanced Technologies				
Pre-Trip Traveler Information	☑	☑	☑	Cable TV, Travelers' Kiosk, and Internet Web site supply customer and agency providers with eligibility requirements and service information, reducing amount of information exchanged by telephone.
Geographic Information Systems		☑	☑	Quickly displays pick-up and drop-off locations on map to support trip eligibility decision (ADA paratransit vs. fixed-route) and vehicle/route/service availability. Automatically schedules trips. Most useful for systems with more than 100 DRT trips/day, both fixed-route and demand-responsive, or several service modes.
Demand-Responsive Transit Software — Computer-Assisted		☑	☑	Quickly takes reservation, checks eligibility and vehicle/route/service availability with only several keystrokes. Especially for systems with more than 100 DRT trips/day, both fixed-route and demand-responsive, or with several service modes.
Demand-Responsive Transit Software — Automated		☑	☑	Quickly takes reservation, checks eligibility (by client and trip) and vehicle/route/service availability with only several keystrokes. Automatically schedules trips. Especially for systems with more than 300 DRT trips/day, both fixed-route and demand-responsive, or with several service modes.

Figure 2.9 Technology Solutions by User Need

Need #9 Improved Scheduling Productivity

Basic Technologies	Small System <10 vehicles	Medium System 10-30 vehicles	Large System >30 vehicles	Application
Customized Spreadsheets & Databases	☑			More efficient trip assignment to vehicle by comparing trip demand and vehicle availability databases during both reservation and routing functions. Provides data for schedule evaluation. Especially for small systems that don't need advanced features of more expensive DRT software. User must design database and spreadsheet structures.
Advanced Technologies				
Geographic Information Systems		☑	☑	Automatically displays and analyzes location information on map for better trip/route matching. Most useful for systems with more than 100 DRT trips/day, or with both fixed-route and demand-responsive, or with several service modes.
Demand-Responsive Transit Software — Computer-Assisted		☑	☑	Automatically compares trip demand and vehicle availability for more efficient trip assignment, and captures data for schedule evaluation. Especially for systems with more than 100 DRT trips/day.
Demand-Responsive Transit Software — Automated		☑	☑	Automatically compares trip demand and vehicle availability, provides system resource impact for various trip assignment options, automatically optimizes scheduling efficiency based on user-provided criteria, and captures data for automatic schedule evaluation and reports. Most useful for systems with more than 300 DRT trips/day.
Mobile Data Terminals			☑	Quickly communicates trip, schedule, and vehicle status between vehicle and dispatcher. Permits real-time scheduling and dispatching. Especially for systems with more than 300 DRT trips/day, and needing fast real-time scheduling capability.
Automatic Vehicle Location			☑	Automatically locates vehicles to support real-time trip scheduling and dispatching. Most useful for systems with more than 300 DRT trips/day, and needing real-time scheduling and dispatching.

Figure 2.10 Technology Solutions by User Need

Need #10 Improved Service Quality

Basic Technologies	Small System <10 vehicles	Medium System 10-30 vehicles	Large System >30 vehicles	Application
Customized Spreadsheets & Databases	☑			Improved scheduling and routing, resulting in fewer late/missed trips and shorter ride times. Collect and organize trip and operations data to evaluate and improve service. Especially for small systems that don't need advanced functions of DRT software. User must design database and spreadsheet structures.
Telephone System			☑	Offers customer option of scheduling or canceling trip, or receiving service information by telephone, 24 hours/day. Most useful to systems with more than 300 DRT trips/day or 10 fixed-routes.
Advanced Technologies				
Geographic Information Systems		☑	☑	Improved scheduling/routing, resulting in fewer late/missed trips and shorter ride times. Most useful for systems with more than 100 DRT trips/day, 5 fixed-routes, or several service modes.
Demand-Responsive Transit Software — Computer-Assisted		☑	☑	Better scheduling and routing, resulting in fewer late/missed trips and shorter ride times. Especially for systems with more than 100 DRT trips/day.
Demand-Responsive Transit Software — Automated		☑	☑	Better scheduling and routing, resulting in fewer late/missed trips and shorter ride times. Quick trip eligibility determination (GIS integrated). Automatically collects trip data for complaint/problem resolution. Most useful for systems with more than 300 DRT trips/day.
Fare Media: Smart Card & Magnetic Stripe Card		☑	☑	Offers customer option to pay fare with card, and transit system can more easily offer fare discounts to seniors and ADA riders, and for off-peak travel. Most useful for systems with more than 200 DRT trips/day or 10 fixed-routes.
Mobile Data Terminals			☑	Quick communication of trip, schedule, and vehicle status permits real-time adjustment to schedule, reducing missed/late trips. Especially for systems with more than 300 DRT trips/day, or needing real-time dispatching capability.
Automatic Vehicle Location			☑	Automatically locates vehicle to support real-time schedule adjustments and service monitoring. Automatically collects vehicle location data for complaint/problem resolution. Most useful for systems with more than 300 DRT trips/day, and needing real-time scheduling and dispatching.
Pre-Trip Traveler Information			☑	Cable TV, Travelers' Kiosk, and Internet access to real-time vehicle location, schedule, trip confirmation, and other service information. Normally requires large investment in GIS, AVL, and advanced computer resources to gather/distribute data.
En-Route Customer Information			☑	Variable message signs provide connector vehicle location, schedule, and other service information. Normally requires large investment in GIS, AVL, and advanced computer resources to gather and distribute information.

Figure 2.11 Technology Solutions by User Need

Need #11 Greater Safety

Basic Technologies	Small System <10 vehicles	Medium System 10-30 vehicles	Large System >30 vehicles	Application
Customized Spreadsheets & Databases	☑			Easier collection, organization, reporting, and trend analysis of safety data (vehicle inspections, condition, and accidents; driver training and safety performance data; passenger incidents). Especially for small systems that want low-cost or low-technical alternative to manual tracking or more expensive software. User must design database and spreadsheet structures.
Advanced Technologies				
Demand-Responsive Transit Software — Computer-Assisted		☑	☑	Supports collection, organization, reporting, and trend analysis of some safety data (vehicle inspections, condition, and accidents; driver training and safety performance data; passenger incidents). Especially for systems with more than 100 DRT trips/day, and needing DRT software to support other important functions.
Demand-Responsive Transit Software — Automated		☑	☑	Automatically collects, organizes, reports, and analyzes some safety data (vehicle inspections, condition, and accidents; driver training and safety performance data; passenger incidents). Most useful for systems with more than 300 DRT trips/day, and needing DRT software to support other important functions.
Mobile Data Terminals			☑	Integrated with Mayday system to alert base station of vehicle accident, robbery, and other problems. Especially for systems with more than 300 DRT trips/day, and using MDTs to support dispatching function.
Automatic Vehicle Location			☑	Automatically locates vehicle in Mayday or other distress call. Especially for systems with more than 300 DRT trips/day, and using AVL to support dispatching function.
Mayday Systems			☑	Automatically alerts base station in distress situation and allows audio monitoring of situation. Especially for systems with more than 300 DRT trips/day, or for vehicles in high-risk service (e.g., high crime areas or late night service).

Figure 2.12 Technology Solutions by User Need

Need #12 More Accessible, More Useful Customer Information

Basic Technologies	Small System <10 vehicles	Medium System 10-30 vehicles	Large System >30 vehicles	Application
Customized Spreadsheets & Databases	☑			Easier collection, organization, and access to client and agency data, and service, route and schedule information. Especially for small systems that don't need more expensive, specialized DRT software. User must design database and spreadsheet structures.
Telephone System		☑	☑	Offers customer option of scheduling or canceling trip, or receiving service information by telephone 24 hours/day. Most useful to systems with more than 300 DRT trips/day, or 10 fixed-routes.
Internet Web Site	☑	☑	☑	Rider or human service agency uses Internet connection for real-time service and eligibility information.
Advanced Technologies				
Geographic Information Systems		☑	☑	Provides customer with more accurate pick-up and drop-off times, fare information, service eligibility, and mode choice. Most useful for systems with more than 100 DRT trips/day, 5 fixed-routes, or several service modes.
Demand-Responsive Transit Software — Computer-Assisted		☑	☑	Supports collection, organization, and access to client and agency data, and service, route, and schedule information. Especially for systems with more than 100 DRT trips/day, and need for DRT software to support other important functions.
Demand-Responsive Transit Software — Automated			☑	Automatically collects, organizes, and accesses client and agency data, and service, route, and schedule information. Most useful for systems with more than 300 DRT trips/day, and need for DRT software to support other important functions.
Fare Media: Smart Card & Magnetic Stripe Card			☑	Customer may get account balance and other information in vehicle. Most useful for systems with more than 200 DRT trips/day or 10 fixed-routes, and needing cards to support other important functions.
Automatic Vehicle Location			☑	Automatically indicates current vehicle location to provide customer with more accurate pick-up and drop-off times, fare information, service eligibility, and mode choice. Most useful for systems with more than 300 DRT trips/day and needing AVL to support other important functions.
Pre-Trip Traveler Information			☑	Cable TV, Travelers' Kiosk, and Internet access to real-time vehicle location, schedule, trip confirmation, and other service information. Requires large investment in GIS, AVL, and advanced computer resources to gather/distribute information.
En-Route Customer Information			☑	Variable message signs provide connector vehicle location, schedule, and other service information. Normally requires large investment in GIS, AVL, and advanced computer resources to gather and distribute information.

Before Moving Ahead

Once you have identified potential technology solutions in these tables, you will want to prioritize needs and then choose the appropriate technology, or group of technologies, that is most suitable for your system. As you go through this selection process and begin to educate yourself on the technology use, costs, benefits, and vendors, it is important to remember to build a foundation with baseline technologies before moving on to the more complex alternatives. For example, before you can install mobile data terminals that automatically collect a large volume of trip, vehicle, and client data, DRT software is needed to store and organize data and to interface with MDTs. Experienced staff are also needed to analyze this rich influx of operations data.

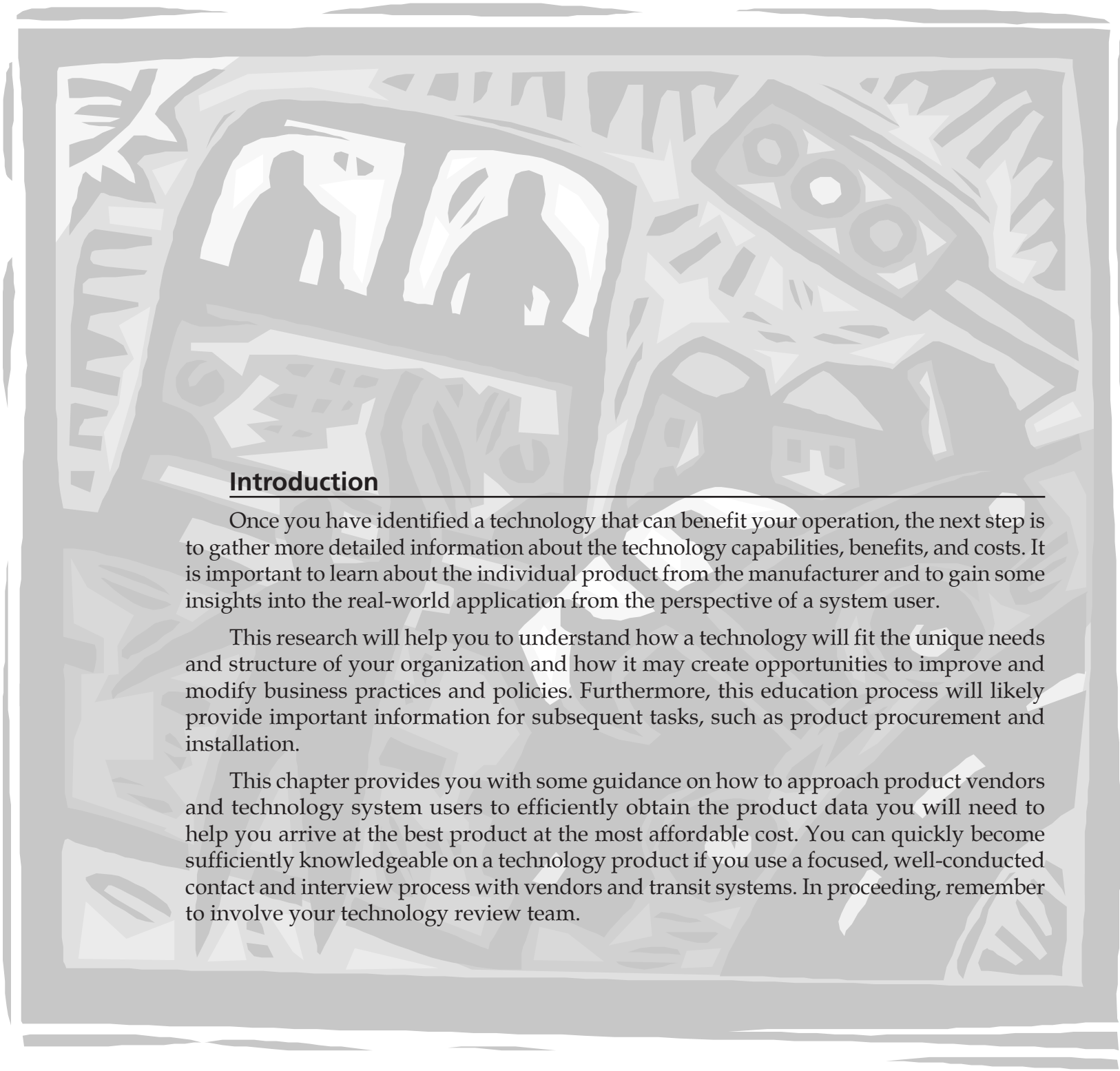
Sharing Has Its Rewards

When defining the environment of your system, make sure to identify opportunities for sharing communication networks. Technology sharing has been essential to the success of the Capital Area Rural Transportation Authority System (CARTS) in Austin, Texas. The system entered into an interlocal agreement with the Lower Colorado River Authority (LCRA) to secure full voice and data radio communications throughout their nine-county, 7,500-square-mile service area. This radio system forms the communications infrastructure that enabled CARTS to use DRT software to consolidate dispatch centers, and eventually install MDTs. Several other agencies use the LCRA radio network as well.

The information in these matrices serve as a useful "technology screening" technique for initial planning purposes. However, more detailed information is needed from transit systems that have implemented similar technologies, product vendors, and other transit and technical professionals. These contacts will help you make wise technology choices and develop a functional technology plan and design. Techniques for gathering this detailed information and making valuable contacts are presented in the next chapter.

The ultimate choice of a specific technology system may depend upon several important factors listed below. (You may have already identified these factors while completing the system analysis process described in Chapter 1.)

- ITS infrastructure plans in the area or region (e.g., able to share radio system infrastructure costs or share dispatching software?)
- Data availability (e.g., GIS base maps)
- Operating system
- Data and system maintenance requirements and on-going operational costs
- State DOT technology grants, programs, and plans
- Funding availability
- Compliance with National ITS architecture (provides description of how technology devices are to interact; compliance is a strong consideration in many federal and state funding grants)
- Compatibility with other transit systems and technologies
- Staff and training needs
- Projected benefits



Introduction

Once you have identified a technology that can benefit your operation, the next step is to gather more detailed information about the technology capabilities, benefits, and costs. It is important to learn about the individual product from the manufacturer and to gain some insights into the real-world application from the perspective of a system user.

This research will help you to understand how a technology will fit the unique needs and structure of your organization and how it may create opportunities to improve and modify business practices and policies. Furthermore, this education process will likely provide important information for subsequent tasks, such as product procurement and installation.

This chapter provides you with some guidance on how to approach product vendors and technology system users to efficiently obtain the product data you will need to help you arrive at the best product at the most affordable cost. You can quickly become sufficiently knowledgeable on a technology product if you use a focused, well-conducted contact and interview process with vendors and transit systems. In proceeding, remember to involve your technology review team.

Vendor Identification

A most immediate question is "Who are the product vendors?" This question is not easy to answer. The technology field is very dynamic — vendors are entering and exiting product markets constantly. The best sources to identify transit vendors and products include the following publications and organizations.

- Transit publications such as *Community Transportation* and *Metro* publish a very useful annual buyers' guide and have product advertisements.
- Transit systems that have procured transit technology can identify vendors and products and provide a list of vendors from their Request for Proposals (RFP) mailing list. State transportation departments, research studies, and RFP announcements in the classified advertisements of transit publications can identify these transit systems.
- Transit associations such as the American Public Transportation Association (APTA) and Community Transportation Association of America (CTAA) maintain a members' product list.

If your operation primarily operates as a real-time, demand-responsive service, you may want to explore relevant products that are targeted for the taxicab and goods delivery industries. The order taking, routing, and scheduling functions inherent in these industries are similar to demand-responsive transit operations. Some innovative taxicab and goods delivery products have been successfully adopted by transit operators.

Product Demonstrations

Once you have identified viable vendors, the challenge is to gather enough information to determine how well the product will address your particular system needs. A product demonstration is the best way to meet this challenge because the meeting provides a dynamic exchange between you and the vendor, and gives the vendor an opportunity to learn about your system needs and directly demonstrate how the product may meet those needs. You can view product demonstrations at transit conferences, arrange for on-site demonstrations, or even employ remote computer hookups (using a product like PCAnywhere®) in which you view the software demonstration on your computer while the vendor is at another site.

Observe the following key rules to make demonstrations more productive:

- Have the right participants. Include staff who will use the technology.
- Let them know who you are. Provide the vendor with a short description of your services, operations, and needs before or during the demonstration so they can more effectively demonstrate how their product will benefit your transit system.
- Get the basics. Make sure you know how the product will meet your specific needs, how it will affect your communications (e.g., radio or cellular) and computer resource requirements, what costs are incurred, and who else uses the product.

Other Transit Systems

The controlled nature of these vendor demonstrations and the vendor's interest in selling their product have some obvious shortcomings. Therefore, it is recommended that you contact other transit systems that have already installed the technology. You not only learn from the contact's credible knowledge and experience, but also develop a valuable support network on which to rely when you later procure, install, and adapt to new technology. Vendors can provide a list of contacts for systems using their products. State and federal transit agencies, transit associations such as APTA and CTAA, and statewide associations can also help to identify systems that use specific technologies.

Given limited time, you will want to contact those systems that are similar in size, market, and services in order to learn more information that is directly transferable. If possible, arrange a demonstration of the technology system to observe it in the "real world." Finally, make sure to get the basics, including:

- why the system installed the technology and what benefits they realized;
- comparison with other proposed products and why the system chose the product;
- quality of the vendor's training and technical support;
- obstacles that can be avoided; and
- a copy of the RFP, installation plan, proposals, and costs.

Previewing Demand-Responsive Transit (DRT) Software

Demand-responsive transit (DRT) software is one of the most significant software technologies being adopted by small urban and rural transit systems. DRT software integrates, administers, and improves the most important system functions, including reservations, eligibility determination, scheduling, routing, billing, and system reporting. It is also the repository and principal evaluation tool for the large sums of operations data produced by advanced transit technologies such as MDTs, AVL, and smart cards.

Computer-assisted DRT software is the lowest cost option and provides the basic capabilities to easily schedule trips, collect data, and generate standard reports. As the cost of DRT software increases, the capabilities generally increase as well. For example, the automated software option provides more complex features, such as automatically routing vehicles based on user-defined criteria and GIS data, and locating vehicles and automatically dispatching trips using MDT and AVL technology.

When evaluating different DRT software, you may discover that these products have similar features and subsequently you may have difficulty distinguishing among the various software products on the market. The following six important features can help you to distinguish among several closely competing software vendors. Note that the sections on integration with other products, integration with the Internet, and routing algorithm only apply to automated DRT software products.

Screen Navigation

Evaluate how you must enter, query, and display data. Software can vary from simple screen navigation to more complex screen sets that offer dozens of options and so-called pop-up screens. Involving your staff (the people who will use the software) in this evaluation is highly recommended.

Integration with Other Products

Software that is integrated with a variety of other software and hardware products has a big advantage. For instance, if you plan to integrate MDTs with your system in the future, DRT software that interfaces with several manufacturers' MDTs will provide you with greater options than a software that only interfaces with a single manufacturer's MDT. Likewise, DRT software that uses or integrates with mapping, database, office automation, or other software that are among industry leaders will most likely grow and progress with that leading company. Avoid software that uses proprietary mapping, database, communication, and other critical software functions.

Integration with the Internet

Make sure the DRT software can be integrated with the Internet. Human service agencies are discovering the convenience and efficiency of scheduling trips and downloading billing and service reports via the Internet. Moreover, the Internet can allow your staff to access and work with the software (e.g., dispatching or generating reports) from remote sites, and allow your transit system to more easily connect to alternative radio, commercial cellular, and other public data networks. Avoid products that are exclusively DOS-based, and be wary of DOS products with a Windows version still in development.

Routing Algorithm

Learn how well the automated scheduling and routing function performs by contacting current users. Generally, a routing algorithm using the street network (sometimes called street centerline) is more accurate than one using triangulation. Non-GIS routing systems, such as those using zones, are much less accurate and difficult to modify and fine tune (calibrate).

Database

Do not install a software that uses a proprietary database. DRT software using a standard database that is ODBC or OLE-DB compliant allows easier data exchange with accounting, vehicle maintenance, report writer software, or other software your transit system might use today or in the future. A standard database allows your staff to create their own reports and ad hoc queries using familiar standard software.

Data Delays

Data-related problems cause a surprising number of installation delays and user problems. It usually takes longer for sites to clean data than anticipated. Furthermore, many operators are frustrated that they are not readily able to produce desired reports from DRT software, especially for customer billing purposes. Transit systems find that a focused evaluation and plan to address data input and output problems is well worth the effort.

Data Input and Output

As transit systems adopt DRT software, they often underestimate the effort required to initially load or convert client, vehicle, route, GIS, and other required data, and sometimes become frustrated with the reporting and billing capabilities of the software. Make sure you understand the data entry and conversion effort that a DRT software requires. Be certain that the software will produce all the detailed reports and billing calculations that your system needs.

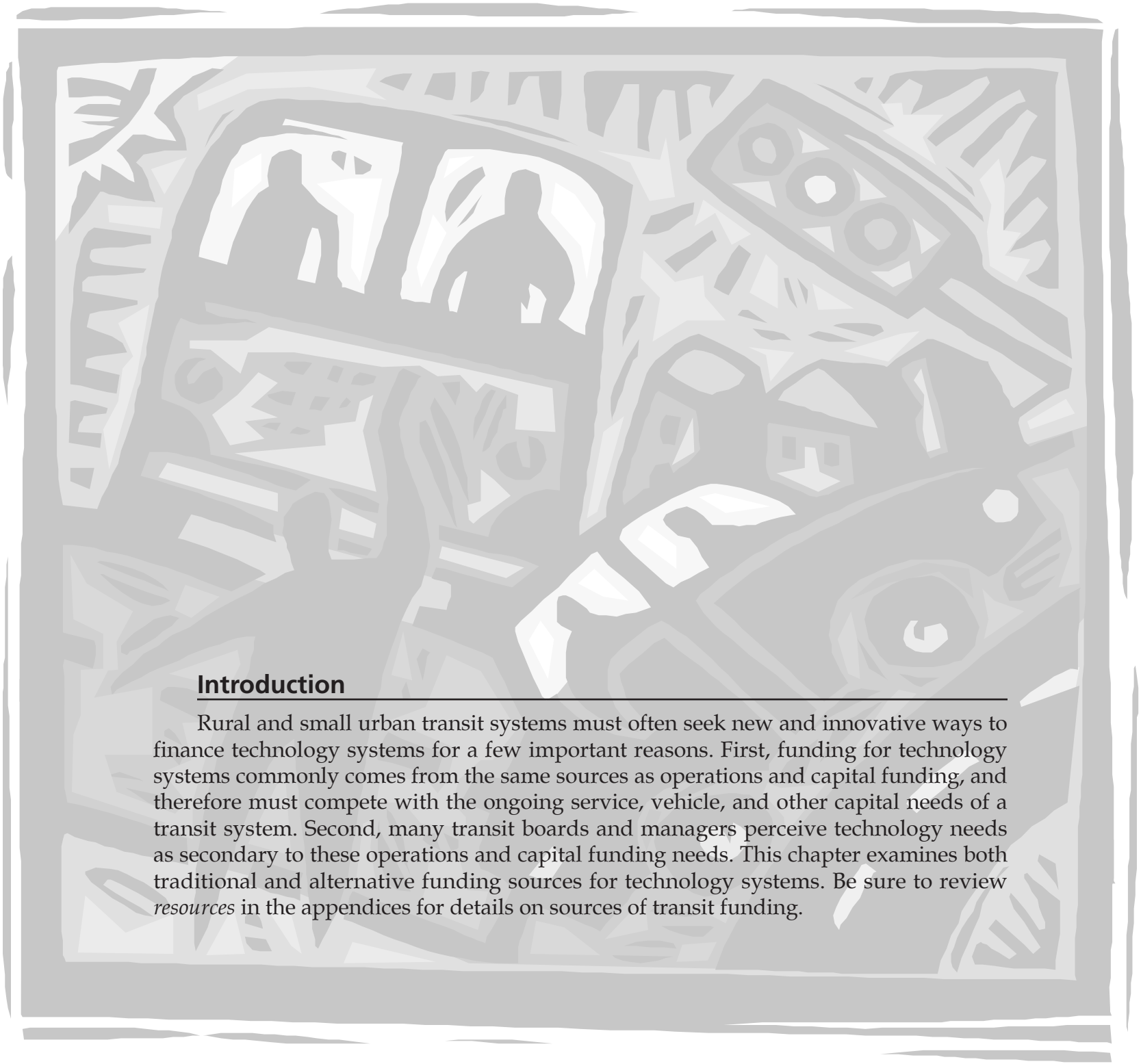
Identifying Costs

After thorough research, you will be fairly knowledgeable and confident about transit technology options. Nevertheless, there are cost items that are commonly overlooked. In addition to the costs of software, equipment, training and technical support, make sure that you gather reliable information on the commonly overlooked cost items briefly described below. Also be aware that many of these items, such as annual software, technical support, and communication service fees, may not be eligible cost items in federal and state capital grants.

- **Transit System Staff —** Additional staff hours for the procurement process, data entry, training, and running parallel systems; new staff hires with needed technical skills; and temporary staff support.
- **Software and Data —** Annual maintenance and technical support fees for software, and initial GIS base map of service area and periodic updates.
- **Computers and Other Hardware —** Computers or server upgrades; peripherals (e.g., specialized printers, oversized monitors, data backup); and annual maintenance for computers, MDTs, and other equipment.
- **Communications —** Additional radio channel or service; dedicated or dial-up telecommunication line and service fee; fees for wireless services (e.g., cellular); and additional telephone equipment (e.g., caller ID box, key system), lines, and usage fees.
- **Training and Support —** Consulting fees for conducting the procurement (e.g., write RFP and evaluate bids), and consulting fees for technical services (e.g., monitoring implementation).

Low-Tech Solutions

The Aiken County Council on Aging in Aiken, South Carolina, provides approximately 350 daily trips for several human service agencies using 15 vehicles. They needed a faster way to take trip reservations, organize driver manifests, and input post-trip data for their demanding billing requirements. They opted for a low-tech solution, AIMS Transport by Saber Corporation, that uses a computer-assisted DRT software, and a bar code reader system that captures trip and mileage data on-board and downloads the data to the computer system at the end of the day. The total system cost was only $30,000, yet it has reduced the data entry of trip data from eight hours to two hours per day and provides a wealth of accurate data for system planning and client case management. And, additional vehicles can be added to the system for only about $1,000 each.



Introduction

Rural and small urban transit systems must often seek new and innovative ways to finance technology systems for a few important reasons. First, funding for technology systems commonly comes from the same sources as operations and capital funding, and therefore must compete with the ongoing service, vehicle, and other capital needs of a transit system. Second, many transit boards and managers perceive technology needs as secondary to these operations and capital funding needs. This chapter examines both traditional and alternative funding sources for technology systems. Be sure to review *resources* in the appendices for details on sources of transit funding.

Traditional Capital Revenue Sources

As might be expected, capital grant programs provide the great majority of funding for technology projects. You might already be quite familiar with these programs, which are typically used to purchase vehicles and other equipment. For small urban and rural systems, federal capital funds are administered by your state department of transportation. Many times these federal capital programs, such as Section 5310 (Elderly and Persons with Disabilities) and Section 5311 (Non-Urbanized Area Formula), are combined with a state capital program; therefore, the federal and state sources become hardly distinguishable to some grant applicants.

Alternative Capital Revenue Sources

There are many alternative revenue sources that transit systems have successfully used to fund technology systems. These sources are quite varied. There are federal, state, local, and private funding agencies, and some of the funding agencies are not directly related to transportation. These funding sources are often competitive, as opposed to the apportioning used in many traditional capital funding programs, and many sources are not traditionally used for transit projects. As a result, transit systems must commit ample time and resources in pursuing these valuable alternative sources.

FTA Demonstration Projects

The FTA has funded many technology demonstration projects under the Advanced Public Transportation Systems (APTS) program which is part of the overall ITS initiative. These funds, which are directly administered by the FTA, are competitively awarded and have financed many model transit technology projects over the last several years.

Also, the FTA administers the Access to Jobs program. These funds are available on a competitive basis to fund transit programs for job access. Although the funding has mostly been used to assist service delivery innovations, some systems such as the Cape Cod Regional Transit Authority, have used this funding to finance technology projects.

Funding Alternatives

The Cape Cod Regional Transit Authority (CCRTA) left no stone unturned in its quest to fund a major technology system. The complex system of DRT software, MDTs, AVL, and an advanced payment system plans to integrate with the other public and private transit systems, and possibly with retail stores and banks using smart cards. The broad project scope has been able to attract a wide range of funding. About 15 percent of the funds came from Federal Transit Administration (FTA) Demonstration Funds, 50 percent were "flexed" from Congestion Mitigation and Air Quality Improvement Program (CMAQ) funding, and the remainder came from the following funding sources: State Mobility Assistance Program (Massachusetts), Job Access and Reverse Commute, Section 5311 Intercity funds, and local businesses.

Federal Highway Administration Programs

The Federal Highway Administration (FHWA) administers the Congestion Mitigation and Air Quality Improvement Program (CMAQ) that is only targeted to pollution non-attainment areas. Although the program funds have been traditionally used for highway projects, the Metropolitan Planning Organization for urban areas and the state department of transportation for rural areas, under certain conditions, have transferred (or "flexed") the funds to transit projects. The FHWA also administers the Surface Transportation Program (STP) and National Highway System (NHS) programs that are targeted to infrastructure improvements, and can be transferred to transit technology projects. In addition, Section 5309 earmarks for capital purchases could be used to provide long-term funding for technology purchases. The process of seeking a capital earmark can be lengthy and involves working with the members of Congress who typically earmark these funds.

Human Service Agency Programs

Federal and state agencies whose service mission depends on public transportation provide capital grant funding for transit technology. The federal agencies include the Department of Health and Human Services, the Department of Commerce, and the Department of Housing and Urban Development. There are commonly several state agencies that administer and match these federal programs, as well as administer similar state human service programs. Community Transportation of Delaware County, Pennsylvania, used local Community Development Block Grants (CDBG) funding to finance a component of their transit technology system. A transit system may be eligible for CDBG funds if the majority of the service area is in a low-income area. Head Start funding can be used for technology procurement that initiates or improves transportation for the clients of the program. A transit agency already coordinating or providing transportation services for a Head Start agency stands the best chance of being included in a local Head Start funding proposal.

Partnerships

Community Transit of Delaware County, Pennsylvania, which provides paratransit services for several human service agencies and transit programs outside of Philadelphia, partnered with other agencies to successfully integrate new technology components. The client identification requirements of a major funding source, the state Medical Assistance Program, drove the design and installation of a system that automatically transmits a picture of the client to the vehicle MDT. In addition, a special project with the Crozier Medical Center that was funded by the U.S. Department of Commerce, called WebTV, allows Medical Center staff to request client trips through an electronic mail hookup. In both cases, although these requirements brought the complexities of additional system requirements, the resulting systems were financed with grants that were traditionally not available for transit systems.

These human service programs are increasingly funded on a "block grant" basis that gives local authorities much greater latitude in deciding the most effective use for the funding. Nonetheless, tapping these human service funds is not simple; it requires you to invest time in developing a relationship with the local service agencies and possibly with the state administrators. Furthermore, you will have to become familiar with programs that are not traditionally tied to transportation. Many systems are increasingly finding that these efforts pay significant premiums.

Local Funding Sources

Some transit systems have acquired substantial funding from local sources. Local government funding has been prominent in several technology systems. This is especially true in cases where federal or state funding has been granted for a technology project, and the grant requires a local match. Some systems have also acquired local government funding by presenting a well-defined technology system, as opposed to a concept, and identifying valuable, specific benefits to local citizens and agencies.

Besides being needed to match federal and state funding grants, local funding can be critical to your technology project for another reason. You may need local funds to financially support the on-going operation and maintenance of your technology systems because the federal and state funding sources can only be used to purchase capital goods. Examples of operational and administrative costs include annual software maintenance and technical support fees, and usage fees for public data networks such as high-speed telecommunication lines and commercial cellular systems.

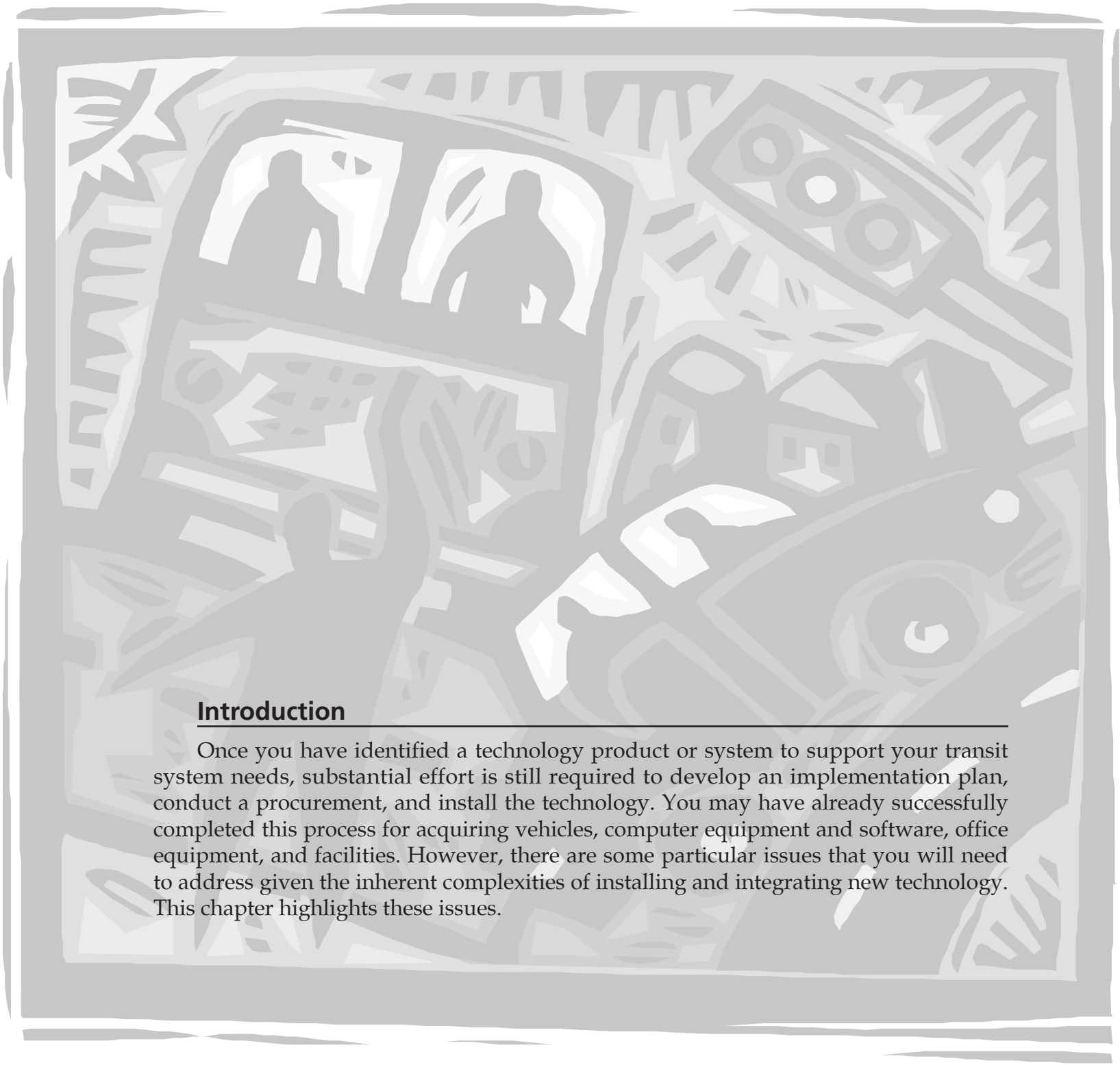
Entrepreneurship

Community Transit of Delaware County, Pennsylvania, purchased the source code and marketing rights of an existing proprietary DRT software, Rides Unlimited, and tailored the product to meet their unique needs. The transit system is installing the product, now called Queue, at four Pennsylvania transit systems with similar operations needs, and providing technical support for the product at those sites.

Businesses are another valuable local revenue source. Businesses provide revenue through the purchase of services, sponsorships, and advertising or simply through donations (especially if your system is operated as a non-profit corporation). Hospitals, dialysis centers, supermarkets, and retailers are often interested in contributing to transportation systems that provide transit access to their services or stores. This can be a standard business transaction in which you sell a service to a business. A transit system can also sell non-transit services. As technologies such as smart cards, Internet services, and communication systems become standard among businesses and transit agencies, the opportunities expand for you to provide a technology service to a business for a fee.

Private Foundations

Many systems have used private foundation grants to fund a part of their system, including ITS solutions. Among foundations there is a wide range of giving practices, but an individual foundation may have a fairly narrow scope in their practice. For example, a foundation may provide only capital funding or only operational funding, and the funding may only be for specific geographical areas, for specific types of programs (e.g., health), or specific client groups (e.g., persons below the poverty level). These sources are very competitive, and large grants require the development of a relationship with the funding agency over several months or even years. For advice on how to approach foundations, visit the Foundation Center Web site at www.foundationcenter.org.



Introduction

Once you have identified a technology product or system to support your transit system needs, substantial effort is still required to develop an implementation plan, conduct a procurement, and install the technology. You may have already successfully completed this process for acquiring vehicles, computer equipment and software, office equipment, and facilities. However, there are some particular issues that you will need to address given the inherent complexities of installing and integrating new technology. This chapter highlights these issues.

Developing an Implementation Plan

Installation requires the effective coordination of a multitude of tasks, organizations, and people. Similar to any complex project implementation, the success of a technology installation greatly depends upon the existence of a quality implementation plan. Even though you will expect an implementation plan from the successful bidder, it is important to develop a preliminary outline for internal purposes well before procurement. This will allow you to begin defining a realistic time frame and arranging for internal personnel and financial resources that will need to be devoted to the effort.

The plan will contain tasks that help your organization change and adapt to the new technology. You will want to monitor task progress and use a format that accommodates changes. As you develop an implementation plan, keep in mind that additional staff resources may be needed because your staff will be performing their regular duties and learning a new technology system at the same time. Also, make sure to build extra time into the due dates to allow for the usual, unpredictable project delays.

Open Architecture

As transit systems explore available technologies, it is wise to require technology that has an open architecture or uses generally accepted standards in order to maximize connectivity to other technology products and systems. The Cape Cod Regional Transit Authority (CCRTA) developed and tested an AVL system in the mid-1990s. This proprietary system was developed from "scratch," and as a result was not compatible with emerging transit technology standards. Subsequently, CCRTA terminated the original AVL project and procured an AVL and MDT system that met several standard communication protocols. This maximum connectivity allows CCRTA to more easily integrate their technology system with the adjacent transit authority, local taxicabs, intercity bus transportation, ferry operations, and private businesses.

In developing your implementation plan, you should at least address the following installation issues. Although some of these issues may have been identified in other sections of this Guidebook, they are important enough to merit further discussion.

- **Integration Opportunities —** You will want to evaluate opportunities to integrate your system with technologies being implemented in adjacent transit systems, private transportation carriers, highway maintenance agencies, and local businesses. Communication infrastructure, such as radio and cellular wireless networks, are prime integration candidates.
- **Intelligent Transportation System (ITS) Architecture —** ITS is a national blueprint to integrate technology devices and information flows among all transportation systems, including highway, transit, air, and sea. You should comply with the ITS architecture.
- **Staff Roles —** Evaluate current job descriptions for all staff and determine how roles will change with the technology implementation. Staff need to be prepared for any changes in responsibilities in advance so they can become accustomed to new expectations.

Training

Quality and comprehensive training is essential to a successful technology implementation. Training helps staff overcome the typical fears of new technology by making them feel more competent in its use and developing a vision of how technology could help them better complete their duties. In transit technology studies, transit management consistently cited ample, quality training as a critical component to successful installation and use of new technology.

- **Training —** Plan to provide ample staff training on using and managing new technology and other skills needed to effectively carry out changing work roles.
- **Additional Staff Resources** — Staff will need to perform their regular duties as well as install and learn the new technology system. Consider adding staff resources such as overtime hours for permanent staff or hiring temporary staff.
- **Staff Incentives** — Staff incentives should be considered to motivate staff. Staff are asked to make an extra effort to participate in training, installation, and other implementation tasks. Dispatchers and schedulers may be reluctant to change to a new system because they are rightfully proud of their prowess in the current system. They may be skeptical of the usefulness of the new technology and feel that it threatens their own usefulness to the organization. These incentives may include premium pay for overtime, evening, and weekend work.
- **Data Preparation** — Do not assume that your client addresses, client eligibility, vehicle, routing, and agency billing data is in good order. Unexpected data entry and conversion tasks commonly cause project delays. These delays are especially common when GIS data is involved. Work to identify data issues and tasks even prior to procurement completion.
- **Record Keeping** — Review your internal paperwork trail (e.g., driver manifests, scheduling forms, operational statistics, etc.), reports, and overall information system. Eliminate any duplication of effort and any unnecessary data collection, and identify any new data that is important to collect.
- **Data Collection (Before/After)** — Do you plan to evaluate the effectiveness of the new technology? If so, you will need to identify and collect data before and after the technology installation for comparison purposes.
- **Policy and Procedures** — What improvements can be made to the daily operational procedures? For example, consider changes in reservation requirements, such as permitting same-day reservations, and examine changes in eligibility enforcement, such as a trip-by-trip eligibility policy.
- **Service Delivery** — What improvements can be made to service delivery? For example, consider offering same-day service, using flex routes, dynamically dispatching excess trip demand to private taxicab operators and connector service to adjacent transit systems.
- **Realistic Implementation Timelines** —Build extra time into the due dates to allow for the usual, unpredictable delays. Based on the experiences of most transit systems nationally, delays can be expected throughout implementation.

Technology Procurement

The purpose of the procurement process is to identify a vendor who is able to provide a product to meet your system's specifications, and to complete a satisfactory contractual relationship to acquire that product. Furthermore, you will want to find a company with whom you can establish a satisfactory long-term business relationship.

You already have some experience conducting procurements for vehicles, computers, office equipment, and facilities. Also, you may be familiar with the extensive literature on conducting procurements that the FTA and transit associations have published. However, the procurement of transit technologies can be substantially different from these items, because a technology installation has a relatively longer time frame, requires addressing complex integration issues, and often involves customization. Therefore, this section does not reiterate common procurement concepts and practices, but instead addresses issues, pitfalls, and mistakes that are particular to acquiring transit technology.

Systems Integrator

Transit operators often favor using a single vendor that is responsible for integrating and installing the various components of a technology system and for resolving all system problems. Initially, using a systems integrator can be more costly. In an attempt to reduce initial costs, the Capital Area Rural Transit System (CARTS) in Austin, Texas, did not use a systems integrator. Management decided to split the procurement into three separate components and be the overall project manager for integrating the software, hardware, and network configuration. They recognized the results to be higher overall product costs, much increased staff time dedicated to project management, and a reduced level of responsiveness on the part of the various vendors. Since that time, CARTS has successfully used a systems integrator.

Procurement Approach

After you identify technology to support one or more of your operational needs, one of the first questions that arises is how the technology is to be procured. During these deliberations, make sure you take into account the following issues:

- **RFP** — Procuring many of the technologies addressed in this Guidebook, such as DRT software, AVL, and MDTs, typically requires the issuance of an RFP as part of the competitive bid process. These products tend to be expensive, and require customization and specialized integration with other technologies.
- **Phased Procurement** — Careful consideration should be given to conducting complex procurements in designated phases. For example, if you determine that a combination of DRT software and MDTs will best meet your needs, install the DRT software first to allow staff sufficient time to adapt, input data into the system, and become comfortable with the product. This phased approach also allows the vendor time to work out any hardware/software interface problems, software customization issues, and programming "bugs" before the next component is added.

- **Package versus Component —** It is desirable to procure all the required hardware and software in one bid. A package procurement approach ensures that the lead vendor (integrator) uses their expertise to properly integrate the various system components, provides the buyer with a single source for problem resolution, and reduces staff time and effort on the procurement process.
- **Piggyback and Group Procurement —** A piggyback or group procurement may be more difficult to arrange than a standard procurement, but can offer significant advantages. Both procurement types save staff or consultant time, may result in a lower overall purchase price, and allow other systems to learn from the experiences of those systems that first install the technology.

Phased Installation

Some transit systems implementing advanced technology systems follow a long-term plan with a phased implementation approach. The Capital Area Rural Transit System (CARTS) is a large, regional system that provides an array of fixed-route and demand-responsive services in the Austin, Texas, region. First, CARTS installed an automated scheduling and routing software in 1994. In 1998, they became a member in a regional radio system to make reliable mobile data and voice communications a reality throughout their large service area, about 7,500 square miles. In 2000, CARTS began installation of mobile data terminals in fleet vehicles. This impressive system is only the beginning; CARTS plans to install a system to allow trip reservations to be made using the Internet, and to develop a new generation of more accurate operations and management reports.

Functional Specifications

Functional specifications for transit technology procurements need to be sufficiently detailed to ensure that the product properly integrates with other current and planned hardware and software systems, and supports the specific needs of the transit system. Yet these specifications should not be overly detailed because the product vendor is the expert and needs to determine their unique approach to compiling the system. Consider the following issues when developing your specifications.

- Review specifications from other transit systems that have conducted successful procurements and modify these specifications as needed; obtain electronic copies.
- Do not use a particular vendor's product specifications.
- As a companion to the functional specifications, include a section that provides background on your operation to include descriptions of your services, vehicles and staff, operations policies and procedures, computer information system, and objectives and goals.
- Be careful to specify what needs to be done, not how it should be done. This allows vendors to use their expertise and creativity in meeting your needs.

- In the development and review of the specifications, involve the same team that you formed to identify system needs and investigate potential technologies.
- Conduct a pre-proposal conference with interested vendors to clarify functional specifications and receive input on your specifications; issuing an addendum based on conference input increases the likelihood of a successful procurement.

Selecting a Bid

Selecting a bid for a transit technology can be relatively difficult for several reasons. As stated earlier, the functional specifications are often quite complex and detailed. Furthermore, quality training and technical support, which can often add up to 50 percent of the total project costs, are critical for successful implementation. Substantial effort and judgement is required in contacting and evaluating company references and project experience. Given these complexities, observe the following recommendations in selecting bids.

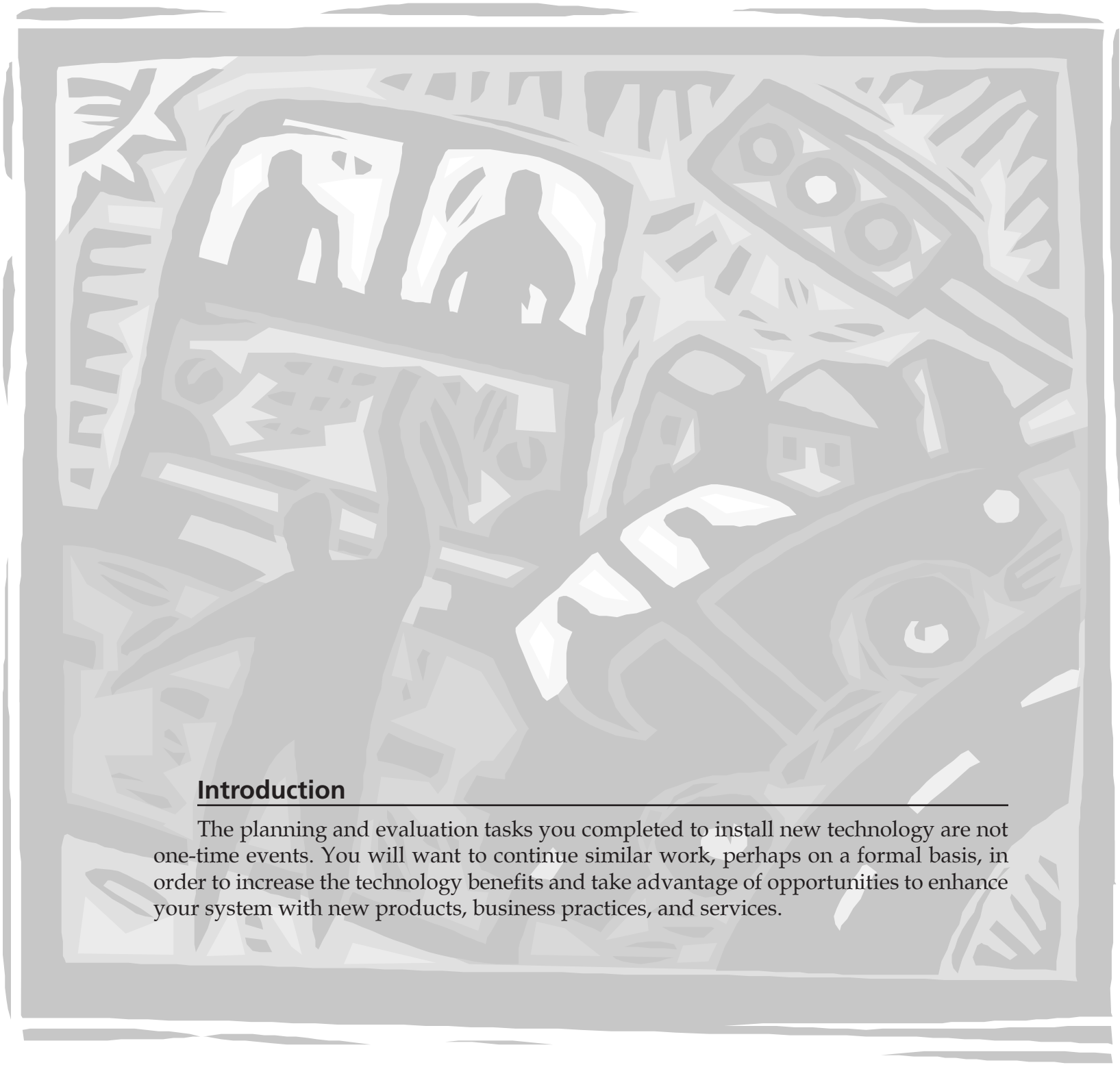
Group Procurement

Purchasing almost any product in quantity will result in a discount. This quantity discount is realized in the purchase of technologies such as computer software and hardware. State DOTs typically lead the effort for group procurements. For example, Maryland and North Carolina DOTs have promoted group procurement of DRT software, resulting in a lower per unit cost. Transit operators are also increasingly collaborating in this area. In addition to lower prices, group procurements often provide a level of influence with a contractor to customize their product for the group, provide more responsive technical support, and, in some cases, locate technical support staff in close proximity to the systems.

- **Evaluation Method —** Use a formal evaluation method for bid selection. The best approach is to publish five to seven evaluation criteria in the RFP and the importance to be given to each.
- **Evaluation Criteria —** Figure 5.1 (page 44) presents some recommended general criteria that function well for procuring products that have substantial variability in product features, system integration and vendor qualifications, such as DRT software. More specific criteria should be used for products that are more standardized and have well-developed performance standards, such as a radio or telecommunications system.
- **Product Demonstrations —** View product demonstrations for the most competitive bids. Involve your review team and/or staff members who will use the technology. Use a format for collecting information and evaluating the product that can be used by the evaluators.
- **References —** Product demonstrations are usually very controlled. The question often arises, "How does the product work in the real world?" Conduct interviews with the vendor references to evaluate the vendor's overall qualifications, technical support, training, and the product effectiveness under actual service conditions.

Figure 5.1 Suggested Evaluation Criteria

1. Proposed cost
2. Compatibility with existing software and hardware used by transit system
3. Effectiveness in meeting specified performance and usability requirements
4. Vendor personnel qualifications and experience
5. Installation support and schedule
6. Quantity and quality of training, technical support, and upgrades
7. Consistency with transit system goals and policies (e.g., firm location, minority business, location of other installations, etc.)
8. Quality of proposal and/or presentation



Introduction

The planning and evaluation tasks you completed to install new technology are not one-time events. You will want to continue similar work, perhaps on a formal basis, in order to increase the technology benefits and take advantage of opportunities to enhance your system with new products, business practices, and services.

Changing Business Practices

During the planning and implementation stages of your new technology, you should have identified several opportunities to change operations and management practices to realize greater technology benefits. Now you may, for example, permit same-day reservations versus only advance reservations, because these can be processed more efficiently with new technology. Transit systems many times require several months to learn all the capabilities and applications of new technology. As your staff continually become more adept at using the new technology, you will continue to discover additional opportunities to make beneficial changes to your current policies and practices.

Emerging Technologies

You will want to stay apprised of evolving transit technologies and evaluate how new products and technologies may benefit your system. For many systems, this activity is part of a long-term, phased technology plan; for those without a plan it is a matter of momentum. There is an impetus toward upgrades and new technology installations that is based on leveraging the benefits of the current system. Once you become proficient using a new technology, such as DRT or GIS software, you may discover that you can significantly increase system benefits by upgrading software or integrating a new technology, such as the Internet, AVL, MDTs, or smart cards. Some of these upgrades and new technologies may be relatively inexpensive.

Some technology applications that cost little, connect readily to many different products, and are easy to use are emerging in the consumer and business electronics products markets. These technology systems could be adapted for use in transit systems. Keep abreast of the following systems and products:

- **Mobile Data Devices —** Palmtop computers, PDAs (personal data assistants), and Web phones are available that provide users with Internet, electronic mail, and paging system connections; voice communications; and application software and databases. These inexpensive devices could replace current MDT and AVL systems.
- **Public Data Networks —** The cellular communication network is growing in terms of coverage area and system capacity, while usage costs are decreasing. Using a public data network requires a lower initial cost and easier system set up, and provides more functionality (e.g., connection to Internet services and data) than radio communication.
- **Internet —** Applications that take advantage of the Internet continue to grow. The Internet offers a seamless connection among transit dispatching centers, transit offices, human service agencies, and virtually any application service provider (ASP), and between the dispatching center and vehicles. The Internet increases connectivity, requiring conformity with a common standard.
- **Application Service Providers (ASP) —** An ASP is a firm that rents the use of technology, usually software applications, installed and maintained on the equipment of the ASP. Users connect to the ASP via the Internet. ASPs now offer turn-key applications for human resources, accounting, inventory control, and customer support. Using an ASP, small transit systems will not have to experience the trials of major software installations nor develop technical staff to maintain an in-house system.

As you keep an eye on new technologies, also keep current on ITS infrastructure advances in your region. You will want to continue to look for opportunities to coordinate your technology efforts with other transit systems, agencies, and businesses in the region.

Customer Service

Focus the evolving use of your technology on providing responsive customer service. The quality of customer service has become increasingly important to business, government, and transit systems over the last decade. Advancements in technology, such as computers, database software, telecommunications, and the Internet, have played a large role in giving employees the tools to provide more responsive customer service. As a result, people have come to expect higher quality service. This expectation is true in transit service as well. For example, technology allows systems to provide more accurate pick-up and drop-off times to customers and quickly take reservations. In businesses, technology and the Internet are taking responsive customer service a step further by allowing customers to directly access useful information. Transit systems are closely following. Some systems allow customers and agencies to reserve trips by using the Internet or automated telephone answering systems and view the current location of vehicles through the Internet.

Summary

Identifying and implementing transit technology is not a one-time event. It is a process. Similar to any business function, you must plan and carry out a process in order to be successful. You need to start by taking stock in your organization and identifying the particular needs of your organization. These initial steps will help you to understand the environment and constraints under which you are operating, and to make sure your journey into the use of advanced technologies is based upon a real set of needs and stays focused on those needs. This process also involves identifying possible technology solutions to support those needs, and a deliberate process to educate you and your staff on the prospective technologies and how they will specifically support your needs. You may conclude that your operation is not ready for the costs and maintenance of an advanced technology solution. A custom database or spreadsheet application available at little or no charge from another transit property or government entity may suffice. Once you have identified the system that you want, you need to complete a procurement, which can be fairly complex for large or advanced technology systems, and carry out a detailed installation process that involves much training and activities to help your staff adapt to the new technology system. If you use the process, activities, and suggestions that you have learned in this Guidebook, your opportunity for success will be greatly increased and you will be able to avoid many mistakes and problems through preparation, implementation, and beyond.

Appendices

Key Transit Technologies

Technical Terms

Technological Resources

Financial Resources

Agency & Association Resources

DRT Vendors

Accounting Software — A computer program for electronically processing, storing, and tracking accounting data such as budgets, payrolls, accounts receivable, and accounts payable. The software allows the user to automatically generate management reports, invoices, and payroll checks more efficiently than manual systems.

Automated Vehicle Maintenance System — A computerized maintenance system that uses telecommunications and in-vehicle technology to automatically monitor vehicle condition, location, and safety. The condition of the vehicle and its components can be monitored in real-time while the vehicle is in service. Low tolerance situations such as low fuel, low oil pressure, engine problems, HVAC problems, farebox problems are flagged and dispatch is notified. The driver can activate a silent alarm in an emergency and automatically notify dispatch and the police to request immediate assistance. An automated vehicle maintenance system usually incorporates automatic vehicle location technology (AVL).

Automatic Passenger Counter (APC) — An automated means of collecting data on passenger boardings and alightings by time and location. An APC system has three basic components: a method of counting passengers, a location technology, and data management. The two most prevalent types of counters are treadle mats and infrared beams.

Automatic Vehicle Location (AVL) — A computerized system that tracks the current location of vehicles in a fleet. The location of the vehicle is determined by using satellites or radio beacons and on-board units that electronically transmit the location data to a base station. Global Positioning System (GPS) is the most prevalent location sensing technology incorporated in AVL systems. AVL is used to assist in applications such as dispatching and schedule monitoring. AVL enables transit managers to manage transit vehicles in real-time with reference to the roadway network and the planned schedule.

Collision Avoidance Systems — Sensor technology on a vehicle that helps prevent collisions between vehicles, or between vehicles and other objects or pedestrians. Visual and/or audible signals are sent to the driver as an alert that an object is in proximity to the vehicle.

Communications — Provides voice and/or data communication among vehicles and base stations. Radio uses a variety of private and commercial systems, frequency bands, and both analog and digital technologies. Several commercial enterprises offer cellular services. The most common communication types include:

CDPD (Cellular Digital Packet Data) — *Allows data files to be separated into a number of packets and sent through idle channels of existing cellular voice networks. CDPD, and other emerging commercial cellular services, offer low equipment capital and maintenance costs because the network is shared and the service provider builds and maintains the network equipment.*

FM Subcarrier RDS — *The information is transmitted on available frequency sidebands of commercial FM radio stations.*

Shared Spectrum or System — *Transit systems may share radio frequency transmission with other users, such as public safety or utilities, using trunking features that allow several users to share a channel or channels to find available transmission slots. Some systems develop a communications system, e.g., transmission towers, with these same entities and use their own frequency.*

Spread Spectrum — *This technology transmits low power signals to send data over several frequencies and uses "receiver intelligence" to decode and re-assemble the information.*

Computer Upgrade — Purchase of new computer equipment or enhancements to existing computers to add more functionality. This could include expansion of memory or storage, or the addition of new software or hardware accessories (high-speed modem for example) to enable the computer to run new programs, access the Internet, receive and send E-mail, and/or operate more efficiently.

Customized Spreadsheets and Databases — An off-the-shelf-software application that performs calculations on a table of numbers, such as sums of money or dates. Businesses use spreadsheets to display financial accounts, forecast sales figures, and plan work schedules. A spreadsheet shows a grid of columns and rows on the screen. Specifically customized databases and spreadsheets can be utilized by transit operators to assist in scheduling and dispatching, general record keeping, and the preparation of various management information reports.

Demand-Responsive Transportation (DRT) Software — This transit-specific software for demand-responsive transit systems incorporates client information, call-taking, scheduling, vehicle routing, agency/client billing, and other paratransit functions. The computer-assisted software versions greatly increase call-taking efficiency, and track scheduled trips and vehicles, produce agency and client invoices, and collect, manage, and report on a broad set of transit data. In addition to these functions, automated software products (with GIS-functionality) provide scheduling suggestions and route vehicles. When integrated with AVL and MDT technologies, trips can be automatically assigned and dispatched on a real-time basis.

Electronic Fare Media — Allows payment of fares without cash. Electronic fare media can read, and in some cases write, information that is stored on the card. These media are expected to make payment methods more user-friendly and make accounting systems more efficient. The most promising types of electronic fare media include:

Bar-Coded Cards — *A type of read-only fare media in which the pattern of bars in a label represent specified data. Bar codes are most commonly used in the retail industry to identify products (e.g., UPC — Universal Product Code). As part of an electronic fare system, bar coded cards and bar code readers represents a relatively low-cost method for transit systems to automatically record client, trip, trip event times, and vehicle odometer data that can be downloaded to the system computers at the end of vehicle runs. The information is then used to generate operations and management reports, and billing invoices.*

Magnetic Stripe Cards — *A type of electronic fare media in which information is imprinted as a magnetic stripe on cards made of heavy paper, thin plastic, or heavier plastic such as that used for standard credit and ATM cards. A number of transit operators use read-only magnetic stripe passes for buses and subways.*

Smart Cards — *A type of electronic fare media that use plastic cards (similar to credit or debit cards) to store and process information. Smart cards contain a microcomputer in addition to electronically erasable programmable memory (EEPROM) and read only memory (ROM). The EEPROM can be used for storing information on the cash content of the card, use history, and other data subject to change. ROM is used for storing the microprocessor's operating program as well as card identification data. The user can reuse the card and increase the cash content on the card by valid electronic transactions.*

En-Route Customer Information — En-route information technologies provide travel information to transit passengers and transit vehicle operators while traveling. En-route information contains travel advisories and in-vehicle instructions for the convenience and safety of passengers. The en-route information can come from technology located next to the roadway or at passenger exchange locations, e.g., bus stops and train stations, or from technology installed in the vehicles. En-route information technology includes variable message signs, highway advisory radio, Travelers' Kiosks, and stop annunciators that automatically announce the next stop using voice and visual messages using electronic communications technology.

Geographic Information Systems (GIS) — GIS uses an electronic map and relational database to display and analyze the spatial relationship between different data. The only common feature among these different data is location. In transit, GIS displays and analyzes vehicle routes, vehicle location, trip pickup and drop off points, bus stops, streets, and landmarks. DRT software is often integrated with its own GIS, or an off-the-shelf GIS, to allow the DRT to recommend trip routing and scheduling assignments. AVL is integrated with GIS to provide real-time display of vehicle location. When the public bus routes and stops are coded in the GIS, the user can locate all bus stops that are within a given distance of a specified location or determine the best route from one's residence to a specified employment location. Off-the-shelf GIS software for personal computers offer easy-to-use and relatively low-cost capabilities. The software needs a location identifier, such as an address or vehicle location point, and a base map on which to locate and display this identifier.

Global Positioning Systems (GPS) — U.S. government-owned location technology that uses signal transmitted from a network of satellites in orbit to determine an object's position through triangulation. The satellites transmit a signal to receivers that compute latitude and longitude for high-accuracy positioning. GPS works anywhere the satellite signals will reach.

Internet — A global network of computers linked together by telephone, cable, and other telecommunication services. Once a computer is connected to the Internet, users can view, send, and receive electronic mail and Web page information. Transit systems use the Internet to display route schedules and current vehicle locations, permit users to schedule trips, and allow agencies in coordinated systems to identify client eligibility, schedule trips, and automatically receive billing and trip information.

Maintenance Software — A computer program for electronically processing, storing, and tracking vehicle maintenance data such as fuel, oil, and water levels; oil pressure; date and nature of inspections; component repairs and replacements; breakdowns; and mechanical and electrical problems of the vehicle. The software allows the user to develop and monitor a comprehensive maintenance plan and to more efficiently monitor the condition of vehicles, conduct preventive maintenance, and reduce vehicle breakdowns. The software can also be used to generate vehicle status reports, historical data, and maintenance summary reports for management as well as to track and update parts and supplies inventories.

Mayday System — An in-vehicle system that transmits an emergency "help" signal through either a satellite or cellular communication system to an emergency response system. The in-vehicle system has an on-board GPS location device that determines the vehicle's coordinates, which are transmitted as part of the Mayday signal so emergency response providers know the vehicle's exact location.

Mobile Data Terminals (MDTs) — These are small computer terminals in vehicles that allow drivers to receive and send text and numerical data to the operations center by radio, cellular, or satellite communications networks. MDTs reduce the amount of operator radio airtime, automatically record trip data, and allow computer automated dispatching when integrated with AVL and DRT software. MDT types range from simple, two-way alpha numeric pagers to specialized, dash-mounted units for transit, and include emerging personal data tools such as palmtop computers, personal data assistants (PDA), and Web phones, that are broadly programmable.

Palmtop Electronic Manifest Device — A small computer that is small enough to fit in a person's palm and/or pocket. Palmtops are limited compared to full-size computers but they are practical for functions that do not require high levels of processing speed, memory, and storage and in situations where highly mobile, small devices are preferred. Palmtops store and update operator manifests, provide interactive maps, provide passenger billing and address information, and perform the same functions as MDTs, including real-time communication between the vehicle and base station of trip and client billing information.

Personnel Software — A computer program for electronically processing, storing, tracking, and reporting personnel related data such as payrolls, payroll taxes, benefits, hours worked, and personnel actions.

Pre-Trip Traveler Information — Travel information that is provided to potential users at home, work, malls, public building, or tourist attractions prior to making their trip. Pre-trip information may be provided on transportation services, available modes, best routes, schedules, fares, stop locations, park-and-ride lots, special events, incidents, and delays. The most common media used are touch-tone telephones and human operators. More advanced technologies include the Internet, customized telephone information systems, pagers, personalized communication devices, cable television, electronic message boards, and Travelers' Kiosks.

Service Bureau — A service bureau is envisioned as a means of providing various services to small transit systems that lack in-house expertise, funds, or access to software to perform the functions themselves. These functions include GIS, vehicle maintenance software, and DRT software. The service bureau helps members develop systems and plans, maintain and better utilize software, and understand technical issues. In some cases, the service bureau directly operates a centralized software system to which members are connected by the Internet.

Stop Annunciators — Device that automatically provides audible and visible announcements of next stop, stop requested, and other travel information for passengers. Commonly used on vehicles and in central passenger waiting areas. In many cases, GPS, dead-reckoning, radio beacons, or another location sensing device is used to automatically locate the vehicle and trigger the announcements.

Telephone System Upgrade — Upgrades to a property's basic telephone system to provide an improved electronic communications system. An initial step involves implementation of a system that routes telephone calls to appropriate recipients, stores messages in digitized form, and provides selected service information to callers. The most common telephone system upgrades include:

Automated Call Distribution (ACD) — *A device that distributes incoming calls to a specific group of agents based on the caller's response to several service options. For example, if the number of active calls is less than the number of agents, the next call will be routed to the agent that has been idle the longest. If all terminals are busy, the incoming calls are held in a first-in-first-out queue until an agent becomes available.*

Interactive Voice Recognition (IVR) — *A variety of applications that provide a telephone interface for callers to interact with call distribution systems, computer databases, or service messages using voice commands or touch-tone keys. The system uses specialized speech recognition software that is trained to identify key words or phrases spoken by the caller when prompted, and then respond appropriately (e.g., route the call or provide information).*

Accounting Software — A computer program for electronically processing, storing, tracking, and reporting accounting data.

Advanced Public Transportation System (APTS) — The name of an FTA program for Intelligent Transportation Systems (ITS) that are transit-oriented applications.

Advance Reservation Service — DRT reservation timing regime that requires requests for reservations to be made 24 hours or more in advance; also called Prescheduled Service. This regime permits software to analyze all scheduled trips, in a batch process, to optimize schedules and routes.

Algorithm — A formula or set of steps for solving a problem (usually mathematical) that ensures that the solution is the best one possible. An algorithm must be unambiguous and must stop when the best solution is calculated. DRT software employs a set of algorithms to optimize scheduling and routing.

Alphanumeric Pagers — Two-way pagers with display screen that are integrated with software to allow basic, low-cost dispatching and trip status communication between driver and dispatcher.

Analog Data Communication — Electronic transmission of information accomplished by adding signals of varying frequency or amplitude to carrier waves of a given frequency. Television, radio, telephone, and cellular communications have conventionally used analog technology.

Application Program — A program designed to perform a set of similar tasks, such as word processing, accounting, statistical analysis, vehicle scheduling, etc.

ASCII — Acronym for American Standard Code for Information Interchange. A standard among different software for representing the characters of the alphabet, numerical digits, punctuation, and various symbols in binary code (ls and Os). An ASCII text file is a plain text file with no special format.

Application Service Providers (ASP) — Firms that rent the use of technology, usually software applications, installed and maintained on the ASP's equipment. Users connect to ASP via Internet or other telecommunication service. ASPs offer turn-key applications for human resources, accounting, inventory control, customer support, and even additional hard drive storage space.

Automated Vehicle Maintenance System — A computerized maintenance system that uses telecommunications and in-vehicle technology to automatically monitor vehicle condition, location, and safety on a real-time basis.

Automatic Vehicle Location (AVL) — A computerized system that tracks the current location of vehicles in a fleet using satellites or radio beacons and on-board units that communicate electronically with a base station.

Automatic Vehicle Monitoring (AVM) — An on-board system that automatically collects engine readings and vehicle operations data. Commonly, an MDT transmits the data to a base station computer system.

Automatic Passenger Counter (APC) — An on-board, automated device that collects data on passenger boardings and alightings by time and location.

Backup — A copy of a program or data made for protection, in case the original is damaged by a software virus, computer malfunction or fire. Common backup devices include a zip drive, tape drive, or CD-ROM.

Bar-Coded Cards — Bar-coded cards allow vehicle operator to automatically collect passenger and trip data using a hand-held computer and bar code reader.

Batch Processing — Processing, analyzing, and scheduling a set of trip requests all at one time.

Baud Rate — A measure of the data transfer speed of a communication device, such as a modem, designated in bits per second. For example, modems often transfer at approximately 56,000 or 96,000 bits per second.

Benchmarking — Evaluating the relative performance of different software or hardware by measuring the computer processing time or the user effort required to perform the same set of functions.

Bit — Binary digit. The basic unit of computer data, either 0 (zero) or 1 (one).

Bug — An error in software (or hardware) that causes a program to malfunction.

Bus — Internal computer circuitry connecting memory, microprocessors and coprocessors. Bus performance is measured in megahertz and can create a processing bottleneck when overloaded.

Byte — A group of eight binary digits processed as a unit by a computer and used especially to represent an alphanumeric character.

Caller Identification — Telephone service that identifies the telephone number or name of the caller.

Cache — Computer CPU stores frequently used instructions and data in the cache and retrieves them from there rather than from RAM; retrieval from RAM must pass through the relatively slower bus circuitry.

Collision Avoidance Systems — Sensor technology on a vehicle that alerts driver to potential collisions with vehicles, objects, or pedestrians.

Central Processing Unit (CPU) — The microprocessor that does the computing and controls the flow of information in the computer.

CD-ROM (Compact Disc Read-Only Memory) — Removable optical disc that stores data and is "read" using laser light. Some personal computer CD-ROM drives can write to CD-ROM discs.

Chip — A microelectronic circuit etched onto a piece of silicon. A chip can be a microprocessor or memory device, or perform other specific tasks such as computing specialized mathematical functions.

Closed Architecture — Software or hardware product specifications that are not published. As a result, a firm must be licensed and receive technical assistance from the product owner/developer in order to develop a product to integrate with the original product. See also Open Architecture.

Compatibility — The level to which personal computers and related peripherals will communicate and function as a system.

Computer-Aided Dispatching System — See Demand-Responsive Transit Software.

Computer Upgrade — Purchase of new computer software or hardware components to enhance existing computer capabilities and functionality such as memory, storage, data transmission, or graphics speed.

Computerized Dispatching — Procedure for assigning demand-responsive transit customers to vehicles. Computer makes recommendation, in either real-time or batch processing mode, on which vehicle run to place a requested trip. May use Geographic Information Systems to map source and destination address for making recommendation.

Contracting, Contracting Out — A procedure followed by many organizations to contract certain functions, such as operations, to private firms. A frequent rationale for contracting is the belief that the contractor has the expertise and capital to perform the function more efficiently and economically.

Coprocessor — A special-purpose processor that assists the main microprocessor by performing certain operations, most commonly graphics and specialized mathematics.

Customized Database/Spreadsheet — A computer software application that performs calculations on a table of numbers as specified by the user. Transit operators can use specifically customized databases and spreadsheets to prepare schedules, record dispatching, perform general record keeping, and prepare management information reports.

Database — A collection of information, organized for easy analysis and retrieval. Consists of individual data elements, each of which is called a field. A collection of fields related to one entity, such as a passenger, is called a record. A collection of records is called a file.

Data Element — A single item of information such as a rider's name; also called a field. A collection of data elements related to a unique entity makes a record. See also Database.

Demand-Responsive Transit (DRT) — Generic term for a range of public transportation services characterized by the flexible routing and scheduling of relatively small vehicles to provide shared-occupancy, personalized, door-to-door, curb-to-curb, or point-to-point transportation at the user's demand; implies existence of a coordinated dispatching service; also called Paratransit, ADA, Dial-a-Ride, and Flexible-Route service.

Demand-Responsive Transit (DRT) Software — Computer software that incorporates transit routes, schedules, demand-responsive trip orders, and vehicle assignments to allow dispatchers to know where the vehicles are in order to more efficiently schedule and dispatch trip requests. Often integrated with AVL, GIS, and MDT technologies to provide advanced system capabilities.

Dial-a-Ride — See Demand-Responsive Transit.

Digital Certificates — Attachment to a piece of Internet data, such as E-mail, Web page, or order form, that acts as a security measure. Certificate verifies by means of a trusted third party, the identity of the person or entity sending the data. Allows firms to receive dependable requests and orders over the Internet.

Digital Data Communication — Electronic transmission of information using the same binary format (in which data is broken into bits and bytes) that computers use. A modem is used to convert the digital information to analog signals for transmission through phone lines and other communication channels using analog signals. Television, non-commercial radio, telephone line, and cellular communications are increasingly offering digital services.

Disc, Disk, Diskette — A round, flat plate coated with a magnetic substance on which data for a computer is stored.

Disk Operating System (DOS) — Can refer to any computer operating system, but is most often shorthand for MS-DOS (Microsoft Disk Operating System) which is the standard for IBM-compatible personal computer. DOS is still a 16-bit operating system (e.g. relatively slower than newer systems) and does not support multiple users or multitasking.

Dispatching — The process of relaying or providing service instructions to vehicle drivers or vehicle operators. Includes assigning customers to vehicles, notifying drivers of assignments, and monitoring the operation of drivers.

Driver Log — A record of vehicle trip information, such as passenger names, trip origin and destination points, and trip mileage, maintained by the driver of each vehicle.

Electronic Fare Media — Electronic technologies for collecting fares and identifying passengers; magnetic stripe cards, magnetic/contactless cards and smart cards

Electronic Payment Systems — Automated fare payment systems that allow passengers to pay for transportation services using electronic media such as magnetic stripe cards, credit cards, debit cards, or smart cards (card with embedded microchip). Farebox or other device reads cards and performs payment entries.

En-Route Customer Information — System that provides real-time travel information to transit passengers and transit vehicle operators while traveling.

Electronic Stamp (E-Stamp) — United States Postal Service application that allows customers to have postage stamps delivered or print postage stamps at home or office, and charges customers. Has possible applications for transit tickets and fares.

Expansion Slot — See Slot

Fare Box — Device for the collection of fares. Also refers to the total revenue a transportation system obtains from passenger fares and local services.

Field — See Database.

File — Comparable to a file cabinet holding data pertaining to a particular topic (e.g., clients, vehicles, employees). A file contains a group of records, comparable to file folders. See also Database.

Fixed-Route — Service provide on a repetitive, fixed-schedule basis along a specific route with vehicles stopping to pick up and deliver passengers to specific locations. Each fixed-route trip serves the same origins and destinations (e.g., set of bus stops), unlike demand-responsive. Typically, fixed-route service is characterized by features such as printed schedules or timetables, designated bus stops where passengers board and disembark, and the use of larger transit vehicles.

Generic Software — Programs that can be used as multipurpose tools, rather than having specific applications. Word processors, spreadsheets, and database managers are the most common examples.

Geocoded — Coding of spatial information, such as a street address, with geographic coordinate information that unambiguously defines the location in a system to allow determination of distances among points.

Geographic Information Systems (GIS) — GIS uses an electronic map and relational database to display and analyze the spatial relationship between different data. In transit, GIS displays and analyzes vehicle routes, trip pick-up and drop-off points, bus stops, streets and landmarks, and it is often integrated with DRT software and AVL systems to provide advanced system capabilities.

Geographical Information Systems (GIS) Service Bureau — A central GIS bureau provides assistance in compiling databases of trip origin/destination information, then utilizing that information to develop efficient subscription routes or service/mode analysis.

Gigabyte — Measure of amount of data, approximately one billion bytes; 1,000 megabytes.

Global Positioning System (GPS) — System of devices that use signal from several satellites to determine position coordinates through triangulation. GPS works anywhere the satellite signals will reach. Combined with communication system and GIS software to form AVL system.

Graphical User Interface — Operating system that uses small pictures or images called icons to represent documents, programs, or commands; a mouse click on the icon initiates the action represented by the icon.

Hard Drive — A large-capacity data storage device containing one or more magnetic disks driven by a motor contained in a sealed case; the principal storage device in a personal computer.

Hardware — The physical components of the computer, as opposed to the programs or software.

HTML (Hypertext Markup Language) — Popular computer metalanguage (easy-to-use, general language from which specific language is created) for creating electronic documents such as Web pages.

Integrator — Technical firm that designs and installs system, such as AVL or DRT automated dispatching, by integrating several software and hardware products; integrator may not produce any of the hardware or software components in the system.

Intelligent Transportation System (ITS) — The use of recent advances in information and electronics technology to improve the development, building, and management of the transportation infrastructure and vehicles.

Internet — System of hardware, software, and telecommunications protocol that allows users to easily connect to other computer systems from all over the world to exchange or display information.

Internet Protocol Security (IPSec) — Uses the encryption of Internet Protocol (IP) packets to keep the information in them from being read by others. The packets are encoded and decoded by network hubs and routers; no special software is required.

Internet Service Provider (ISP) — Entity that provides Internet access to computer users through telephone dial-up, cable television, and other telecommunication services, usually for a fee. AOL (America Online), AT&T, and GTE are noted ISPs.

In-Vehicle Computer — An on-board computer or a terminal with computation capabilities.

In-Vehicle Terminal — See Mobile Data Terminal.

Local Area Network (LAN) — See Network.

Macintosh — Brand name of a personal computer manufactured by Apple Computer, Inc., which competes with IBM-compatibles but uses different microprocessors and a different proprietary operating system.

Mainframe Computer — Large, multi-user, multifunction computer.

Magnetic Stripe Cards — Fare and passenger information is imprinted as a magnetic stripe on a paper or plastic card such as those used for standard credit and ATM cards. Cards are read by farebox, or other electronic device, in electronic payment system.

Megabyte — Measure of the amount of data; one million bytes.

Megahertz — A measure of the speed of a computer's processor, signifying one million cycles per second.

Maintenance Software — A computer program for electronically processing, storing, tracking, and reporting detailed vehicle maintenance and repair data, including parts and supplies inventory.

Maintenance Software Service Bureau — Central maintenance service bureau that assists small transit systems in developing comprehensive maintenance plans and provides annual or semi-annual updates of those plans.

Mayday System — An in-vehicle system that transmits an emergency "help" and vehicle location signal through either a satellite or cellular communication system to an emergency response system.

Memory — See Random Access Memory.

Menu — A list of commands that typically can be executed by moving a pointer to the desired command.

Menu-Driven — Programs that are operated by selecting from menus of commands.

Menu-Driven Telephone Information System — Telephone answering system in which the callers select from voice menus to direct their calls to a desired location.

Microprocessor — An integrated circuit that performs computations and controls the flow of information in a computer. The type of microprocessor used is one of the most common means of describing the capability of a personal computer.

Mobile Data Terminals (MDTs) — Small computer terminals in vehicles that allow drivers to receive and send text and numerical data by radio signals to the operations center.

Modem Modulator/Demodulator — A device that translates computer data into signals to be sent over a telephone line (e.g., analog data) and converts incoming signals back into a form understood by the computer (e.g., digital data).

Multi-User — A computer that can be used by several operators at a time, from separate keyboard terminals.

Network — A set of conjoined computers that can share storage devices, peripherals and applications. Networks may be connected directly by cable, or indirectly by telephone lines and/or satellites, and can be part of an office system (LAN — local area network), campus system (WAN — wide area network), or a global web of numerous other networks.

Network Upgrade — Enhancements to a computer network to improve telecommunications between users by increased memory and telecommunications speeds.

Node — Any device that can communicate with other computers in a group of interconnected computers. Usually a node refers specifically to a computer system or terminal that is part of a network.

Off-the-Shelf Software — Commercial software widely available from retail stores and software vendors that does not require additional effort to customize for the customer's needs.

Open Architecture — Software or hardware product specifications that are published in order to permit other entities to develop related products that operate or integrate with it. For example, anyone can develop software to operate on the open architecture personal computer, while on the other hand, a firm must be licensed to develop software for the closed architecture Macintosh computer.

Open Source Code — Unlike proprietary software, no single entity owns the source code used to create the software application. Instead, the source code is widely available, allowing anyone to make changes or improvements. Several developers often collaborate to improve, add-on, or fix bugs. Noted example of open source code product is the Linux operating system.

Operating System — A master software program that allows the computer to run software applications; controls the flow of commands and data within the computer, and between the computer, software applications and its peripherals. Examples are Windows, DOS, UNIX, Mac OS, and Linux.

Order Taking — See Reservation Function.

Package — A group of programs distributed as one product.

Packet — A block of data transmitted from one computer to another on a network or on the Internet. A packet contains three parts: the data to be transmitted; the data needed to guide the packet to its destination; and, the data that corrects errors that occur through transmission. A typical transmission contains several packets.

Palmtop Electronic Manifest Device — A handheld computer that electronically stores and updates the vehicle schedule, e.g., manifest, for drivers, and provides capabilities similar to MDTs.

Paratransit — Passenger transportation that, on a regular basis, provides a more flexible service than fixed-route service but is more structured than the use of private automobiles. Paratransit includes demand-responsive and subscription service, taxis, limousines, carpools, vanpools, and jitney services.

Peripherals — Add-on devices that are plugged into the computer, such as CD-ROM drives, printers, modems, and scanners.

Personal Computer (PC) — Originated as a nickname for the IBM personal computer but is commonly used to refer to single-user, desktop computers. Sometimes called microcomputers.

Platform — Another name for a computer system including both hardware and software.

Point Deviation — Public transportation service in which the vehicle is required to arrive at designated transit stops at a prearranged schedule, but is not given a specific route to follow between these stops. It allows curb-to-curb service for passengers who request it.

Port — An outlet on a computer through which the computer communicates data to peripherals, such as printers or modems, or into a network.

PowerPC — Name of a type of personal computer containing a microprocessor that is used in IBM-compatible and Apple computers.

Pre-Trip Traveler Information — Travel information that is provided to potential users at home, work, malls, public building, or tourist attractions prior to making their trip.

Processor — See Microprocessor.

Program — A collection of commands to the computer to be executed as a group.

Proprietary Product (Source Code) — Software or hardware that is owned by individual or firm. Users and developers usually required to purchase or pay license fee to use product or develop another product to integrate with it.

Random Access Memory (RAM) — A chip containing the operating memory of a computer holding the programs and data that are currently involved in operations and can be changed dynamically (uploaded or downloaded).

Read Only Memory (ROM) — A chip containing the operating memory of a computer holding the programs and commands that can be involved in operations. These programs and commands are "burned in" and thus cannot be changed dynamically.

Reservation Function — In DRT systems, process of taking trip request details and verifying eligibility; recorded onto form or computer screen.

Route Deviation — Public transportation in which vehicle may deviate from fixed-route occasionally to provide curb-to-curb service to an exclusive passenger (e.g., ADA-eligible client).

Router — The part of a communications network that receives transmissions (data) and forwards them to their destination using the shortest telecommunication route available. Data may travel through multiple routers on the way to its destination, especially over the Internet.

Routing — In DRT systems, providing the precise street path to a driver or vehicle.

Real-Time Scheduling — Scheduling methods where users call for trips at the actual time they wish to be picked up; trip request and pickup without advance reservations.

Request for Proposal (RFP) — The document that specifies a purchaser's needs for a product or service and asks vendors to propose providing the product or service.

Same-Day Service — Demand-responsive reservation system that responds to a request for service within the same service day but not as quickly as immediate, real-time service. For example, a system that responds in two to four hours.

Scheduling — Giving an estimated pick-up time for a requested trip, and assigning a trip to a vehicle.

Search Engine — Internet Web site that allows user to search for Internet content, such as Web sites and Web pages, based on user-defined search terms and criteria; there is commonly no cost for use. Popular search engines include Yahoo, Google, Alta Vista, and Direct Hit.

Service Bureau — A service bureau is a means of providing various services to small transit systems that lack in-house expertise, funds, or access to software to perform the activities themselves.

Slot — A connection in a computer for plugging in boards that add functions or capabilities, such as additional memory, a modem, and coprocessors.

Smart Card — Electronic fare media that uses plastic cards, similar to credit cards, with an embedded microchip for storing and processing information. Used on electronic systems, such as farebox, to pay fares.

Software — Programs and languages used to communicate to computer hardware the tasks to be performed.

Software, Public Domain — Software that is available free and can be used without payment to the author.

Software, Utility — Programs that perform housekeeping functions that enhance the use of the computer and increase control and flexibility of computer use, includes anti-virus, file compression, and screensaver programs.

Source Code — The original computer language in which a software program is written; source code must be changed to modify the program.

Speech Recognition — Computer application allowing conversational access through spoken input and output. Examples include transcribing information into computer records and documents, and navigating menus in phone answering system.

Spreadsheet — A program used to set up, manipulate, and perform computation on the numbers in large tables (matrices) of numeric and alphabetic information.

Stop Annunciators — Provides audible and visible announcement of next stop and stop requested.

Storage — Computer device to store data such as hard disk drive, diskette, CD-ROM, and zip drive.

Subscription Service — A service in which routes and schedules are pre-arranged to meet the on-going travel needs of riders who sign up for the service in advance and require the requested transportation on a regular basis.

Telephone System Upgrade — Advanced telephone systems that may interactively route telephone calls, store messages (voice mail), notify recipients concerning new messages, or provide integrated voice response capabilities to provide information to callers on system schedules, fares, and current service status.

TIGER Files — Files produced by the U.S. Bureau of Census that contain demographic and digital map data of the U.S. Files display basic map features, such as streets, railroads, and rivers. Private firms, such as GDT and WAVTECH, further enhance these files and sell them to transit systems and other users for use in GIS.

UNIX — Standard operating system that operates on personal computers and networks.

Variable Message Signs — Displays information and messages that can be changed on-site or remotely via traffic management systems.

Voice Over IP (Internet Protocol) — Emerging application that allows users to use Internet connections to firms' Web pages to converse with the firm. Saves long distance telephone charges, but requires a multi-media personal computer with a microphone or headset.

VGA (Video Graphics Display) — High-resolution video standard for IBM-compatible machines. Older standards are CGA and EGA.

Window — An area of the monitor screen used to display menus, different applications, or portions of one application.

Windows — Microsoft operating software system that allows operating and application software to function using user-friendly computer windows and icons, and can operate more than one program at a time (e.g., multitasking). Windows 98, Windows NT (for networks), and Windows 2000 are the most recent versions. The features and application software compatibility with these different versions varies.

Word Processor — A program for entering, editing, and formatting text documents.

Work Station — A single-user minicomputer.

XML (Extensible Markup Language) — Popular computer metalanguage (easy-to-use, general language from which specific language is created) for creating electronic documents such as Web pages.

Zip Drive — A storage device that records and reads data onto a zip disk which is a magnetic disk in a removable, sealed case; this media protocol analyzes the data and reduces, or "packs," in order that it require less storage capacity.

If you wish to find out more about transit technologies and financing included in this Guidebook, refer to the publications listed below. A Web site address is provided for those resources that are known to be available on the Internet. Contact information valid as of November 2000.

Technological Resources

"Advanced Public Transportation System Deployments in the United States: Update, January 1999, FTA, Volpe National Transportation Center, 1999.

This report is a compilation of existing and planned APTS technology and service deployments. A total of 551 agencies submitted information as part of the NTD (National Transit Database).

www.fta.dot.gov/research/pdf/aptsius99.pdf

"Advanced Public Transportation Systems: Evaluation Guidelines," FTA, 1994.

This document presents instructions to contractors that are responsible for evaluating APTS operational tests. The contents are valuable to transit systems, as well, for evaluating APTS efficiency, user acceptance, and goal attainment, and for using both qualitative and quantitative evaluation methods.

www.fta.dot.gov/research/pdf/aptseg.pdf

"Advanced Public Transportation Systems: The State of the Art Update '98," Federal Transit Administration, January 1998.

This report is the latest in a bi-annual series of state-of-the-art reports. It presents a description of selected advanced technologies and describes how each technology has been adopted for use in public transit systems. The next update will be available in late 2000.

www.fta.dot.gov/research/pdf/aptssoa98.pdf

"Automated Vehicle Location Successful Transit Applications: A cross-cutting study," FTA, 2000.

This document presents the use of AVL in a variety of transit systems throughout the U.S. It uses a variety of formats to present this information, including case studies, brochures, guidelines, and study analysis, in order to make the information accessible to many different types of transit professionals, users, board members, and elected officials.

www.itsdocs.fhwa.dot.gov/\jpodocs\repts_te/8v301!.pdf

"Benefits Assessment of Advanced Public Transit Systems," FTA, Volpe National Transportation Center, 1996.

This report identifies and quantifies the expected benefits that the transit industry will realize by using various types of advanced public transportation technologies.

www.fta.dot.gov/research/pdf/baapts.pdf

"Best Practices Procurement Manual," FTA, 1999.

This manual provides detailed guidance on developing procurement specifications and a Request for Proposal, and carrying out a fair and effective procurement process.

www.fta.dot.gov/library/admin/BPPM/preface.html

Community Transportation, Community Transportation Association of America. Annual Buyers Guide issue.

This annual guide provides listing and description of available transit technology products.

www.ctaa.org/ct/buyers

"Evaluation of the Benefits of Automated Vehicle Location Systems for Small and Medium Sized Transit Agencies," University of Wisconsin Milwaukee's Center for Urban Transportation Studies, 1998 [presented at 1999 Transportation Research Board annual conference].

This study found that small- and medium-sized transit agencies perceived great benefits from the use of AVL. Benefits included improved efficiencies by permitting automated dispatching and scheduling, better on-time performance, and improved customer service.

www.uwm.edu/Dept/CUTS

"Intelligent Transportation Systems Benefits; 1999 Update, U.S. Department of Transportation, 1999.

This report documents evaluations of ITS projects, including transit related projects. It highlights the benefits identified by other authors and directs the reader to the detailed source document.

www.fta.dot.gov/research/info/bksf/bkstxt.html

"Intelligent Transportation Systems for Transit: Solving Real Problems," Advanced Technology and Innovations course offered by National Transit Institute, Rutgers University, Brunswick, NJ.

This course presents an overview of the capabilities of ITS technologies to solve transit problems, and a methodology for determining their costs and benefits. It uses actual case studies.

NTI course and contact information: www.ntionline.com

Intelligent Transportation Systems (ITS) Projects Book, U.S. Department of Transportation, January 1998.

Comprehensive listing and description of hundreds of ITS projects throughout the U.S., including transit management and mobility.

www.fta.dot.gov/research/info/bksf/bkstxt.html

"ITS Deployment Guidance for Transit Systems Technical Edition," Federal Highway Administration, April 1997; Washington, D.C.

This document provides guidance for the transit community on developing and implementing ITS (Intelligent Transportation Systems) and using the National ITS Architecture. The report gives practical assistance based on real-life experiences with transit ITS technologies. The report contains sections on ITS benefits and concerns, the National ITS architecture and how to use it, best practices/lessons learned, how to find out more information about ITS, existing and planned standards, and sample RFPs and specifications.

www.itsdocs.fhwa.dot.gov/jpodocs/repts_te/3tv01!.pdf

"ITS Toolbox for Rural and Small Urban Areas," North Carolina State University, Civil Engineering, 1999.

Describes transportation technologies, and identifies benefits, applications, implementation steps, and institutional uses.

www2.ncsu.edu/eos/service/ce/research/stone_res/tahmed_res/www/index.html

"RTAP Survey of Rural Transit Providers," KFH Group; Bethesda, Maryland, March 1997; American Public Works Association.

This report reviews a wide variety of attributes and rural transit needs based a survey of 350 transit sites. There is a section on computer and software needs and current levels of use, giving insights into the computer capabilities of rural operators. The survey results indicated that many rural operators have not even attempted to use computer technology in any form.

KFH Group, 4920 Elm Street, Suite 350, Bethesda, MD 20814; Telephone (301) 951-8660

"Rural Public Transportation Technologies: User Needs and Applications," Prepared for FHWA and FTA by TransCore, 1998.

This report presents the findings and recommendations of a national study conducted as part of the U.S. DOT's overall Rural Intelligent Transportation System (ITS) Program. The study examined the opportunities and challenges of planning and deploying advanced public transportation systems (APTS) technologies in rural and small urban areas. Research included user and operator surveys and site visits to determine information requirements, problems, interest, and concerns of both operators and passengers of transit systems in rural and small urban areas.

www.itsdocs.fhwa.dot.gov/\jpodocs\repts_te/45$01!.pdf

"Small Urban and Rural Advanced Public Transportation Systems," NCSU Civil Engineering and Institute for Transportation Research and Education, 1999.

This report, prepared for the FTA, provides transit managers with technology product information, case study experiences and peer contacts, guidance on acquiring the APTS product that meets the needs of their transit system, and the expected payoffs and potential problems that may result.

www2.ncsu.edu/eos/service/ce/research/stone_res/tahmed_res/www/index.html

"TCRP Report 18: A Handbook for Acquiring Demand-Responsive Transit Software," Transportation Research Board, 1996.

This handbook describes how DRT (demand-responsive transportation) software benefits transit systems, and guides systems in assessing software needs and procuring products to meet those needs.

www.fta.dot.gov/research/pdf/r18.pdf

"Technology Options for Small Urban and Rural Transit Operations," Department of Civil Engineering and Institute for Transportation Research and Education (ITRE), North Carolina State University, 1998.

Computer conducted assessment interview to match transit technologies with particular system's needs. Detailed list of transit hardware and software vendors, and transit technology publications and Web sites.

www2.ncsu.edu/eos/service/ce/research/stone_res/tahmed_res/www/index.html

"Transit Technology Guidebook: Procurement and Installation," prepared by Institute for Transportation Research and Education, North Carolina State University, for the Office of Transit, Ohio DOT, 2000.

This is a concisely written handbook that guides transit professionals through the different phases of technology acquisition. It includes conducting a technology needs assessment, matching needs with the appropriate technology, conducting a procurements, and planning for implementation. It makes extensive use of easy-to-use checklists and tables.

Institute for Transportation Research and Education (ITRE), Box 8601, Raleigh, NC, 27695-1601; Telephone (919) 515-8896; www.itre.ncsu.edu/transit/index.html

Financial

"Innovative Financing Handbook," Federal Transit Administration, 1998.

This handbook describes a variety of innovative financing techniques and structures (e.g., grants, bonds) that may be used by transit operators to finance capital projects.

www.fta.dot.gov/library/policy/if.htm

"Innovative Financing Techniques for America's Transit Systems," Federal Transit Administration, 1998.

This notice is intended to provide a snapshot of the innovative financing techniques that are available to transit systems today, as well as a prospective look at techniques that may become increasingly important over the next five years. The handbook summarizes FTA's experience to date and provides detailed examples of the more complex transactions.

www.fta.dot.gov/library/policy/if.htm

"TCRP Report 31: Funding Strategies for Public Transportation, Volume One, Final Report" Transportation Research Board, 1998.

This report addresses the current state of funding for public transportation in the United States, the various circumstances that have contributed to today's funding environment, and specific strategies that transit agencies are pursuing to identify new sources of funding.

Transportation Research Board, National Research Council, 2101 Constitution Ave. NW, Washington, DC, 20418; www.nationalacademies.org/trb/bookstore

"TCRP Report 31: Funding Strategies for Public Transportation, Volume Two, Casebook" Transportation Research Board, 1998.

This report presents 17 case studies of financing techniques used successfully by U.S. transit systems to improve their financial conditions. The cases, which address both capital and operating needs, are presented in two main categories: funds generated through external funding sources and funds generated by transit agencies. Most of these case studies are related to urban systems and fixed-route modes.

Transportation Research Board, National Research Council, 2101 Constitution Ave. NW, Washington, DC, 20418; www.nationalacademies.org/trb/bookstore

Agency and Association Resources

These resources are Web sites for transit and technology organizations and associations that provide reports, guidebooks, technical assistance and vendor information related to transit technologies. URLs valid as of July 2001.

APTA (American Public Transportation Association)	www.apta.com
Catalog of Member Products and Services (COMPS)	intranet.apta.com/davdynvir/webcompscover.asp
Glossary of Transit Terminology	www.apta.com/info/online/glossary.htm
APTA 2000-2004 Strategic Plan	www.apta.com/aptainfo/stratplan.pdf
California PATH Database, the world's largest bibliographic database pertaining to Intelligent Transportation Systems (ITS)	www4.trb.org/trb/tris.nsf/web/path
CTAA (Community Transit Association of America)	www.ctaa.org
Annual Buyers' Guide	www.ctaa.org/ct/buyers
ITS publications in National Transit Resource Library	www.ctaa.org/ntrc/its
Federal Transit Administration	www.fta.dot.gov
Transit Bookshelf	www.fta.dot.gov/research/info/bksf/bkstxt.html
ITS (Intelligent Transportation Systems)	www.its.dot.gov
ITS Cooperative Deployment Network	www.nawgits.com/icdn.html
ITS America	www.itsa.org
ITS World home page	www.sgcpubs.com/tme
National Transit Institute courses, Rutgers University	www.ntionline.com
Transportation Research Board, National Research Council	www.trb.org
Bookstore	trb.org/trb/bookstore
U.S. Department of Transportation	www.dot.gov
Webopedia, online dictionary and encyclopedia (in plain English) for computer and Internet technology	www.webopedia.com

Company Name	Company Address	Phone Fax	Web Site/E-mail	Product Name	Product Type	Integrated Products
Aleph Computer Systems, Inc.	11-49 47th Ave. Long Island City, NY 11101 1700 Shattuck Ave., Ste. #1 Berkeley, CA 94709	P (718) 361-8485 P (510) 843-4443	www.alephcomputer.com contact@alephcomputer.com	ACSI CAD	Taxicab dispatch and scheduler	MDTs
CTS Software, Inc.	P.O. Box 7228 Jacksonville, NC 28401	P (800) 704-0064 P (800) 555-6940 F (910) 455-3476	www.cts-software.com hventers@onslowonline.net	CTS Software	DRT, computer-assisted	GIS
Mobilitat, Inc.	1605 Green River Way Green River, WY 82935	P (888) 806-6595 F (888) 806-6595	darrell@sweetwater.net	Easy Rides	DRT, computer-assisted	MDTs, GIS
Multisystems, Inc.	10 Fawcett St. Cambridge, MA 02138-1110	P (800) 735-1669 P (617) 864-5810 F (617) 864-3521	www.multisystems.com	MIDAS-PT, Mobility Master	DRT, computer-automated	MDTs, AVL, GIS
Route Logic, Inc.	1041 Wilshire Cir. East Pembroke Plains, FL 33027-2209	P (954) 431-7250 F (954) 704-0056	www.routelogic.com info@routelogic.com	Paralogic	DRT, computer-assisted	GIS
RouteMatch	1349 W. Peachtree St. Ste. 1400 Atlanta, GA 30309	P (404) 876-5160 F (404) 898-1145	www.routematch.com sales@routematch.com	ParaMatch	DRT, computer-automated	MDTs, AVL, GIS
Shah Software, Inc.	P.O. Box 9445 Midland, TX 79708-9445	P (800) 968-2748 F (915) 694-4982	www.shahsoftware.com shahjagat@aol.com	Transportation Manager	DRT, computer-assisted	
Surfside Software Systems	601 Cleveland St. Ste. 500 Clearwater, FL 33755	P (888) 310-3200 P (727) 562-2862 F (727) 447-4469	www.surfside.com sales@surfside.com	TranWare	Taxicab dispatch and scheduler	MDTs, AVL
TechKnow Solutions	5904 Richmond Hwy. Ste. 403 Alexandria, VA 22303	P (703) 765-7717 F (703) 960-2363	www.techknowsolutions.com	Easy Dispatch	Taxicab dispatch and scheduler	GIS
Teleride, Inc.	214 King St. West Ste. 300 Toronto, ON, Canada M5H 3S6	P (416) 596-1940 F (416) 595-5653	www.teleride.com info@teleride.com	TransView	DRT, computer-automated	MDTs, AVL, GIS
Trapeze Software Group	14400 N. 87th St. Ste. 120 Scottsdale, AZ 85260	P (480) 627-8400 F (480) 627-8411	www.trapezesoftware.com info@trapezesoftware.com	Pass	DRT, computer-automated	MDTs, AVL, GIS
TRIPSoft	1921 Northwood Dr. Williamsville, NY 14221	P (800) 554-9363 P (716) 810-0176 F (716) 634-5911	www.eonmosaic.net inquiries@eonmosaic.net	TRIPSoft	DRT, computer-automated	
Two Like Minds	P.O. Box 6758 Rochester, MN 55903	P (507) 287-0658	mbrich@mindspring.com	Transportation Management System	Taxicab dispatch and scheduler	MDTs, AVL

Contact information valid as of July 2001.