TCRP

SYNTHESIS 57

TRANSIT
COOPERATIVE
RESEARCH
PROGRAM

Sponsored by
the Federal
Transit Administration

Computer-Aided Scheduling and Dispatch in Demand-Responsive Transit Services

A Synthesis of Transit Practice

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

TRANSIT COOPERATIVE RESEARCH PROGRAM

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Computer-Aided Scheduling and Dispatch in Demand-Responsive Transit Services

A Synthesis of Transit Practice

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SUBJECT AREAS
Public Transit

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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 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 Academy of Sciences, acting through the Transportation Research Board (TRB), and the Transit Development Corporation, Inc. (TDC), a nonprofit educational and research organization established by APTA. TDC is responsible for forming the independent governing board, designated as the TCRP Oversight and Project Selection (TOPS) Committee.

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FOREWORD

By Staff
Transportation
Research Board

Transit administrators, engineers, and researchers often face problems for which information already exists, either in documented form or as undocumented experience and practice. This information may be fragmented, scattered, and unevaluated. As a consequence, full knowledge of what has been learned about a problem may not be brought to bear on its solution. Costly research findings may go unused, valuable experience may be overlooked, and due consideration may not be given to recommended practices for solving or alleviating the problem.

There is information on nearly every subject of concern to the transit industry. Much of it derives from research or from the work of practitioners faced with problems in their day-to-day work. To provide a systematic means for assembling and evaluating such useful information and to make it available to the entire transit community, the Transit Cooperative Research Program Oversight and Project Selection (TOPS) Committee authorized the Transportation Research Board to undertake a continuing study. This study, TCRP Project J-7, "Synthesis of Information Related to Transit Problems," searches out and synthesizes useful knowledge from all available sources and prepares concise, documented reports on specific topics. Reports from this endeavor constitute a TCRP report series, *Synthesis of Transit Practice*.

The synthesis series reports on current knowledge and practice, in a compact format, without the detailed directions usually found in handbooks or design manuals. Each report in the series provides a compendium of the best knowledge available on those measures found to be the most successful in resolving specific problems.

PREFACE

This synthesis will be of interest to transit practitioners, transportation professionals, and social service providers, as well as to private and nonprofit organizations providing demand-responsive transit (DRT) service. It explores the experiences of selected transit agencies, four contract service providers, and four software vendors, focusing on current practice, successful implementation of computer-aided scheduling and dispatch (CASD) systems, and impediments to success. The report summarizes the state-of-the-practice experiences of a selected group of transit agencies about the implementation and use of CASD systems employed to provide Americans with Disabilities Act and other DRT services. In addition, it identifies much of the past and ongoing research pertaining to the topic.

This synthesis report from the Transportation Research Board includes a literature review, supplemented by survey responses from three types of sources (public transit agencies, software vendors, and private service carriers with contracts with transit agencies to operate DRT services). Case studies from two transit agencies (Charlotte Area Transit System and New Jersey Transit) that have recently implemented entirely new CASD systems are included.

A panel of experts in the subject area guided the work of organizing and evaluating the collected data and reviewed the final synthesis report. A consultant was engaged to collect and synthesize the information and to write the report. Both the consultant and the members of the oversight panel are acknowledged on the title page. This synthesis is an immediately useful document that records the practices that were acceptable within the limitations of the knowledge available at the time of its preparation. As progress in research and practice continues, new knowledge will be added to that now at hand.

CONTENTS

COMPUTER-AIDED SCHEDULING AND DISPATCH IN DEMAND-RESPONSIVE TRANSIT SERVICES

SUMMARY

The scope of this synthesis is to (1) search out useful information on the use of computer-aided scheduling and dispatch (CASD) in demand-responsive transit (DRT) services, (2) develop an amalgamation or compendium of the current knowledge and successful practices used in computerizing the functions necessary to efficiently and effectively operate such DRT services, and (3) report on measures used to resolve specific problems in planning and implementing CASD. The ultimate objective in compiling a considerable storehouse of information is to make this information available to the public transit community. Private and nonprofit organizations that are providing DRT services will similarly benefit from a review of these results.

As with most TCRP synthesis studies, this synthesis identifies much of the past and ongoing research pertaining to the topic, and it assembles and analyzes information gathered through survey questionnaires from a selected number of transit agencies involved in providing DRT services. In addition, because of the unique way in which CASD activities are implemented in the DRT industry, information has been elicited through survey questionnaires specifically targeted to DRT software vendors and major private service providers that operate as much as two-thirds of the nation's DRT services under contract to transit agencies.

It is especially illuminating to compare agencies' expectations with the vendors' views on the capabilities of the systems they have installed, as well as the reasons why successful implementation of such systems is sometimes impeded. Moreover, the perspectives of other end users of CASD, such as private contract service providers, are important to consider because they are charged with using CASD as a tool to ensure that the performance and efficiency goals of transit agencies with which they contract are attained.

Completed surveys were received from 21 transit agencies, a 40% response rate. Of these, 14 represent agencies that are among the 75 largest DRT service providers, based on passenger miles of service. The experiences of two agencies that have recently implemented entirely new CASD systems—Charlotte Area Transit System and New Jersey Transit Corporation—are reviewed as case studies. Those studies represent an in-depth look at some of the lessons learned and how particular agencies overcame impediments to successful implementation of CASD software.

More than 90% of the responding agencies enter into contracts for all or a portion of their services with the private sector. However, they have mostly retained control over the procurement and operation of CASD software and hardware.

The study identified a number of important ways in which the procurement and implementation processes could be improved. Specific areas include the development of agency CASD needs and specifications for software, suggestions for improving the evaluation of vendor-proposed software products, time allotted for various phases of implementation, en-

suring that the software passes acceptance testing before staff training takes place, and recommendations for making training more effective.

The study found a plethora of research relating to CASD. This report contains an extensive list of citations from a literature search. The pace of research has accelerated over the past 5 years. The TRB Committee on Paratransit and the APTA Access Committee have both actively sought technical papers for presentation at annual meetings. In some cases, state departments of transportation have funded research efforts aimed at improving efficiency and coordination in the delivery of DRT services.

The research results cover several categories. Many of the studies pertain to topics involving DRT management planning, procurement, and implementation of software. Other research features the evaluation of computerized DRT systems, as well as associated technologies such as mobile data terminals and automatic vehicle location systems.

Finally, significant research pertains to highly technical simulation models and development of mathematical routing and scheduling algorithms. It is believed that a greater effort could be made among user agencies and software developers to incorporate some of this high-quality, advanced research in their CASD system designs and applications, to produce better results for CASD systems performance.

CHAPTER ONE

INTRODUCTION

BACKGROUND

Computers have played a central role in demand-responsive transit (DRT) operations ever since such operations began to be offered in the 1970s. DRT is generally meant to include public dial-a-ride transportation services, shared-ride taxis, and Americans with Disabilities Act of 1990 (ADA) public paratransit services for mobility-impaired elderly and disabled individuals. As many readers are aware, the public transit provisions of the ADA call for transit agencies receiving federal funds to operate both mandatory accessible fixed-route service and "comparable, complementary" paratransit service for individuals with disabilities who cannot use accessible fixed-route service.

APTA defines DRT as follows (*1*):

> [P]assenger cars, vans or small buses operating in response to calls from passengers or their agents to the transit operator, who then dispatches a vehicle to pick up the passengers and transport them to their destinations. A demand response operation is characterized by the following: (a) The vehicles do not operate over a fixed route or on a fixed schedule except, perhaps, on a temporary basis to satisfy a special need; and (b) typically, the vehicle may be dispatched to pick up several passengers at different pick-up points before taking them to their respective destinations and may even be interrupted en route to these destinations to pick up other passengers. The following types of operations fall under the above definitions provided they are not on a scheduled fixed route basis: many origins–many destinations, many origins–one destination, one origin–many destinations, and one origin–one destination.

According to APTA, in fiscal year (FY) 2002, the number of agencies providing such services was 5,251. The total operating expense amounted to $1.95 billion, and the capital expenditure totaled $218.3 million. The number of unlinked passenger trips provided in FY 2001 was 103.4 million, compared with 42.4 million passenger trips in 1991 (*2*). This translates into 370,000 unlinked passenger trips on an average weekday.

Some of the other pertinent nationwide DRT statistics for FY 2002 are as follows (*1*):

Total passenger miles:	853,079,000
Total vehicle miles:	802,564,000
Revenue vehicle miles:	688,002,000
Total vehicle hours:	54,362,000
Revenue vehicle hours:	46,854,000
Number of active vehicles:	34,699
Number of operating employees:	56,746

Ranked according to passenger miles of service provided, the nation's largest DRT agency was the Metropolitan Transportation Authority, New York City (MTA NYC). MTA NYC Transit and MTA Long Island Bus together provided 23.5 million passenger miles of service in FY 2001. The following 10 transit agencies, ranked in descending order, provided 12 million or more passenger miles of service (*1*):

MTA NYC, New York, N.Y.
Access Services, Los Angeles, Calif.
Regional Transportation Authority, Chicago, Ill.
Metro Mobility, Minneapolis, Minn.
Massachusetts Bay Transportation Authority, Boston, Mass.
Metropolitan Transit Authority of Harris County, Houston, Tex.
Miami–Dade Transit Agency, Miami, Fla.
Port Authority of Allegheny County, Pittsburgh, Pa.
Pee Dee Regional Transportation Authority, Florence, S.C.
VIA Metropolitan Transit, San Antonio, Tex.

HISTORY OF COMPUTER-AIDED SCHEDULING AND DISPATCH SYSTEMS

Before the enactment of the ADA, DRT services were typically operated in small communities or medium-sized cities. Small DRT systems controlled their trips and vehicles manually in the early 1970s. A few operators developed their own rudimentary software and operated in a computer-assist mode to track and control requests for trips. Some used basic spreadsheets; for example, controlling the number of entries in any 1-h time frame based on estimates of vehicle and seating capacity. Trip data in spreadsheets could be sorted or even easily moved from one time block to another.

The development of fully computerized software for scheduling and dispatching began in the 1970s. According to *TCRP Report 18: A Handbook for Acquiring Demand-Responsive Transit Software* (*3*), Massachusetts Institute of Technology researchers were among the earliest developers of this type of advanced software. Creating an optimal schedule was seen as a classic operations research problem. In its basic formulation, known as the "traveling salesman" problem, the challenge was to create the most efficient schedule for a salesman to service his or her clients. That

methodology—a series of mathematical computations—could be incorporated into computer software. The methodology itself is referred to as an algorithm.

Some readers will recall that the aforementioned activities reflect the "pre-PC [personal computer] days," when mainframe computers were large, expensive, and costly to operate. Consequently, DRT operators were slow to accept and implement software containing the new algorithms. Instead, they honed their manual scheduling skills, added more schedulers and dispatchers, and adopted the basic computer-assist approaches, such as the use of spreadsheets, as mentioned. Some service providers could boast of handling 1,000 or more trips a day by using manual techniques.

However, as conditions changed—namely, the growing demand for advance reservations, increases in vehicle fleets, and constantly changing sets of vehicle schedules—it became evident that continuing manual operations would overwhelm a system's dispatchers and create difficult control problems. The functions required for the successful operation of these services, such as trip reservations, routing and scheduling, dispatch control, financial reporting, and management statistics and reports, could be implemented in most cases only through the use of computers with more sophisticated, customized software.

The development and application of advanced technologies to improve the performance of DRT systems accelerated following the enactment of the ADA in 1991, particularly as these services began to be offered to eligible clients in urban areas served by large public transit systems. Computerization to facilitate efficient, high-quality DRT service delivery became an essential requirement.

As described in *TCRP Report 18*, there was renewed interest in computer software during the ADA paratransit start-up era, at a time when PCs with microprocessors were becoming prevalent. Consequently, there were many firms that began developing and marketing both off-the-shelf and customized systems to perform most of the functions for advance reservations systems. Real-time scheduling, which is used in the taxi industry, for example, was not adopted in the early years as an approach for delivering DRT trips. Today, the overwhelming majority of DRT operators still opt for advance scheduling. One exception is the concept of real-time autonomous dial-a-ride transit (ADART), which is discussed later in this chapter.

Many transit agencies that had not previously offered DRT services, including those in large urban areas, started to offer paratransit services. They developed separate administrative staffs, and either operated the services with their own personnel or found it advantageous to contract with private transportation operators to offer the service. In the beginning, the scale of many of these new operations was small, and the DRT functions—reservations, scheduling, dispatching, and accounting—were performed manually.

However, the numbers of eligible DRT users and the vehicle fleets grew quickly, and agencies began to acquire DRT software from the numerous DRT-specialized software vendors. For many agencies, that would be their first experience with DRT-type operations and with the software that could help control the operations.

IMPLEMENTING AND USING COMPUTER-AIDED SCHEDULING AND DISPATCH SYSTEMS

There are a variety of reasons why DRT operators turn to computer-assisted scheduling and dispatch (CASD) systems to assist in the management of their services, including:

- Growth in demand for DRT services,
- Need to manage and monitor large volumes of data,
- Desire to ensure that services meet or exceed service quality standards, and
- Improving the quality of service for the users.

However, one of most important, overriding considerations is to seek gains in efficiency; that is, to control costs. A small gain in system productivity, the number of trips completed per service hour, can generate huge savings—particularly for large DRT systems.

In recent years, in recognizing that efficiencies can be achieved through a diverse array of management tools apart from technological advances, researchers have sought to determine what the impact of CASD has been on performance and cost of operations and how to improve the successful implementation of these systems.

PURPOSE AND OVERVIEW OF THE SYNTHESIS

This synthesis project was designed to provide state-of-the-practice information on the implementation and use of CASD systems employed by public transit operators to provide ADA and other DRT services. Specifically, information was gathered about the experience of a selected number of transit agencies, contract service providers, and software vendors with the implementation of CASD systems, in regard to the factors that led to successful implementation of such systems, as well as the impediments to success.

Because transit agencies have become concerned about the financial impact of operating DRT service, many have

sought to reduce the costs of service delivery by the use of service carrier contracts (*4*). A special study by TRB (*5*) indicated that 60% of transit systems providing DRT services contract for more than 25% of this service (50% contract all of it). Moreover, because the vast majority of the nation's largest transit systems operate DRT services under contract, as much as two-thirds of the DRT operating expenses and two-thirds of the amount of DRT service (e.g., based on vehicle revenue miles) are provided by contract carriers. According to that study, 85% of these contracts were with private entities, and 15% were with nonprofit organizations.

Furthermore, that study reported that general managers of public transit agencies were dissatisfied with the aspects of contracting that involved operational control (e.g., scheduling and dispatching). All of these factors led to the inclusion of a selected group of national private DRT contractors in this synthesis, and their viewpoints vis-à-vis CASD use were elicited to provide a full picture of the practice.

The actions and activities of CASD software vendors have a significant impact on CASD implementation and utilization, but the literature review did not yield any information about studies or evaluations of the impact of software implementations by vendors. Major topics that might warrant further examination include agency/vendor relationships; caliber of vendors' technical and training staffs; whether one software package fits all; and whether the vendors are furnishing proven, error-free products. Because it appeared quite logical and meaningful to include vendors' perspectives in this synthesis study, survey questionnaires were sent to a selected number of developers of such software.

Methodology

Survey questionnaires were developed to elicit information and experiences about some of the key elements involved in the implementation and use of CASD systems, including

- Planning and procurement process,
- Implementation process,
- Staff training,
- Evaluation of software performance features,
- Results versus expectations,
- Business and operating practices, and
- Impact on controlling contractor performance.

The surveys were distributed in January 2004 to 55 selected public transit agencies that provide DRT services, 5 CASD software vendors, and 6 large private service carriers that contract with transit agencies to operate DRT services. Of the 55 agencies, 31 were reported in the National Transit Database of the FTA as being among the nation's 75 largest (measured by passenger miles of service). The remainder consisted of 19 medium-sized urban transit agencies and 5 that serve predominantly rural areas and small towns. The 55 agencies in the sample represented 10% of the 550 or so agencies that provide ADA paratransit and dial-a-ride services. The agency selection process took into account geographic distribution, with 35 different states represented in the sample.

Responses were received from 21 transit agencies, a 40% rate. The responses are considered representative of large and medium-sized urban DRT agencies. There were only two responses from small agencies, which cannot be considered representative.

The extent to which small and rural agencies (those providing 100 or fewer trips per day) use stand-alone CASD software is not known. These operators vary greatly in fleet size and the number of trips delivered. Smaller agencies can benefit from software, but they often have much different CASD system requirements. In many cases, they need computer assistance with just basic features for manual scheduling and uncomplicated reporting.

Researchers at the University of Illinois at Chicago (*6*) found that the benefits of CASD increase with the number of vehicles and trips. That finding could partly explain why it was difficult to identify smaller agencies that use scheduling and dispatching software and to elicit responses from this group.

The sampling of CASD software vendors included several of the nation's major companies, as well as one small company. Similarly, several of the large providers of contract DRT service were included in the sample of private service carriers. The response rates for those two groups were very high—four of the five software vendors (80%) and four of the six service providers (60%). Although the vast majority of the transit agency respondents have used one or more of the software products provided by vendors or used the contract services of one or more of the private carriers in the survey, the responses from these groups did not correlate with the CASD experience of individual transit agencies. The vendor and carrier questionnaires were designed to elicit more general information about common or usual practices, in contrast to their experience with individual transit operators.

The breakdown of respondents by size of operations (based on DRT passenger miles and number of vehicles) is shown in Table 1 and by the types of communities they serve in Table 2. As mentioned, responses to specially targeted survey questionnaires were received from four software vendors and four contract carriers. The questions consisted of requests for data and statistics, check-off questions, satisfaction ratings, and those requiring open-ended narrative responses.

TABLE 1
RESPONSES BY TRANSIT AGENCIES BY POPULATION OF SERVICE AREA

Transit Agency Size	Large Agencies*	Medium-Sized Agencies	Small/Rural Agencies
Under 50,000			1
50,000–199,999			1
200,000–999,999	2	5	
1,000,000 or greater	12		
Total transit agencies responding	14	5	2

*Included in APTA listing of 75 largest DRT agencies based on passenger miles.

TABLE 2
TYPES OF COMMUNITIES SERVED BY RESPONDING TRANSIT AGENCIES

Type of Community	Percentage of Responses	No. of Transit Agencies
Urban	29	6
Suburban	5	1
Metropolitan	51	11
Rural	5	1
Statewide	10	2
Total	100	21

The transit agency questionnaire contained a section of supplemental questions that, it was made clear, could be answered at the agency's option. This approach encouraged agencies to complete the main body of questions and to participate in the survey even if they chose not to respond to the open-ended supplemental questions.

Organization of the Report

This synthesis gathers much of the information currently available about CASD systems. A review of the literature is presented in chapter two. Chapter three profiles the agencies that responded to the agency survey questionnaire in regard to the DRT services they provide. Chapter four discusses the experiences of agencies and companies with the planning, procurement, and implementation of CASD software. Among the topics included in that chapter are identifying software products, descriptions of the procurement processes used, staff training, software acceptance testing programs, agency/vendor relationships, and performance features. Chapter five discusses the impact of implementing an advanced CASD system on agency business and operating practices. Selected case studies are presented in chapter six based on extensive follow-up interviews with two of the respondents. In chapter seven, there is a discussion of the survey results of software vendors, and chapter eight discusses the responses of private service contractors. The report concludes in chapter nine with a discussion of the findings, as well as suggestions for further study. Appendix A includes the survey instruments and Appendix B contains lists of the respondents.

This report also features references and a bibliography about CASD. A glossary of terms and acronyms is also provided.

CHAPTER TWO

REVIEW OF THE LITERATURE

Research into ways in which technology can enhance mobility, accessibility, reliability, productivity, and overall quality of service in passenger transportation has proliferated over the past decade in the United States and elsewhere. Spurred on through resources provided by the FTA, state transportation agencies, and university research centers, the search for new tools and innovative technologies and the means to successfully integrate them into transportation management processes has become known variously as applications of advanced technologies in transportation, or simply as intelligent transportation systems.

Although there have been several management and organizational studies of the many nonautomated DRT system elements required for effective DRT system performance, this section focuses on research that pertains to the use of computers for scheduling, dispatching, and related functions.

EARLY STUDIES ON COMPUTER-AIDED SCHEDULING AND DISPATCH TECHNOLOGY

In 1991, the FTA Office of Research, Training and Rural Transportation is said to have introduced the concept of the "mobility manager" (*7*). The mobility manager "is a central agent who not only can provide one-stop shopping for transportation information, such as schedules and fares, but also can make real-time reservations for a person while on the phone." Furthermore, the mobility manager was also designed to handle the fare collection for the passenger, process payments to various operators, and generate bills to agencies or companies that subsidize the trips.

Among the most important advantages of the mobility manager are (1) access by telephone or through a computer network to a single contact point (e.g., the provider's dispatching system); and (2) for social service agencies and other providers of shared-ride transportation, simplified user access and eligibility validations, documentation of all passenger trips, a financial clearinghouse to reduce administrative overhead, and improved advanced scheduling and real-time dispatch response.

The International Taxicab and Livery Association itself sponsored a study of the mobility manager concept (*8*). That research envisioned general public transportation being offered by taxis, paratransit operators, buses, private shuttles, commuter and light rail lines, and other modes—all linked through a single computer network.

This endeavor would all become a reality, researchers in the early 1990s argued, with the implementation of a wide variety of intelligent transportation systems technologies, including vastly improved communications, computer software and hardware, control technologies, and a more abundant, quicker exchange of data.

In 1998, the Grand Rapids (Michigan) Area Transit Authority created an Office of Mobility Management (*9*). All paratransit services (management, travel assessment, eligibility certification, and reservations) were consolidated under that office. Among the agency's goals in implementing this concept were to provide for a more active elderly and disabled population, improve public perception by providing a comprehensive menu of mobility options, and lower costs through centralized administration of an entire family of community mobility services.

In *Assessment of Computer Dispatch Technology in the Paratransit Industry* (*10*), prepared in 1982 for the FTA Office of Technical Assistance and Safety, that report's authors catalogued the state of the art and the current operating capabilities of CASD software in taxi and paratransit scheduling and dispatch, reviewed the technologies available to improve hardware and software, and recommended future technological directions for computer-aided dispatch. However, they maintained that these changes would have only a marginal impact on the mobility of a community, for the ultimate goal should be to offer the general public and ADA passengers the opportunity for shared-ride, immediate response service.

The research, which largely involved interviews with taxi companies, concluded that "taxi companies that transitioned from voice dispatch or computer-assisted dispatch to fully-computerized dispatch have experienced a reduction in personnel costs, greater customer satisfaction, increased ridership, faster response times, and an overall more efficient operation" (*10*). Automation also facilitated the generation of reports and more accurate record keeping, as well as reduced personnel and fuel costs.

For taxi companies in particular computerization was leading to the elimination of advance reservations requirements, for the passengers ultimately would be able to access the reservations system directly (i.e., they would not have to call the transportation provider), eliminating the need even for a telephone call and removing many impediments to transit usage. This would be the beginning of

real-time, shared-ride taxi services operating in a dynamic dispatching mode.

Those authors also studied paratransit operators and management companies, and found that paratransit scheduling was much more complex than for other services, given the special needs of passengers, specialized training requirements for drivers, and care that had to be taken in grouping passengers. Thus, unlike with the application of automation for taxi passengers, specialized software still had to be developed for ADA paratransit DRT services.

In 1991, a transit management and consulting firm assessed computer dispatch software for paratransit (*11*) and found that the most critical features of such software involved the accuracy and consistency of the geodata file, as well as the strength of the methodology used to match trip demand with vehicle capacity. The firm evaluated virtually all of the software that was being marketed at the time, tabulating the features and weaknesses of each.

Although all of the software packages that the firm examined contained records and billing modules, the study concluded that these features needed to be more flexible, and that many of the packages did not feature information from a passenger certification database. Fully computerized scheduling and dispatching, including automation of all databases and record keeping, was still in the developmental stage.

It was not long, however, before there were many companies offering more comprehensive software packages to meet some of the needs as mentioned. Decisions about automating a particular DRT system's scheduling and dispatching functions became more complex, for the features and capabilities varied greatly from vendor to vendor.

Moreover, many of the software products developed were suitable for taxi operations, but they did not entirely meet the requirements for ADA-compliant DRT operations. To address some of the confusion about how the transit community should procure and implement such systems, TRB sponsored research into software requirements for DRT. Known as TCRP Project A-6, that study was subsequently published in 1996 as *TCRP Report 18: A Handbook for Acquiring Demand-Responsive Transit Software* (*3*).

This study was designed to assist DRT providers with assessing software needs for automating DRT management and operations functions, assist in procuring software to meet those needs, and develop software specifications for each of the functions.

The handbook remains a virtual textbook and basic "primer" for practitioners in improving the implementation of CASD software in DRT services. It provides a history of DRT service and describes how it works. It discusses software in great detail (e.g., types and features of software, status of software use, specialty software, nature of the DRT software market), includes a tutorial on computer hardware, and describes the then existing state of the art based on a survey of DRT providers and experts in the field.

In that handbook, the case for automation was set forth, including an analysis of the benefits. An approach for deciding whether and how much computerization is worth doing was presented. One of the most important chapters provides a step-by-step guide to acquiring DRT software. That section details the principles of competitive procurement and discusses the subject of contract service providers. Finally, that study's authors offer a description of implementation tasks and issues.

Much useful information was provided in that study's appendixes, such as sample Requests for Proposals (RFPs), descriptions of software features, a comprehensive glossary of terms, and a vendor directory. The handbook describes in detail the tasks for the procurement of DRT software, discusses proposal evaluation criteria, and offers the following principles of software procurement:

- Provide complete and unambiguous information concerning software needs to each candidate vendor.
- Request and obtain the same set of information from each candidate vendor.
- Allow vendors to exercise creativity in meeting your needs, when appropriate, by specifying what needs to be done rather than how it should be done.
- Describe the selection process and timeline to the vendors.
- Explain the criteria for evaluating the proposals to the vendors.
- Consult with all persons in your organization who will interact with the software product.
- Specify requirements that do not favor any vendor except for reasons that pertain to their product and services.

For readers who are looking for a checklist of implementation issues and problems to be aware of, the handbook suggests the following:

- Implementation takes time.
- The skills of the DRT staff may need to be upgraded.
- Software needs to be thoroughly tested.
- Software and hardware need to be coordinated.
- Transferring data from the old system to the new one is a critical step.
- Setting of parameters (average speeds on different road links, under different conditions, and accurate mapping of the service area) may be a pitfall.

- Training on the new system should take place at the agency's site, and incentives for active participation by reluctant employees may need to be provided

A methodology for assessing the technology needs for paratransit operations in small urban and rural transit systems was developed in 2002 by Rieck for the state of Iowa (*12*). The research offers guidance in approaching initial assessments and presents a point system that would dictate to which of four technology profile levels a paratransit system would be assigned. Points are awarded for annual budget, percent of contract revenue, fleet size, service area (number of counties), complexity of reporting required, method of assigning drivers and vehicles, and level of paratransit service. The more points assigned, the higher the technology level.

According to Rieck, the six factors that most affect performance are

1. Prescheduling format;
2. Type of trip;
3. Eligibility;
4. Fleet-to-user density;
5. Service cost or contract rate; and
6. Service concept, such as dividing service areas into sectors and assigning and parking out vehicles in those sectors.

MEASURING EFFECTIVENESS OF COMPUTER-AIDED SCHEDULING AND DISPATCH SYSTEMS

There are many variables that affect the performance of DRT systems, and so there have been very few before-and-after studies that have isolated the impact of CASD deployment. Dessouky et al. (*2*) developed mathematical models to evaluate the impact of implemented technologies and practices on productivity and operating costs. They concluded that CASD systems produce a productivity benefit in terms of an annual increase in the number of passenger miles per vehicle that could be operated. When examining the operating expense per passenger trip, however, they concluded that "there is no corresponding cost impact." In other words, there were other costs that offset the expected benefits from productivity improvement.

The effectiveness of CASD in paratransit has been studied by Pagano and associates at the University of Illinois at Chicago (*13*). The objective of their 2001 nationwide survey was to "gain insights into the processes used, problems encountered and benefits and costs experienced in implementing computer-assisted scheduling and dispatching systems."

Because that study closely parallels the work contained in this synthesis, the major findings by Pagano et al. (*13*) are summarized as follows:

- Fully one-half of the operators did not use major features of their new CASD systems. Importantly, most operators do not use one of the most lauded features, optimization.
- Operators noted gains in efficiency, effectiveness, and quality, with some reporting significant changes, but on the whole, pre- and post-implementation comparisons did not show the kind of dramatic efficiency changes that operators have hoped for.
- Training issues were significant and have seriously degraded potential positive impacts at most sites.
- The survey indicated that no vendor had provided satisfactory report generation capabilities or the training required to create and interpret the report output.
- Operators were strongly in favor of adding a dedicated project manager to the CASD system implementation process.
- Overall, the implementation of CASD systems was positively welcomed, but few operators were able or willing to fully exploit the power of CASD technology.

In explaining the last finding, Pagano et al. (*13*) noted that both policy and personnel issues limit full implementation of CASD systems. They cited as an example the policy of some agencies to contract out services to existing paratransit operators, who use agency-leased vehicles to support service for targeted populations. Because the contractors cannot serve other clients by using those agency vehicles, the full power of CASD to optimize schedules is not being utilized.

In another approach to learning about the impact of CASD, the same group of University of Chicago researchers followed up their effectiveness study with a before-and-after evaluation of service quality for a conversion from a manual system to automated operations in Peoria, Illinois (*14*). The study concluded that "passengers experienced greater on-time rates at both pick-up and drop-off, overall satisfaction with the service increased, and customer reporting of ride denials was reduced."

On the other hand, they noted that "the use of CASD to promote higher vehicle productivity resulted in slightly longer ride times." This confirmed an earlier finding by Kikuchi (*15*), who noted that there is a trade-off that must be considered when attempting to optimize paratransit travel: the more customers who are added to a vehicle (through effective use of CASD), the greater is the efficiency, but also the greater are the passenger ride times. Thus, the quality of service ultimately is diminished. Nonetheless, Pagano et al. (*14*) concluded that CASD systems can increase service quality as well as the efficiency and effectiveness of DRT systems.

More recently, Pagano and a staff of researchers and investigators completed a statewide multiyear strategic plan

for CASD for the Illinois Department of Transportation (DOT) (*6*). The plan mapped out approaches for implementing CASD systems in DRT agencies in Illinois. The planning took into account the needs of different sized agencies, as well as a methodology for using CASD to facilitate coordination in brokerage operations.

Their report is very likely the most comprehensive study of CASD implementation completed in the United States as of this date. The researchers studied programs for CASD implementation in 36 states, asking questions about benefits, planning stage problems, administrative obstacles, software issues, and operator issues. They surveyed seven representative software vendors.

Although the conclusions and recommendations pertain particularly to the state of Illinois, the report contains much useful information about "lessons learned" from earlier implementations of CASD systems. For example, Pagano et al. (*14*) reiterated the importance of Kikuchi's lessons learned from an evaluation of the Delaware paratransit system in 1988:

- Define objectives and purposes first.
- Define rules and guidelines clearly.
- Reduce cost and improve efficiency.
- Know that accurate historical data, especially travel time data, are essential for setting parameters.
- Take precautions against breakdowns.
- Direct management involvement is essential.
- Recognize that dispatchers and management must know how the model works, including its shortcomings.
- Consider management data needs as well as hardware compatibility.
- Continue the hunt for cost-saving measures.

Ned Einstein, a researcher who conducted some of the first studies of special paratransit services for the U.S.DOT (1978–1980), has concluded, somewhat counterintuitively, that the substitution of computerized for manual scheduling and dispatching has not improved performance noticeably (*16*).

This is not an argument against computerization, he notes, for it is practically essential in most large service areas. Maintaining that "No field of public transportation is as saturated with mythology as is paratransit service," Einstein argued that a software program is only marginally better than a competent scheduler or dispatcher. Therefore, he would focus efforts to improve performance and efficiency elsewhere, on factors that really matter. Among those he cited are the following:

- Continually optimizing prescheduled (subscription) trips;
- Group trips that are not time dependent;
- Eligibility;
- A "thick" fleet and user density, which yields higher performance;
- Differentiating fares based on zonal structures; and
- Deployment of vehicles in time and space.

One area that is beginning to be examined is the effect that DRT staffs have on successful implementation of CASD systems. For example, Schweiger and McGrane (*17*) found that increased worker stress and lower job satisfaction often accompany the implementation of new technologies, including CASD systems. They found that operating employees have a wide variety of responsibilities and thus it is difficult for them to maintain a technical focus. Those authors recommended new ways of managing implementation of new technologies to prevent stressing employees beyond reasonable expectations.

SIMULATION AND MODELING OF TRAFFIC NETWORKS AND REAL-TIME VEHICLE SCHEDULING AND DISPATCHING

A relatively recent focus of research involves the use of simulation as a comprehensive tool for urban traffic network analysis and real-time scheduling of vehicle fleets (among them, DRT fleets). To the average administrator of a DRT system, those kinds of research are no doubt very esoteric, requiring as they do a background in statistical modeling or operations research for practitioners to understand them. However, a review of several recent technical papers should underscore how important critical components of the CASD software are to DRT system performance, namely the caliber of the software package's scheduling algorithm and the degree to which the CASD parameters (e.g., average travel speed) reflect the real-time urban traffic network conditions at any time.

For example, improved computational capabilities are beginning to make simulation of DRT systems (i.e., scheduling DRT vehicles) in conjunction with analysis of urban traffic networks a viable design option for a DRT service. One such modeling scheme has been proposed by researchers at the University of California (*18*). According to those authors, for any kind of flexible, real-time, reroutable system (e.g., DRT), "it will be possible to model optimal routing algorithms which may be based on the individual vehicle's position, passenger calls/requests, and real-time traffic conditions. Once a DRT request enters the system, a routing and scheduling routine takes over and computes the best service option, based on a set of rules that are updated in real-time using historical system information through the 'network condition update' module."

If one views a framework controlled by today's state of the art, these kinds of solutions to scheduling and dispatching challenges may appear "futuristic." On the other hand,

as the capabilities of computer hardware forge ahead, and to the extent that urban areas can use advances in computational power to capture and simulate urban traffic networks, such techniques for real-time schedules may be in the offing, perhaps only a few years away.

Two researchers, Liping Fu of the University of Waterloo and Stan Teply of the University of Alberta, recognized that most paratransit systems have not taken into account the dynamic and stochastic variations in travel times in urban traffic environments (*19*). Indeed, current scheduling algorithms are based on the assumption of constant travel times from day to day for a particular time of day and geographic area. Fu and Teply proved that under this approach a high percentage of passengers are not picked up or dropped off during their desired pickup time windows.

Such variations in travel times, typically owing to random fluctuations in travel demands, interruptions of traffic controls, and unpredictable occurrences of traffic incidents, inevitably have an impact on the scheduling reliability and system productivity. Fu and Teply used "artificial neural network techniques" to heuristically estimate origin–destination times in a "dynamic and stochastic fashion" (*19*). Testing of their model on a real-world scheduling problem in Edmonton, Alberta, proved that the reliability and productivity of the schedules could be improved over current approaches in which the scheduling algorithms are based on the assumption of constant travel times.

In many respects, notwithstanding technological advances, these concepts are still Utopian more than a decade later. The vast majority of shared-ride, DRT services continues to require advance reservations and to produce vehicle manifests and passenger pickup and drop-off schedules in advance. Also, although dynamic dispatch control of vehicles and schedules has improved markedly as a result of advances in software, inefficiencies still remain (e.g., passenger no-show rates are still unacceptably high), most scheduling systems continue to experience problems with schedule adherence, and errors in databases or in data inputs and exchanges plague many DRT services.

AUTONOMOUS DIAL-A-RIDE TRANSIT TECHNOLOGY

One researcher has conducted an ongoing experiment with ADART. This concept, conceived at the John A. Volpe National Transportation Systems Center, includes the development and coordination of navigation, communication, routing, and scheduling technologies to produce a much higher level of automation for dial-a-ride and DRT (*20*). According to staff at the Volpe Center, the ADART fleet covers a large service area without any centralized supervision: "Like an army of ants, the vehicles accomplish their tasks with no one in charge."

As the Volpe Center analysts see it, the revolutionary concept of no one in charge eliminates the technical inefficiency of conventional dial-a-ride, which would otherwise result from centralized and manually operated control centers. Instead, ADART consolidates trip requests, scheduling, fare collection, and vehicle routing into a single automated system. Here is how it works, as described by the Volpe Center analysts (*21*):

> Registered users simply call the on-board vehicle computer and enter their location and destination via a touch-tone keypad; the ADART system then develops an itinerary and states a pick-up and destination arrival time. When the vehicle reaches that point in the itinerary, the on-board computer displays the address and directions for quick reference by the driver. Because new users must identify a payment method when they register, there is no need for on-board fare collection.

With funds from the FTA and assistance from the Volpe Center, the Regional Transportation Authority (RTA) of Corpus Christi, Texas, has been implementing such an ADART system in phases. The tests thus far have been successful, and the RTA has announced that it is ready to move from Phase Two, in which the on-board computers of two transit vehicles driving the streets of Corpus Christi "talk" to each other, to Phase Three, in which 12 vehicles constitute the system.

The RTA project, successfully tested at each step, has evidently generated wide interest among transit providers. It is said to show genuine promise for improving service and reducing costs. Therefore, transit professionals responsible for providing DRT services might watch for progress reports about that project.

Readers should be aware of the Volpe Center's comprehensive report in June 2003 cataloguing the existing and planning deployments of Advanced Public Transportation Systems technologies and services in the United States as of 2002 (*22*). Besides the deployments of CASD systems, the report covered advanced communications systems, automatic vehicle location (AVL) systems, automated operations software, automated transit information systems, and other aspects. Transit agencies in the 78 largest metropolitan areas provided data for that report.

Until advanced technologies such as ADART are proven feasible, transit agencies and other service providers will continue to focus on resolving obstacles to successful implementation of currently available software and communications.

CHAPTER THREE

PROFILES OF RESPONDENTS

This chapter presents the service characteristics and CASD experiences of the 21 public transit agencies that constitute the survey sample for this synthesis. There are several different approaches that agencies have used to deploy their CASD systems to fit particular service delivery models. They include performing the major DRT functions: operating reservations, scheduling trips, and dispatching and delivering the trips—with private or nonprofit contractors, with in-house staff, or with combinations of in-house staff and outside contractors.

AMOUNT OF SERVICE OPERATED AND NUMBER OF REGISTRANTS

The average number of passenger trips operated by the responding agencies, including in-house, dedicated contract service, and nondedicated contract service, is shown in Table 3. Consistent with what is shown by national trends, the large agencies prefer to use dedicated contract service providers or a combination of dedicated in-house and dedicated contract operations. Medium-sized and small agencies tend to operate their services with in-house staff.

For those large agencies responding, the average number of individuals registered to use DRT and paratransit services was 17,920, whereas the number for medium-sized agencies was 5,533. Table 4 shows the average fleet sizes. The survey responses indicate that most large agencies own their fleets, whether they operate in-house or by means of dedicated contract service. The large number of ambulatory vans in agency fleets, compared with the number of wheelchair-equipped vehicles, potentially introduces complexities in scheduling, for care must be taken in the design of the software to distinguish whether a particular passenger requires a wheelchair vehicle or not, and whether the vehicle manifest for an ambulatory van includes wheelchair passengers or not.

TYPES OF SERVICE

All of the agencies surveyed operate ADA paratransit (see Figure 1). Five large agencies and one medium-sized agency also include non-ADA-eligible disabled passengers in their DRT services. One large agency operates trips for social service agencies in addition to operating paratransit

TABLE 3
AVERAGE NUMBER OF PASSENGER TRIPS OPERATED AND PROJECTED, 2003

Travel Agency Size (no. responding)	In-House	Dedicated Contract Service	Nondedicated Contract Service
Large agencies (14)	292,662	948,609	244,744
Medium-sized agencies (4)	115,410	70,263	60,170
Small/rural (1)	59,565		

(N = 19).

TABLE 4
NUMBER OF DRT VEHICLES IN DAILY MAXIMUM SERVICE AS OF DECEMBER 2003

	Average Fleet Sizes of Respondent Agencies		
Agencies	Total	In-House	Dedicated Contract Service
Large (N = 14)			
W/C-equipped	241	79	162
Ambulatory van	172	11	161
Sedans	70	24	46
Medium-sized (N = 5)			
W/C-equipped	66	42	24
Ambulatory van	3	3	
Sedans			
Small/rural (N = 2)			
W/C-equipped	17	17	
Ambulatory van	5	5	
Sedans	2	2	

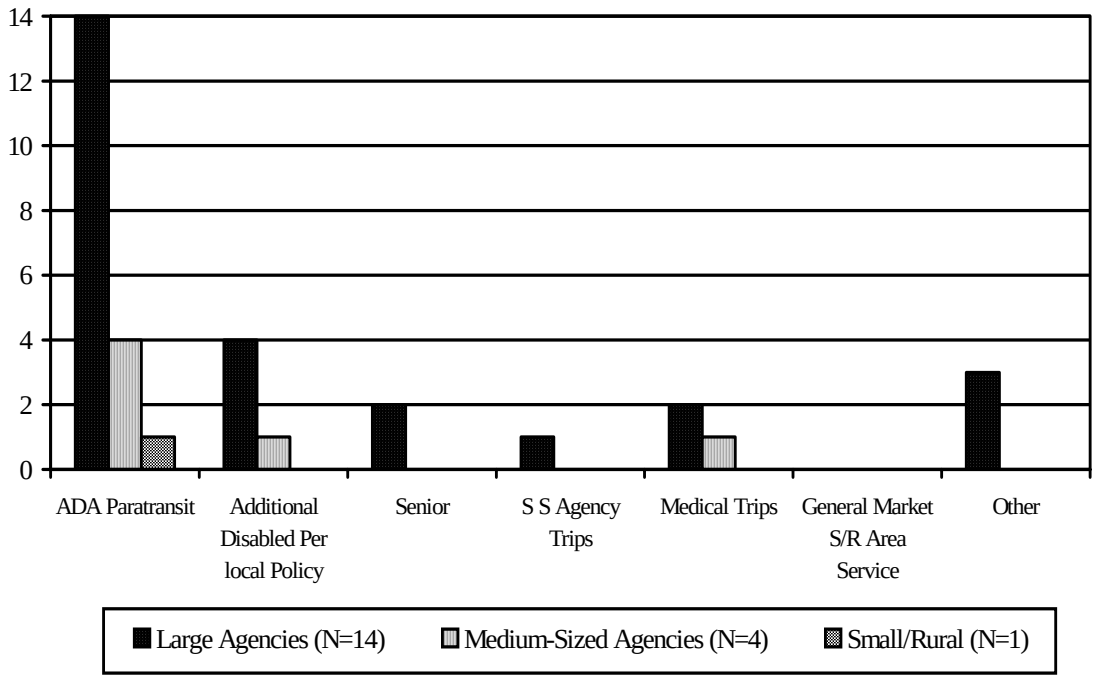


FIGURE 1 Types of CASD service. (SS = social service; S/R = small/rural.)

service, and 3 of the 21 agencies provide medical trips as well. Two agencies, the Southeastern Pennsylvania Transportation Authority, in Philadelphia, and Pace Suburban Bus, in Arlington Heights, Illinois, also operate services for seniors (age 65 and older) who are not ADA eligible.

SERVICE DELIVERY MODELS

The profile of transit agency respondents shows that more than one-half of the large agencies prefer to contract with private carriers for operation of DRT service. The responses indicate that 58% of the large agencies use contract carriers to provide their service, 7% operate in-house only, 8% use both in-house and contract carriers, and 8% use brokers in addition to in-house and contract carriers. Another 15% of the agencies have a mix of in-house, contractor, and taxi service. The remaining 7% use either contractors or taxi companies. Fifty percent of the medium-sized agencies operate service in-house, whereas the rest use combinations of in-house, contract, and taxi companies.

However, fewer large agencies opt for contracting out of their reservations and customer service centers, preferring to control this function through in-house staff. The responses indicate that 43% of the large agencies rely on in-house staff to operate reservations centers, whereas only 29% assign this function to contractors.

One reason for this situation may be found in TRB *Special Report 258: Contracting for Bus and Demand Responsive Transit Services* (*5*). That study found that the greatest negative effect of contracting, as indicated by general managers of transit agencies, was limited control over contractor services. Because the reservations center is the principal function for direct interaction with all customers, the desire to have more control over that operation could explain why large agencies prefer to perform reservations in-house. In many respects, this is evidently the most sensitive function of all in the DRT system, for reservationists have to interact with customers on a variety of issues.

Schedules are completely developed in-house by 29% of the large agencies, whereas 36% use service contractors. For both reservations and scheduling the remaining agencies use combinations of in-house and contractor scheduling. Three-fourths of the medium-sized agencies perform scheduling in-house.

VIA Metro Transit in San Antonio, Texas, and the New Jersey Transit Corporation (NJ Transit) both create initial schedules in-house and send them to service contractors for final adjustments. King County in Seattle contracts out its reservations and scheduling center activities. Same-day requests are fulfilled by 11 of the 19 agencies responding.

With respect to dispatching (monitoring and controlling service), 21% of the large agencies do that in-house and 44% use service contractors (see Figure 2). The remainder use combinations of the two methods. In-house dispatching is used by 50% of the medium-sized agencies

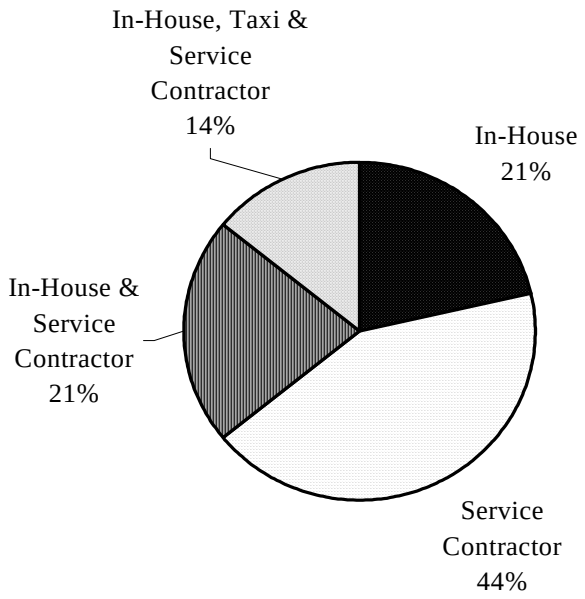


FIGURE 2 Dispatch and service control model (large agencies, *N* = 14).

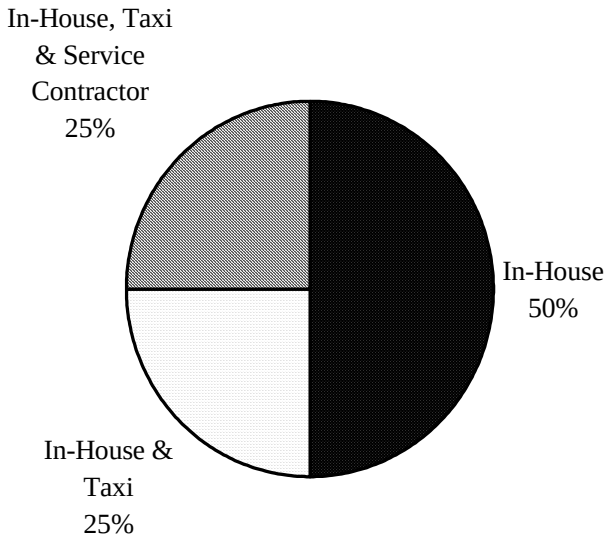


FIGURE 3 Dispatch and service control model (medium-sized agencies, *N* = 4).

and combinations of in-house capability and contractors and taxi companies are used by the remaining 50% (see Figure 3).

PAYMENT FOR TRIPS

Large agencies that use contractors predominantly pay for trips based on revenue service hours (11 of 14). One of them, LA Access Services, Inc., in Los Angeles, uses all three methods, depending on the type of contract and type of service delivery. The medium-sized agencies are split among three methods in their handling of payments: per passenger mile, per trip, and per revenue service hour.

EXPERIENCE WITH COMPUTER-AIDED SCHEDULING AND DISPATCH SOFTWARE

All of the large and medium-sized agencies have used more than one model or brand of CASD software. Three agencies, Utah Transit Authority, Houston's Metropolitan Transit Authority (MTA) of Harris County, and the Delaware Transit Corporation, have had experience in imple-

menting four new upgrades. One-half of the agencies responding began using CASD software after 1994. Four of the large agencies began using CASD software in the 1980s. Eight of the agencies reporting are currently using software purchased in 2000 or later.

At the time of the initial survey, the Charlotte Area Transit System (CATS) was operating the oldest system (begun in 1993). CATS implemented an entirely new CASD system in February 2004; its experience is discussed in depth as a case study in chapter six.

REASONS FOR UPGRADING FROM PREVIOUS SYSTEM

As shown in Figure 4, the most common reasons cited for upgrading or implementing a new system were to keep up with growth in demand, to improve scheduling and dispatching (including the production of optimized schedules in a timely manner), and to improve productivity. Other reasons included the need to upgrade to the Windows operating system, to better manage trip-by-trip eligibility, to supersede software owned by a service contractor, and to replace a vendor that no longer supported the version of its software being operated by the agency

FEATURES OF COMPUTER-AIDED SCHEDULING AND DISPATCH SYSTEMS

All of the agencies reported that they were operating full-featured systems that are, with two exceptions, capable of providing manifests and billing for multiple service providers. Figure 5 depicts the functionalities of their current CASD systems.

Of the 20 agencies that were asked whether they believed their current systems could handle projected demand, 14 said they were satisfied they could handle future demand, whereas 6 indicated they were not satisfied with the growth potential for their current CASD systems. Two of the six agencies that were concerned about future demand stated that they were planning to upgrade their DOS-based systems in 2004.

COST OF INSTALLATION AND MAINTENANCE

Only 2 of 20 agencies found that the installation costs exceeded their budgets. However, 5 of 20 found that the annual maintenance costs exceeded their budget expectations, particularly for the Windows operating environment. One

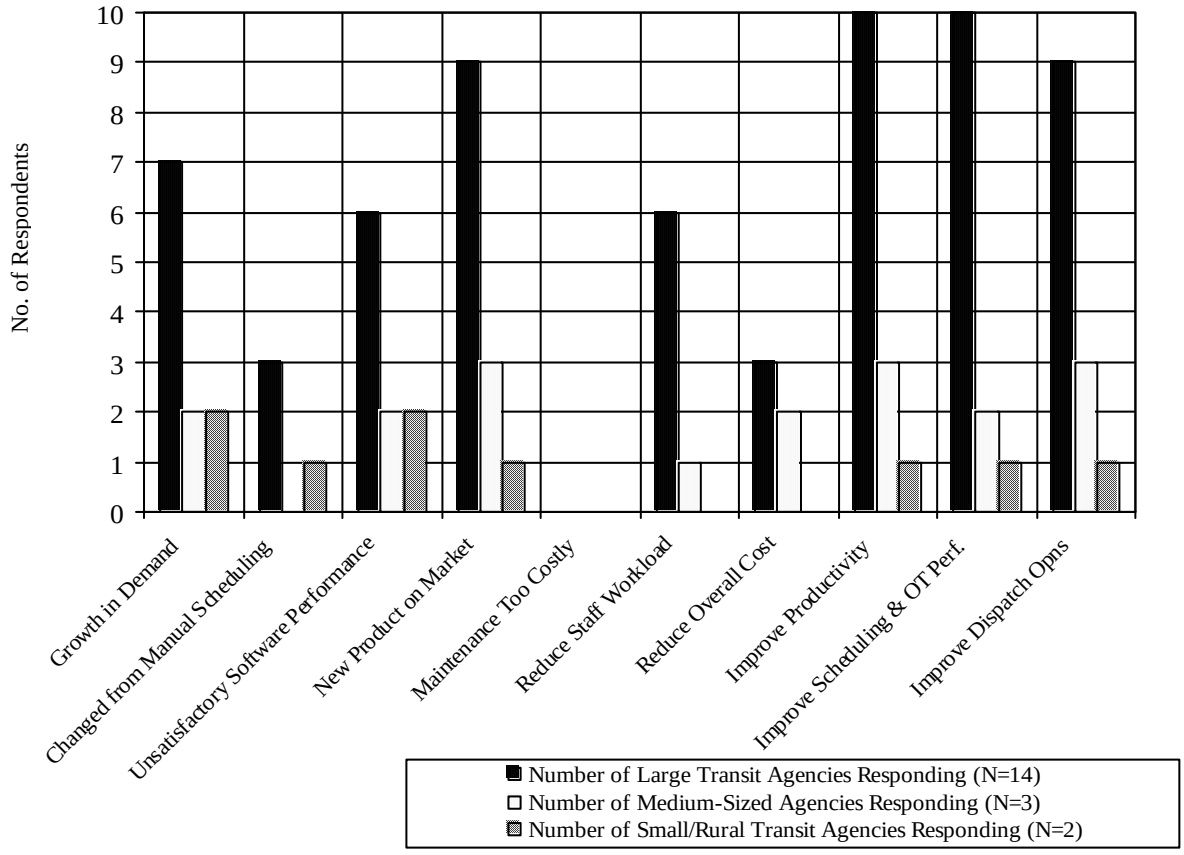


FIGURE 4 Reasons for acquiring a new system.

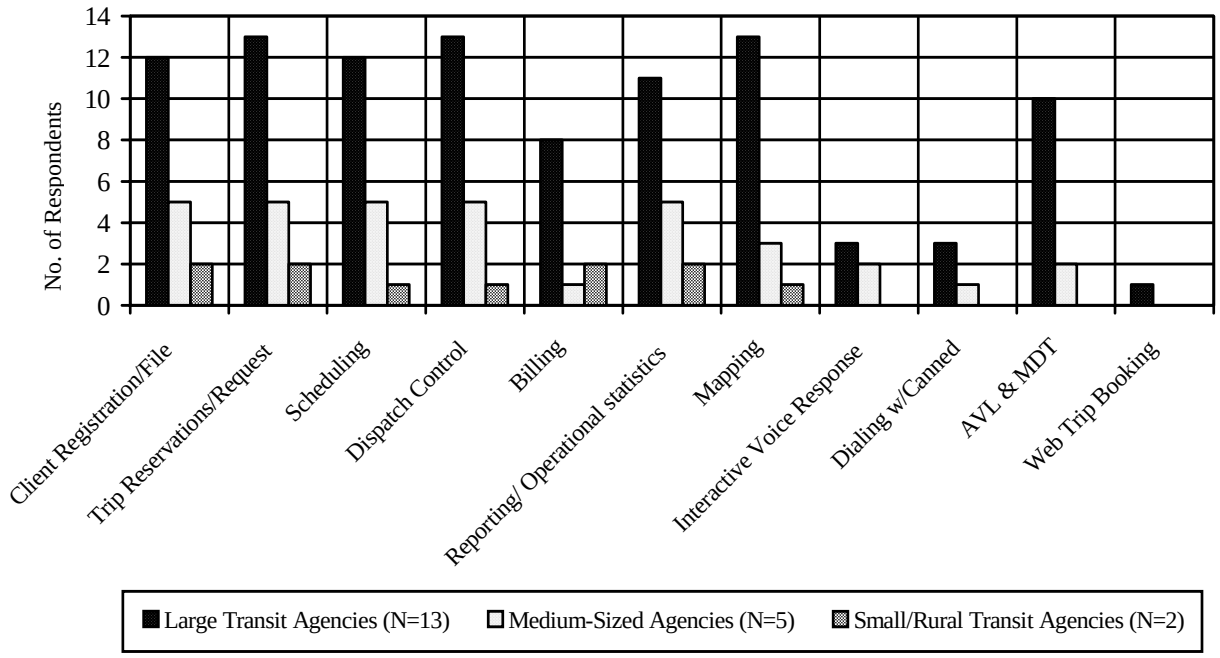


FIGURE 5 Functionalities of current CASD system.

of the maintenance budget overruns stemmed from an erroneous assumption that the cost of training was included in the vendor's original proposal, when it was not. Another agency exceeded its maintenance budget owing to unanticipated costs associated with an AVL system that was packaged with its CASD software.

Most of the agencies have full-time, in-house information technology (IT) staffs assigned for systems maintenance involving hardware issues, applications software other than DRT software, and administrative systems. It was found that brokers and/or service contractors also have dedicated IT staffs for CASD system maintenance in most installations.

SUMMARY

Of the 75 largest transit agencies providing DRT service in the United States, 14 are represented in this survey. Most enter into contracts with private transportation companies that directly deliver service to customers in accordance with their trip requests. Many of the private contractors also perform dispatching and scheduling of trips but, according to survey results, in nearly as many cases, large agencies prepare the schedules by using in-house staff and transmit those schedules to the contractors who operate them. Whether schedules are prepared by the agency itself or by the service provider, a CASD system procured by the agency is used.

The responding agencies develop schedules for large vehicle fleets. As of 2004, they have deployed more than one brand and/or more than one generation of CASD software. Their staff members have had ample experience with CASD software. New software systems were implemented by transit agencies primarily to address issues such as growth in demand for service and to boost scheduling and dispatching performance.

The agencies reported that they were operating full-featured systems that could handle all of their reporting and billing requirements, in addition to supporting the principal DRT scheduling and dispatching functions. Only eight agencies reported purchasing new software in 2000 or later and, as a consequence, some of the agencies with older systems are concerned about whether future demand can be accommodated. Few agencies reported any significant cost overrun problems for the purchase of hardware, software, and system maintenance.

CHAPTER FOUR

EXPERIENCES IN IMPLEMENTING AND USING COMPUTER-AIDED SCHEDULING AND DISPATCH SYSTEMS SOFTWARE

Transit agency experiences in implementing and using CASD software are discussed in this chapter. The operating impacts of decisions made during the procurement, testing, and training phases of implementation are explored. Reasons for success or lack of success are documented. Finally, a detailed performance evaluation of CASD software features is presented, focusing on those areas in which the software did not perform according to transit agency expectations.

IDENTIFYING AVAILABLE SOFTWARE PRODUCTS

Analyses of the survey data revealed how agencies identify the various software products that may be suitable for their operations. Most agencies relied on information furnished through APTA or by word of mouth from other agencies (see Figure 6). A number of agencies cited transit exhibitions and the software vendors themselves as primary sources. One started the process by requesting information from all companies identified as having products for paratransit scheduling.

The majority of agencies surveyed believed that it was very important or somewhat important to have independent professional advice on the selection of CASD software. Only one agency, NJ Transit, reported employing an outside consultant for this purpose.

PROCUREMENT PROCESS

Of the agencies that described their procurement processes, eight used the Request for Proposal (RFP) process, nine negotiated a contract with a single source, and one small agency used a low-bid procurement process. Five agencies also included customized specifications in their requests for bids.

Only three agencies used the specifications and needs analysis submitted by software vendors in their bid specifications. The King County DOT, in Seattle, hired a consultant to undertake a business analysis and to develop specifications for its mobile data computers (MDCs). The rest developed their specifications independently in-house.

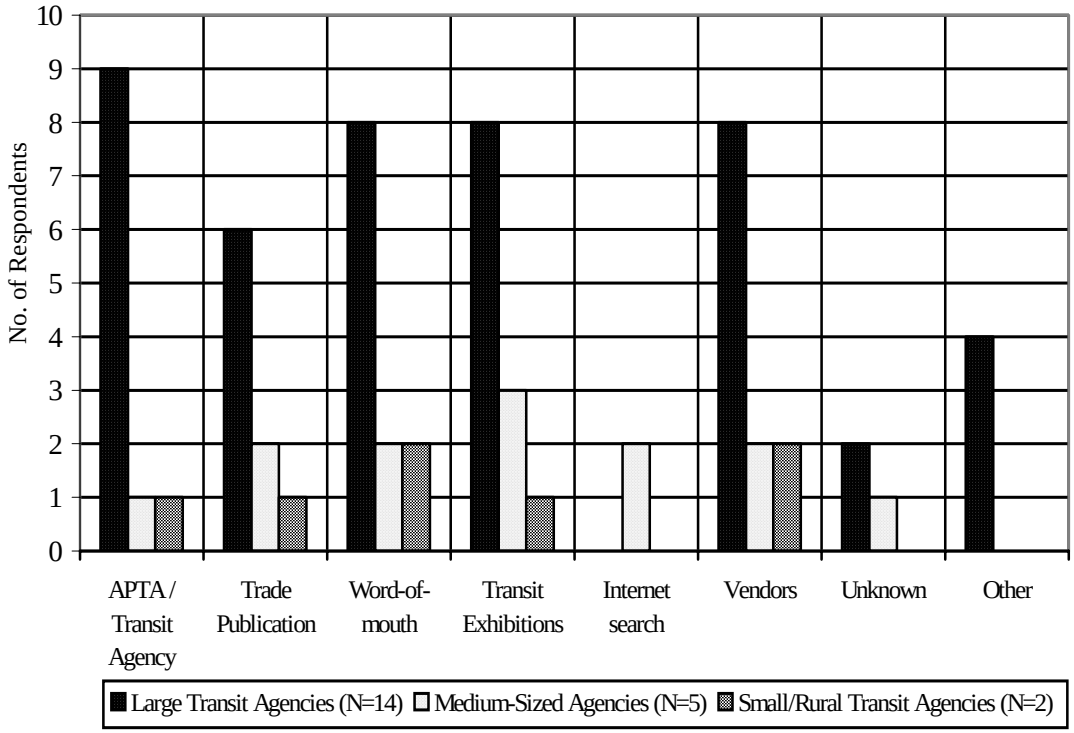


FIGURE 6 Sources of software products.

Virtually all of the agencies required on-site demonstrations of the software, and they completed reference checks of the vendors. Eight agencies required demonstrations with the use of the agency's own data.

One agency commented that it is very important that a series of meetings be held with software vendors to finalize system specifications. That agency also reported that visits to installed sites at other agencies should take place only after an orientation of the vendor's system is provided. Another agency indicated that it will definitely seek outside consultant support for its next software procurement, primarily because of the need to analyze agency requirements and to develop specifications accordingly.

Here is how one agency described its overall experience:

> Our initial installation of a product came with no prior computer experience on the part of our staff and the contractor's staff. Therefore, the introduction of a sophisticated scheduling system was overwhelming. By the time we purchased an upgraded product recently, all of those initial user issues had gone away. In the beginning, we did not really know all of the features we needed or would require at the front end. As we tried to acquire them over time, it became a difficult, almost impossible task to integrate all of the features. We recommend that you know what you need upfront, including every functional detail. This approach will ensure that the CASD system will meet the agency's objectives, including handling multiple contractors, multiple funding types, and multiple fare categories and trip types.

IMPLEMENTATION PLANNING

All of the agencies managed the implementation process themselves. Five of the largest agencies performed an extensive study of the process and they developed a detailed plan with a timetable. Ten others had less extensive plans. Only four left the entire planning effort and timetable up to the software vendor.

The most frequently cited problems in timely implementation were establishing an accurate database, hardware and network problems, and software bugs (see Figure 7). One large agency believed that its vendor was very responsive to resolving the hardware and network issues. However, another agency reported conflicts between its hardware and software vendors over problems, with the two different vendors involved blaming each other. It was difficult for the agency to resolve such differences. One of the respondents emphasized how important it is, early in the procurement cycle, to get accurate information about hardware capabilities and the capacity and flexibility of the hardware to support upgrades and growth.

In some cases, serious problems arose because vendor-proposed software modules had not been fully developed as part of the overall package. One agency labeled the vendor's products as "beta," indicating that the agency believed that the modules had not been adequately tested before installation.

A number of agencies experienced problems in meeting implementation schedules owing to many unexpected software situations. Some agencies set so-called "drop dead" dates to go live, and because their old system was scheduled to be shut down by a certain date, they had to move to the new system before they were ready to do so. Those agencies concluded that their implementation schedules should have allowed enough time for resolving

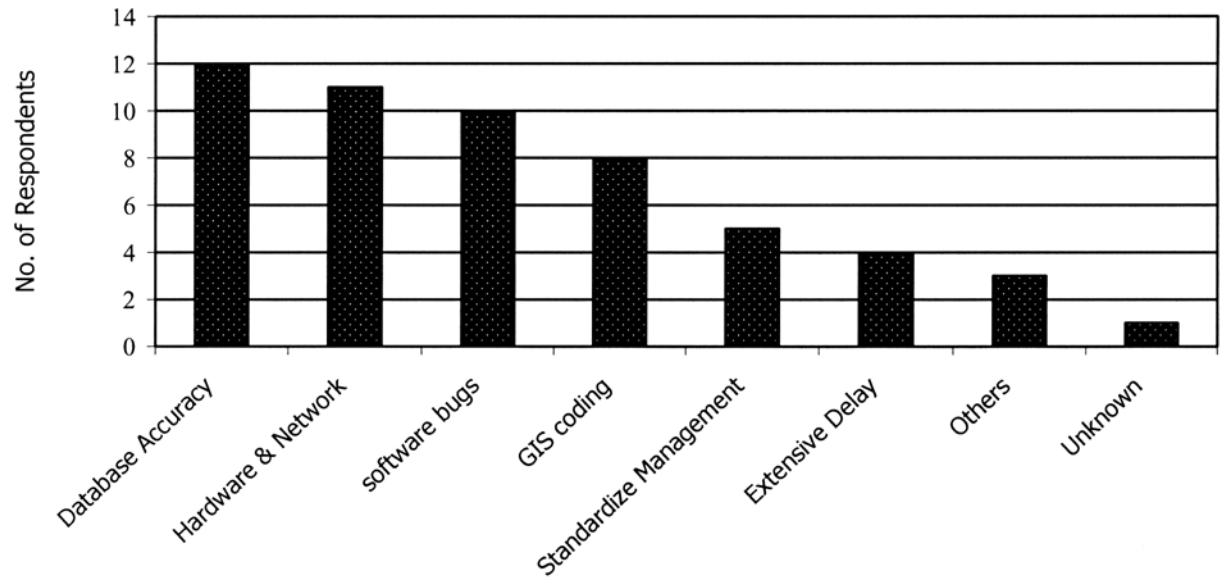


FIGURE 7 Problems that caused delays during implementation ($N = 19$).

unforeseen issues. Agencies that required customized software were the most likely to experience unexpected delays. When agencies in that group found that their customized software was not fully developed and tested, their training schedules were delayed and disrupted and, if they had a drop-dead date to go live, training had to be abbreviated.

One agency's implementation was delayed because its vendor was still developing necessary documentation at the time the new system was to begin being used. Some agencies mentioned that phased implementation might be considered as a "security blanket," suggesting that staff members needed time to gain confidence in the new system. In addition to permitting implementation to proceed only when each phase was successfully completed, agencies believed that such phasing also could promote staff buy-in and increase the effectiveness of training. To avoid delays that might result from inconsistencies between the new system and an agency's internal operating procedures, some agencies reported that such matters should be addressed at an early phase of implementation.

Most agencies agreed that it was desirable to give a role to private service contractors in the planning and implementation processes. All reported giving contractors varying degrees of input. One-third of the agencies believed that contractors should participate only after the design and testing phases were completed. Three of the agencies believed that contractors could also advise on operational impacts, help to develop training programs, and participate in testing the system and evaluating results.

Agencies were nearly unanimous in stating their belief that it was very important or somewhat important for a transit agency manager in charge of a CASD installation or upgrade to have had previous experience in implementing CASD.

Most of the agencies were very satisfied or somewhat satisfied with the conversion of their legacy databases to the newly implemented systems. The literature review found that studies of CASD implementation cited that activity as being critical during the implementation phase. Notwithstanding, a number of agencies cautioned against taking the conversion phase too lightly by not leaving enough time for preparation and auditing of data that are transferred to the new system. Respondents specifically emphasized the need to preprepare data through cleansing and scouring, identifying and removing errors and inconsistencies, and having sufficient staff resources to perform manual corrections.

ACCEPTANCE TESTING

Several agencies found that they had difficulty during the testing phase owing to time constraints in their implementation plans. Most of them discovered a number of mostly random software problems after going live, primarily because it was impossible, when performing preliminary testing, to simulate all of the different scenarios that occur during a live day of service. When testing was done in a controlled environment with a limited number of vehicles and/or trips, agencies found that doing so does not replicate the experience of a genuine service day.

One medium-sized agency used its old system until its system users were absolutely certain that the new one was ready. The approach used by a large agency in introducing MDCs in conjunction with a new CASD system was to conduct a "proof of concept," by using the agency's own data in a test environment. Then, the agency followed up with a 30-vehicle test of MDCs in a live environment before accepting the new system.

STAFF TRAINING

The majority of the agencies surveyed indicated that their staffs and their contractor's staffs had some basic familiarity with computers (see Table 5). All of the agencies used vendor personnel to conduct the training programs. One large agency's supervisors were trained to train the staff. A small agency, Tompkins Consolidated Transit, in Ithaca,

TABLE 5
BASIC LEVEL OF COMPUTER FAMILIARITY OF THE AVERAGE AGENCY STAFF MEMBER OR CONTRACTOR STAFF MEMBER USING CASD

	Agency Staff Member			Contractor Staff Member	
Basic Level of Computer Familiarity	Large Transit Agencies (N = 11)	Medium-Sized Agencies (N = 4)	Small/Rural Transit Agencies (N = 3)	Large Transit Agencies (N = 10)	Small/Rural Transit Agencies (N = 1)
Very knowledgeable	2			1	
Somewhat knowledgeable	7	2	2	6	1
Not very knowledgeable	2	2	1	3	
Not knowledgeable					
Don't know					

TABLE 6
AVERAGE NUMBER OF HOURS OF TRAINING

	Hours of Training				
	Agency Staff			Contractor Staff	
Staff Members	Large Transit Agencies (N = 10)	Medium-Sized Agencies (N = 3)	Small/Rural Transit Agencies (N = 2)	Large Transit Agencies (N = 10)	Small/Rural Transit Agencies (N = 2)
Management	27	15	10	11	12
Reservationists	21	16	10	10	
Dispatchers	28	29	10	19	
Schedulers	31	24	10	17	
Administrative personnel	24	13	10	11	12
Technical support personnel	25	16	10	6	

New York, used its in-house expert. Only five of the responding agencies did not have management present during the training sessions to address policy questions.

Schedulers and dispatchers in the large agencies surveyed received the greatest amount of training—an average of 31 h for the former and 28 h for the latter (see Table 6). In medium-sized agencies, dispatchers received more training than did schedulers, possibly because some of the scheduling in those agencies was done by dispatchers. Staff members in the small/rural category received only 10 h of training. Staffs of companies under contract to large agencies received much less training.

Most agencies reported being "somewhat satisfied" with their staff training programs. However, there were a number of agencies that were unhappy with the time allotted for training on their new systems. One agency reported that its staff did not get hands-on training for all software functions and that the vendor was not fully familiar with local policies before conducting the training programs.

That training is a very critical phase in the implementation process was supported by the many comments about the amount of training, as well as its timing. Most agencies would have preferred more time to permit staff members to become familiar with the complexities of their new systems (see Table 7). They found that the basics needed to be reiterated for staffs to "get it," and to attain a "user comfort level." Allowing extra time up front, agencies noted, would pay off in easing the transition to a new system.

TABLE 7
ALLOWED MORE TIME FOR INSTALLATION AND IMPLEMENTATION, INCLUDING TRAINING AND DATA DEVELOPMENT

Transit Agency Size (no. responding)	Allowed More Time for Installation/Implementation
Large agencies (14)	10
Medium-sized agencies (5)	4
Small/rural (1)	1

The respondents recommended that basic training take place away from the worksite to avoid interruptions. However, one agency found that its staff members were required to take too much time away from their regular duties for extensive training, because the system had so many customizations and complicated interfaces with other agency computer applications. Because of time constraints, the staff of another agency did not receive complete knowledge of what their system was capable of before going live. As a result, the staff never fully understood all of the features. Some agencies employed the train-the-trainer approach, which worked well when staff members could not be spared for group training sessions.

The timing of the training program is critical, according to several respondents. It was suggested that training be concentrated in the period just before going live so that staff members have a fresh knowledge of the system. Such efforts should be augmented with continued, on-site, follow-up training by the vendor. However, agencies need to be aware that additional funds may be necessary for follow-up training.

One agency reported a problem because the vendor did not finish trouble shooting the software before training began. As a result, the training handouts were not ready at the start of training. In addition, brochures and materials pertaining to the features of the software should be written in clear, concise language.

AGENCY AND VENDOR RELATIONSHIPS

Only one agency reported outstanding synergy resulting from agency and vendor interaction during the implementation process (see Figure 8). Another 10 agencies felt that the relationship was somewhat successful. Because eight agencies thought that their relationships with vendors were either only partially successful or not successful at all, indications are that this issue may need to be addressed in the future.

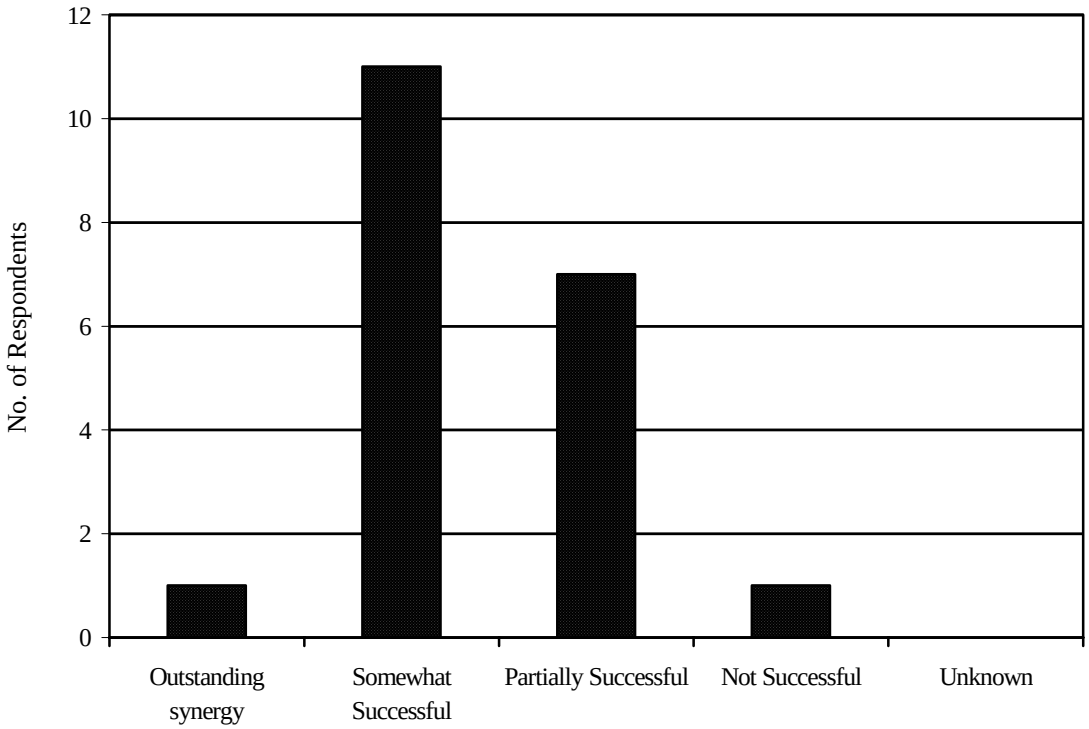


FIGURE 8 Vendor and agency relationships ($N = 20$).

Another area that seemed to merit more attention is that of incorporating agency policies and report design into the overall system design. There were 11 agencies that were completely or somewhat satisfied with the software vendor in this regard, but 10 agencies were not very satisfied.

One large agency used its private call center contractor's staff to design reports, because it found that the vendor's off-the-shelf reports were not very useful. Another large agency had anticipated that its annual maintenance and support fees would cover most minor software adaptations and changes, but learned later that it would be charged for all of them.

PERFORMANCE FEATURES

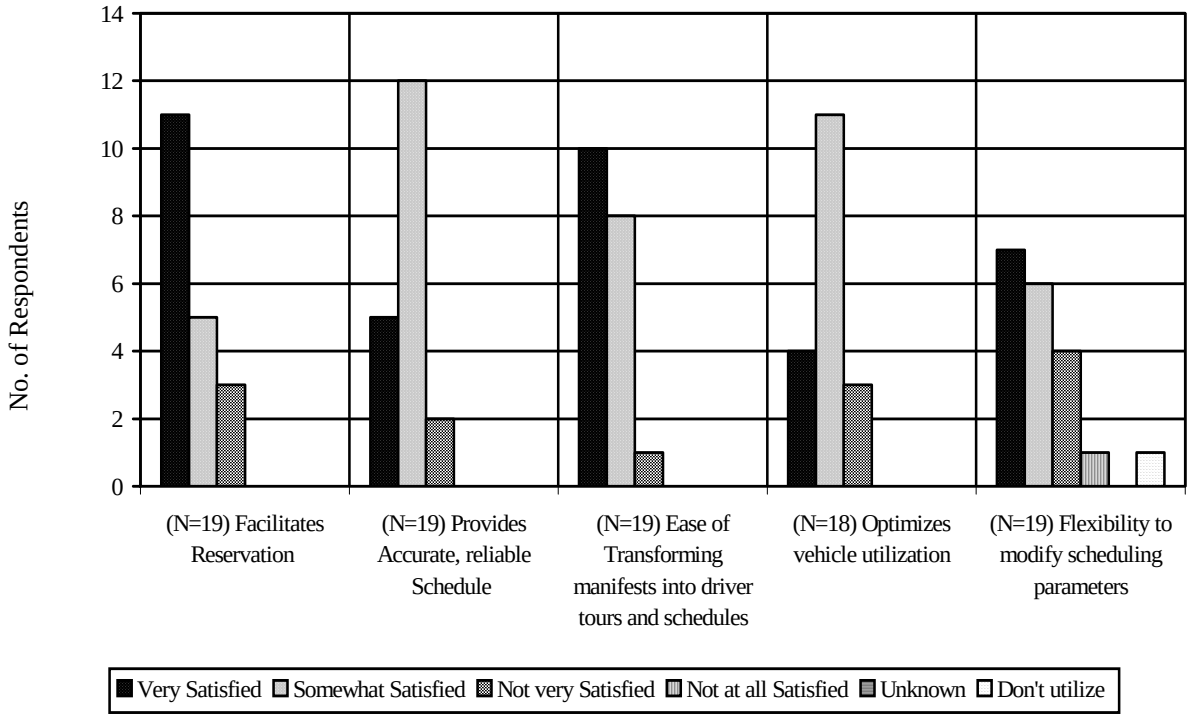
Survey respondents evaluated 22 individual features of their current CASD systems in terms of their expectations regarding benefits, performance, and problems they had experienced. The results of this evaluation are shown in Figure 9.

The responses indicate that the feature of CASD systems that provides the greatest benefit and satisfaction is the ability to improve the efficiency and accuracy of the reservation process. New systems have enabled users to process large volumes of transactions, to handle reservations for multiple contractors more easily, to comply with "zero denial" policies by offering more scheduling options, and to eliminate confirmation callbacks to customers. Dynamic dispatching (ability to insert trips) and the availability of real-time customer information were also mentioned as high-value features.

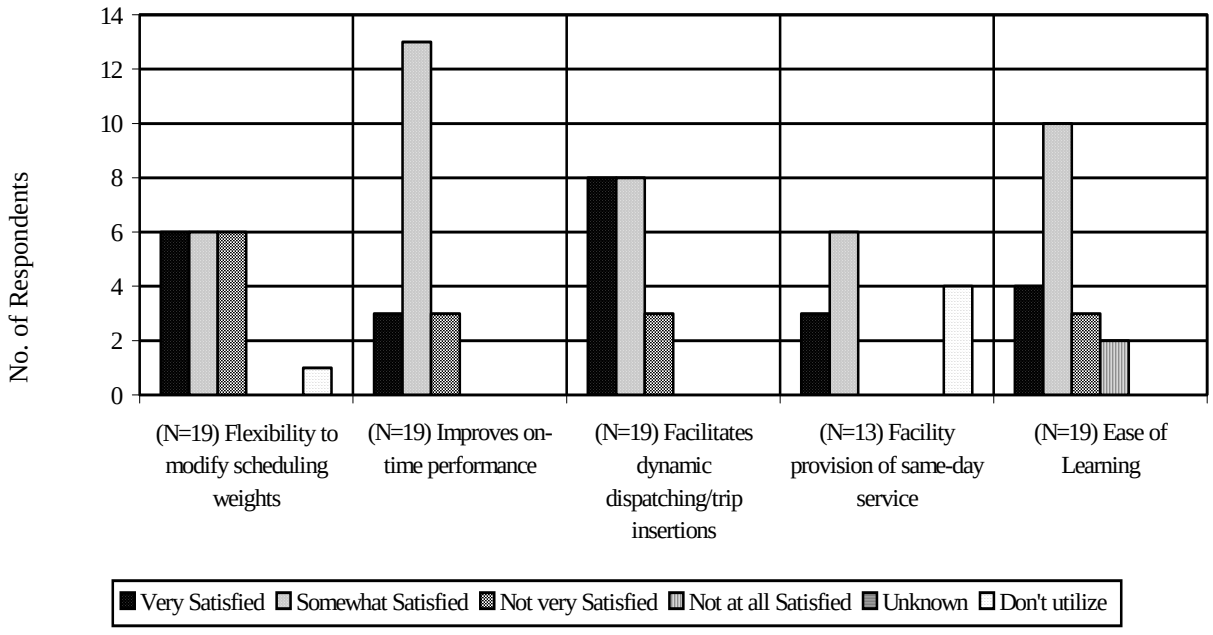
A by-product of improvements in scheduling and dispatching was less stress for drivers, as reported by one agency. Also, an agency that has a complex fare structure (i.e., zone fares) was very satisfied with a feature that facilitated the tracking and recording of fares.

There were areas in which software features did not meet agency expectations. Problems with the accuracy and adequacy of reports plagued some agencies. Also mentioned were difficulties in the structure of data files, which hindered data retrievals and the export of data to spreadsheet programs for further analysis.

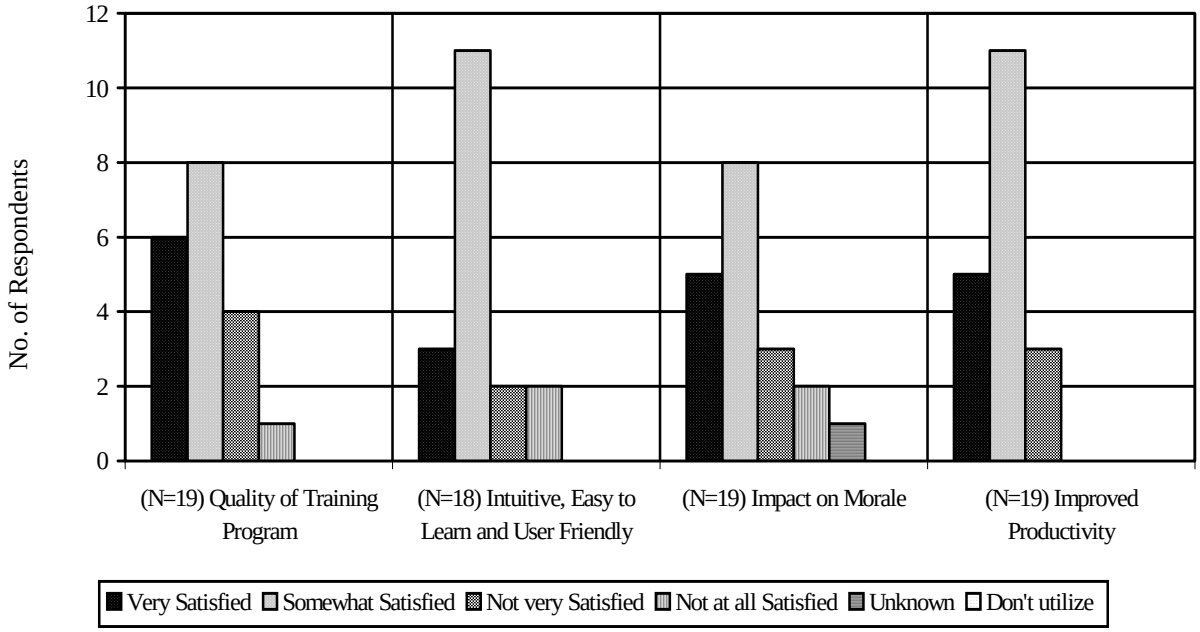
Although there was overall satisfaction with features that enhanced the reservations process, one agency found shortcomings in the modules that managed complaints and eligibility. One agency perceived a major deficiency in the small amount of text space available, for notes and comments on individual trips, on its reservations screens. Also, geocoding, the mapping system used in the reservations process for locating origins and destinations, needed to be updated much more frequently than expected, especially in growing communities. One agency regretted that updating geocodes was not incorporated in its annual maintenance agreement.


No. of Respondents
14
12
10
8
6
4
2
0
(N=19) Facilitates Reservation
(N=19) Provides Accurate, reliable Schedule
(N=19) Ease of Transforming manifests into driver tours and schedules
(N=18) Optimizes vehicle utilization
(N=19) Flexibility to modify scheduling parameters
Very Satisfied
Somewhat Satisfied
Not very Satisfied
Not at all Satisfied
Unknown
Don't utilize

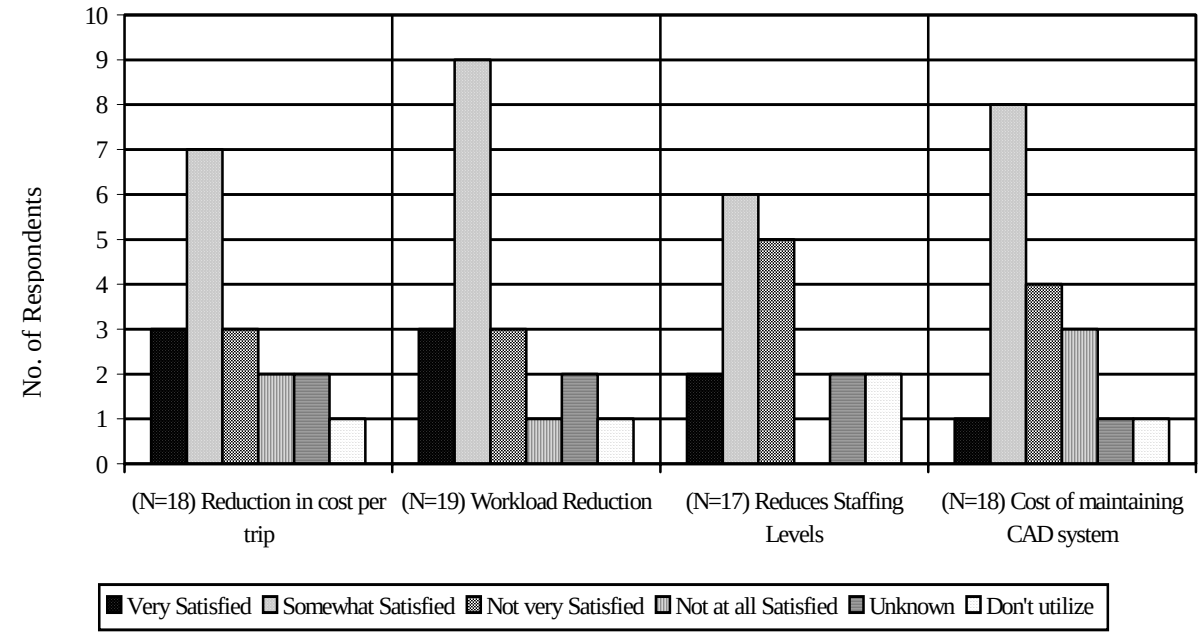
(**a**)


No. of Respondents
14
12
10
8
6
4
2
0
(N=19) Flexibility to modify scheduling weights
(N=19) Improves on-time performance
(N=19) Facilitates dynamic dispatching/trip insertions
(N=13) Facility provision of same-day service
(N=19) Ease of Learning
Very Satisfied
Somewhat Satisfied
Not very Satisfied
Not at all Satisfied
Unknown
Don't utilize

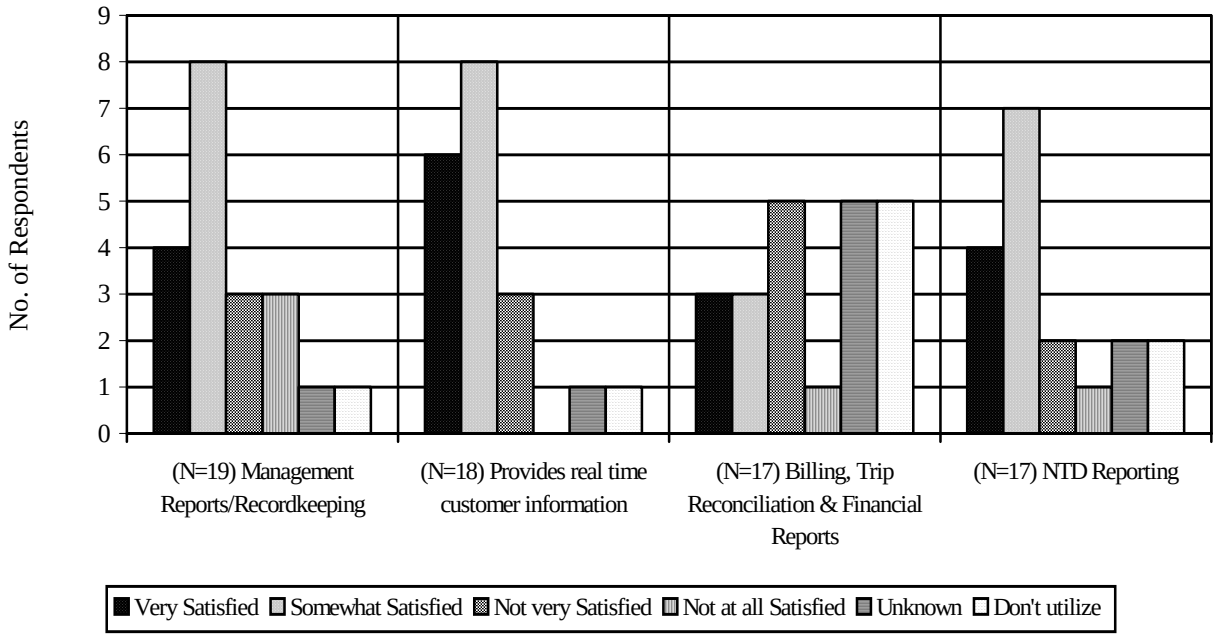
(**b**)


12
10
8
6
4
2
0
No. of Respondents
(N=19) Quality of Training Program
(N=18) Intuitive, Easy to Learn and User Friendly
(N=19) Impact on Morale
(N=19) Improved Productivity
Very Satisfied
Somewhat Satisfied
Not very Satisfied
Not at all Satisfied
Unknown
Don't utilize

(**c**)


10
9
8
7
6
5
4
3
2
1
0
No. of Respondents
(N=18) Reduction in cost per trip
(N=19) Workload Reduction
(N=17) Reduces Staffing Levels
(N=18) Cost of maintaining CAD system
Very Satisfied
Somewhat Satisfied
Not very Satisfied
Not at all Satisfied
Unknown
Don't utilize

(**d**)



(**e**)

FIGURE 9 Satisfaction with the performance of a feature in the current system.

Some users experienced confusing procedures for changing and adjusting system parameters and evaluating the effects of such changes. They wished that more time had been spent in learning about these and other system capabilities.

Agency expectations in the areas of reducing staff costs and easing billing and trip reconciliation requirements have not been generally met. For example, an agency that expected the system to handle Medicaid-funded billing was disappointed. However, it was clear that the preparation and finalization of the next day's schedules could be accomplished with fewer personnel.

SUMMARY

Transit agencies found that the CASD software met their expectations of improving performance in the areas of reservations, dynamic dispatching, and providing accurate, reliable information about their customers. However, in several key areas they experienced impediments that limited successful implementation. In retrospect, they would have approached implementation differently.

In the area of procurement, the agencies believed that greater care should have been taken in establishing system specifications for the bidding or RFP process. Many recognized the importance of having independent advice from professionals knowledgeable in CASD software.

A common conclusion was that they had not paid enough attention to analyzing their specific requirements—particularly, that they failed to distinguish software features they needed from those they did not. In some cases, agencies overlooked some of their requirements and had to incorporate additional features late in the implementation process.

Recalling the software demonstrations that had been performed by vendors that submitted proposals, agencies recognized that some of their specific questions about how the software would perform in their local operating environments were not addressed in the demonstrations.

The majority of the respondents said they needed more time for implementation than they had planned for. The most significant problem involved establishment of an accurate database. A great deal more time was needed than anticipated to correct data errors and inconsistencies.

Hardware problems and software bugs caused delays in implementation. Correcting software errors during acceptance testing delayed other phases of implementation. For example, training was either delayed or it had to be repeated when the software errors were corrected. Problems with customized software should have been expected, for they also necessitated additional time for testing and acceptance.

Agencies responding to the survey had suggestions for improving training programs, including conducting training in phases (basic followed up by advanced), having training take place away from the regular workplace, and concentrating training in the period just before going live.

Finally, agencies expressed the view that the implementation process would be more successful and smoother if the transit agency manager of a CASD installation had prior experience or a background in installing new software.

CHAPTER FIVE

BUSINESS AND OPERATING PRACTICES

Agencies implementing new CASD software have had to modify their organizations and/or their operating practices to conform to new operating environments and to work within the limitations of the software. In some cases, business practices were changed to take advantage of enhanced capabilities of the software. In others, previous customs were no longer viable, owing to software limitations.

Several agencies changed their call-taking practices. One found that its new system made it possible for customer service representatives to develop scheduling alternatives more quickly, improving customer satisfaction and reducing the time customers spent on the telephone. That agency was also able to reduce the advance reservation window from 7 days to 3, which improved its operational productivity, because no-shows, advance cancellations, and last-minute schedule changes were reduced significantly.

Another agency that had been operating with a "flexible and friendly" policy—which offered to call customers when the vehicle arrived at their location—found that this approach could not be maintained after the implementation of their new software system. Its policy now had an adverse effect on efficiency. The agency also learned that it was very difficult to manage these rules changes.

When the new system was implemented at one agency that had been using paper forms to record trip requests and then entering data later, the change to real-time entry of trip requests caused call takers to struggle initially with the new requirements.

The extent to which the software functions could be used effectively was limited at some agencies, because the skill levels of their work forces were not adequate for handling some of the more complex CASD software functions. In the area of trip reconciliation, some agencies were not prepared for the amount of staff time and effort required for completing post-trip tasks. Some agencies invested much effort and staff time posting data on trips, only to find that the reports that were subsequently produced using those data did not meet their needs in terms of content and format. One agency was so dissatisfied that it stopped using some of the report functions, concluding that the value of the reports and information was not worth the extra effort to produce them.

Several of the respondents found that the schedules generated by their CASD systems could be improved by assigning full-time schedulers to examine and adjust (rationalize and tighten up, check for maximum ride time) the schedules before they were distributed to drivers. One reason why computer-generated schedules often fail to produce desired productivity could be because daily service disruptions and lapses by drivers were more common than agencies had anticipated. Because these disruptions interfered with agencies' ability to operate computer-generated schedules efficiently, they had to revise their scheduling parameters and practices to accommodate the so-called real world.

Thus, agencies learned that setting system parameters to produce highly efficient, more productive schedules could lead to problems in the area of schedule adherence (late-running routes) and that there are trade-offs between productivity and on-time performance.

An agency that provides service based on the ADA-required three-quarter-mile boundary rule found that its system software could not provide the necessary eligibility information. Consequently, it was necessary to revise the reservations practices to perform such checks manually.

In the case of an agency that had operated a hub sector service structure before the implementation of new software, the CASD software was not capable of maintaining timely operations, and that service approach was ultimately eliminated.

New systems enabled a number of respondents to improve their business practices and capabilities vis-à-vis monitoring private contractor performance. An agency that converted from a decentralized CASD system by which contractors were responsible for reservations and scheduling to a centralized operation and control system found that its manifests were more accurate, lessening the need for intervention in regard to contractor's activities. Also, some agencies found that disagreements with contractors about no-shows, reservation details, and trip completion data could be more easily resolved as a result of more accurate reporting. Finally, the capacity of contracting agencies to monitor and audit contractor performance selectively was greatly enhanced in localities where private contractors operate scheduling systems.

Several agencies noted that the addition of MDC and AVL technology, in conjunction with the implementation of new CASD software, produced quicker resolutions of

service disruptions. Such technology improved the monitoring of contractor driver performance as well.

In summary, the primary areas in which new CASD systems brought about changes in business and operating practices were improving the handling of customers and their reservations, as well as facilitating the monitoring of contractor operations for compliance. Some agencies found that it was difficult for their personnel who lacked sufficient computer skills to adjust to the new operating environment, and they had to replace or reassign some staff. Also, agencies had to reorganize their staffs to cope with the higher workloads required for trip reconciliation and other data entries.

CHAPTER SIX

CASE STUDIES

It was decided to include case studies involving agencies that have recently implemented new CASD systems to illuminate some of the points raised by survey respondents and to provide details about how various impediments to successful implementation have been addressed. Two responding agencies agreed to provide more background and information about their experiences. One is from the group of the 75 largest agencies (in this case a statewide agency), and the other is a medium-sized agency that serves both urban and rural populations.

CHARLOTTE AREA TRANSIT SYSTEM

Description of Service

CATS operates door-to-door special transportation in the city of Charlotte and curb-to-curb in six towns in Mecklenburg County, North Carolina. All individuals in Charlotte, Pineville, and Matthews who are certified as ADA eligible are served. In the other smaller towns, the ADA's three-quarter-mile rule is applied. This is the ADA requirement that includes, among other eligibility criteria, that the user or client must reside within three-quarters of a mile of a publicly operated fixed-route bus service.

In 2003, CATS operated 93,383 vehicle hours and provided 186,714 passenger trips by using in-house staff. There are 4,200 persons registered to use the service. The service area is considered to be urban. Service is provided to eligible users who reserve up to 5 days in advance. It operates 7 days a week. On weekdays, the service starts at 5:00 a.m. and ends at 2:00 a.m.

CATS had been using DOS-based software since 1993. A decision was made in 2003 to acquire a new, full-feature CASD system. The new, full-feature system went live in February 2004. CATS sought new CASD software to achieve greater efficiency, to address conditional eligibility issues, and to create an option for charging different fares for outlying zones. Performance was also an issue, for the old system did not permit enough flexibility in setting average travel times and other parameters. CATS wanted a system that would interface and fully mesh with its fixed-route computer system, for the system to be able to determine trip eligibility based on the three-quarter-mile rule and with the MDC and AVL systems the agency was already using.

Procurement Process

CATS first explored sole-source negotiations with the vendor that provided its original software. Experience and research identified vendors that might have appropriate CASD systems to consider. The in-house project manager contacted other cities that had implemented new systems to learn more about the types of systems and capabilities that were available.

CATS decided to embark on an RFP process. Its chief technology officer provided guidance in the development of needs and specifications. Efforts were made to be explicit about the requirements. There were two bids submitted by nationally known software vendors. Each was asked to present a full demonstration of its product for the five-member evaluation staff. Among the 12 factors used in evaluating each of the bids was the rating of each bidder's qualifications, based on information gathered from users of the competing bidders' systems in other transit agencies across the country. Furthermore, CATS developed a detailed timetable for completion of the installation, with specific milestones. The plan included extended periods for training that were thoroughly spelled out. Nevertheless, contract negotiations took longer than expected, one reason being that the CATS staff had to schedule sessions relating to CASD procurement in the midst of a heavy workload of projects.

Implementation

The shift to using the new system occurred overnight, beginning on a Friday evening. There was no testing of the system using CATS data before the switch, because it was not feasible for the staff to operate in a dual-system mode. Thus, there were no tests using the agency's own data. Unfortunately, there were a number of problems that occurred after the changeover.

The data conversion process was meticulous, and care was taken to correct errors before the data were sent to the new vendor for loading onto the new system. The suppliers of the MDC and AVL systems had previously worked and interacted with the software vendor, so there were no major problems in integrating these technologies into the new system. However, one area that needed extra attention was the subscription database. CATS had to go back and manually recreate its subscription lists in the database.

Improving Procurement and Implementation

Although the CATS staff believed that the overall processes went well, they offered the following suggestions for improving the opportunity for successful implementation:

- An agency procuring a new system should dictate the scope of vendor software demonstrations, as well as the amount of time and detail devoted to each feature constituting the demonstration. Because the vendor demonstrations did not focus on the capabilities of the features of greatest interest to the CATS evaluation committee, the committee members believed that they did receive answers to all of their questions about those features. That was the case, even though the agency provided the vendors with specific questions on features that they wanted to have addressed in more detail.
- The timetable for implementation should be examined in detail, and every effort should be made to devise a timetable that is as realistic as possible. That is, the agency should ask specific questions about the time allowed for each phase of implementation.
- The task of converting data and ensuring 100% accuracy required the assignment of extra staff members—a situation that should be a part of every implementation plan.
- If feasible, running dual scheduling on a segment or sample of real data (real trip requests) might prove helpful. However, for medium-sized systems where staff resources are constrained, developing schedules in a dual mode usually is not possible.
- Training programs for drivers are very important. CATS instituted such training, in increments, after drivers had completed their daily shifts.
- CATS strongly recommends planning for additional customer service and reservations personnel for a period of several weeks after going live.
- It was not useful to apply the parameter that permits the scheduling group to specify different speeds for different parts of the service area (speed zones). Travel times produced by using speed zones were not realistic. However, the agency anticipates the development of a feature to permit specifying different average travel speeds for center city inbound and outbound trips at any particular time of the day.
- CATS favors developing target productivity expectations for, as an example, 6 months and 12 months after implementation. If a software vendor markets its product based on higher productivity projections, there should be an agreed-on measurement mechanism for holding the vendor to such a commitment.

Results

Although it is too early to assess the performance of the new CATS CASD system, the preliminary indication is that scheduling of vehicle routes from day to day is more consistent and, as a result, the drivers are able to regularly transport the same passengers on a daily basis. This was not possible with the old scheduling system.

NEW JERSEY TRANSIT

Description of Service

NJ Transit's Access Link Paratransit System, located in Newark, is the country's largest statewide DRT service. It serves 18 of New Jersey's 21 counties. There are nearly 10,000 certified, preregistered passengers, and the average weekday ridership is 2,000 passengers. The fleet consists of 183 wheelchair-equipped vans and sedans.

The state has been divided into six geographic regions for ease of operation, control, and efficiency. Service is scheduled and delivered by six service providers, each of which provides curb-to-curb service in the region for which it has a contract.

NJ Transit adheres strictly to the ADA three-quarter-mile "shadow" surrounding NJ Transit local fixed-bus routes in determining eligibility for trips. The hours of service extend from 4:30 a.m. to 2:00 a.m. on weekdays and from 6:00 a.m. to 12 midnight on weekends and holidays. Passengers may call the centralized reservations and operations center (in-house operation) at corporate headquarters in Newark to request a trip up to 14 days in advance.

Procurement Process

Because of the unique requirements involved in automating DRT reservations, scheduling, and dispatching for a statewide service, the Access Link officials monitored CASD technological developments and decided to wait until suitable products for the agency's unique application were available on the market. Access Link needed primary CASD software that could be integrated with several software modules from other vendors.

In 2000, NJ Transit began to develop the specifications for its system. The integrated system needed to encompass the following:

- Certification administration, following ADA guidelines;
- Trip reservations;
- CASD;
- Customer service module, including complaints and commendations;
- Client suspension module;
- MDC communications module on board vehicles;

- AVL on board vehicles;
- Interactive voice response telephone system for customers to make inquiries and to cancel or reserve trips by using voice recognition or pushing buttons on their telephones; and
- A web module to enable customers to reserve or cancel trips or to make inquiries by means of the Internet.

Access Link officials visited other agencies that had similar requirements during the period when specifications were being development. NJ Transit's procurement officers developed an RFP with extensive input from the Access Link scheduling experts and from other staff members. NJ Transit's RFP was targeted to primary contractors and/or management consulting firms with CASD implementation experience. The primary contractor would be responsible for overseeing the entire process, including the selection of a subcontractor to supply the basic CASD software, as well as other contractors to supply the other modules to interface with the primary software. All of the proposed subcontractors were to be identified in the proposals that would be submitted by the primary contractor.

The primary contractor would also be responsible for proposing a data center hosting subcontractor that would supply the servers, for NJ Transit did not wish the system to be hosted on its own in-house servers. Also, the primary contractor would oversee the development of data center service specifications, selection of hardware in accordance with the CASD software vendor's requirements, network design, user acceptance testing, provision of backup systems, and ensuring that the system had sufficient capacity to serve the agency's needs.

The agency acknowledged that much of that developmental work required customization. Three primary contractors submitted bids, each specifying the subcontractors that would provide the primary CASD software and other modules.

Implementation

The implementation was scheduled to take place in phases over a 24-month period. At the time of this report, the implementation had entered its third year, with two modules (interactive voice response and web/Internet access for customers) not yet completely implemented. The contractor chosen following an extensive evaluation process had implemented similar software and hardware at another major transit agency. NJ Transit reported feeling fortunate when the contractor designated as its NJ Transit project manager was the same individual who had overseen implementation at the other major agency.

NJ Transit believed strongly that retaining a primary contractor represented the correct approach, solid in concept, for implementing a complex system. The agency did not have the level of expertise in staff to oversee the planning and integration of all of the elements on its own.

However, much of success would hinge on the talents and expertise of the staff who had successfully implemented the system at another agency. According to NJ Transit officials, when the project manager for its primary contractor (the person with previous implementation experience) left after a few months, the progress toward successful implementation was interrupted. Other project managers followed (three in all), but they did not have the level of experience and detailed knowledge about paratransit operations needed to ensure tight control over all of the subcontractor activities and to provide answers to all of the agency's concerns.

One of the first problems involved the choice of the subcontractor for application hosting. It was discovered that the company providing the hosting environment apparently did not have a clear picture of the enormous amount of data that would be housed on its own servers. That company was in the business of providing hosting for websites, and it may not have fully understood the implications and the impact of data volumes related to CASD and other advanced technology systems. The primary contractor had to find a replacement.

When the time for training programs arrived, other major problems emerged. The CASD software, some of which had been customized, experienced "major functionality problems." As a result, the early training courses had to be repeated after the software problems were addressed. NJ Transit also found that some of the trainers were not well versed in the version of the software that the agency was using.

NJ Transit, like most agencies, must consider the proper settings for a large number of system parameters. When Access Link officials asked the software vendor to describe the impacts, on scheduling and dispatching, of changes in the settings, they found that they could not get accurate answers. The only way of learning about the impacts was through trial and error.

NJ Transit offered early involvement by its service contractors, particularly during the development of training programs. Some NJ Transit business procedures had to be changed. For example, NJ Transit offered ride transfers for customers who travel from one of its six regions to another. The rules for transfers had to be revised to fit the customized zone transfer module designed by the software vendor. Also, reservations agents had previously kept a text log for comments, but the character text field in the new system was limited. As a result, to record comments, the agents

had to open a new log for a passenger's trip once the first log was filled with text.

NJ Transit previously retained destination and scheduling information for cancelled trips, but the new system did not permit doing so. Finally, the agency was frustrated by the inability to change ancillary data about a particular trip (e.g., changing the fare or comments for the driver) without having to cancel the trip and reschedule it. The agency would like to be able to make a minor change without canceling and rescheduling, because once the trip is canceled, the passenger may not receive the same slot in the schedule as he or she was originally promised.

Improving Procurement and Implementation

Based on their experience, senior NJ Transit officials suggested a number of actions that could be taken to improve the procurement and implementation processes.

- During the consideration of bid proposals, agencies should devote sufficient attention to asking the primary contractors and subcontractors (in particular, the CASD vendor) the right questions about how the CASD system will meet agency requirements. Too often, the vendor makes agencies conform to the operating characteristics of its software.
- The software providers must do more to understand their customers' needs, and especially to help customers fully understand during the RFP/proposal stage, the capabilities of their products. The more that agencies question vendors about how software meets their needs, the more likely it is that future CASD software development will incorporate flexibility to meet the needs of different users.
- It is important to incorporate stronger control over the qualifications of senior staff members who replace those in position at the time the contract is awarded. The caliber of personnel assigned is critical to the success of implementation.
- Modifications of specifications should be reviewed and clarified line by line with contractors and subcontractors until agreement is reached.
- Agencies should ensure that the software vendor provides fully tested and functioning software, free of functionality problems.
- NJ Transit suggested two levels of training: one for staff members involved in the acceptance training and another for the general staff once the testing is completed. Also, agencies should take steps to ensure that vendor-provided trainers are completely knowledgeable about the version of the software that is being installed.
- There should be careful review of how much time is allotted for testing and training. Usually such activities take longer than anticipated.
- NJ Transit is receptive to the early involvement of service contractors in the development of system specifications and ways in which the system will function. However, the agency noted that contractors must make genuine contributions, and they must prepare to invest considerable staff time.

Results

The system has produced some modest gains in efficiency. For example, customers' calls are now answered within 2 min, compared with their having to wait on hold for an average of 10 min with the old system. As a result, only 5% of the calls are now categorized as "lost," whereas previously lost calls averaged 25%. Finally, the average processing time for reservations is approximately 4 to 5 min. It had ranged from 7 to 10 min with the old system. It is still too early to evaluate productivity and other performance measures. Once a historical database is built up, NJ Transit expects to take steps to measure and maximize efficiency. It will also be working with the contract carriers in using features of the system that could improve efficiency through dynamic dispatching.

CHAPTER SEVEN

RESULTS OF SURVEYS OF COMPUTER-AIDED SCHEDULING AND DISPATCH SOFTWARE VENDORS

BACKGROUND

Four selected software vendors completed surveys that included questions specifically tailored to elicit their views on CASD implementation. The vendors included several of the largest suppliers of DRT software in the United States as measured by market share. They provided detailed comments on practically all aspects of the procurement and implementation processes.

It appears that vendors have given a great deal of thought to how CASD procurements can be successfully adapted. Careful consideration of their points of view might lead to a better understanding of the business environment in which the vendors operate and perhaps lead to changes in agency procurement processes.

Three of the four vendors have had more than 6 years of experience in developing and marketing DRT software to the industry (see Table 8). The four offer a variety of products for different scopes of operations, and they have installed software at a total of 207 agency and company sites since 1990 (see Table 9). This includes 38 sites at which fewer than 500 trips a day were scheduled, 129 sites of 501 to 1,000 trips per day, and 40 sites of greater than 1,000 trips.

TABLE 8
RESPONSES FROM SOFTWARE VENDORS BY YEARS OF EXPERIENCE

Years of Experience	No. of Software Vendors	Percentage of Responses
0–5	1	14
6–10	2	29
11–15	1	14
Beyond 15		
Total software vendors responding	4	57

TABLE 9
NUMBER OF DRT SOFTWARE INSTALLATIONS BY SIZE

No. of Trips per Day	Total No. of DRT Installations
Fewer than 500	140 (N = 4)
501–1,000	388 (N = 3)
More than 1,000	119 (N = 3)

Note: Size of installation measured in trips per day.

The companies have had experience with all of the different types of bidding procedures (competitive low bid, RFP, and negotiated single source). Specifications contained in the bid documents they received were developed in-house (the most common) or by outside consultants. They observed that agencies used transit exhibitions and word of mouth as the most frequent methods of learning about software.

The most frequently reported reason, among vendors, as to why transit agencies change their DRT software is to improve scheduling. Meeting the growth in demand and improving dispatch operations were also important reasons.

Vendors believe that most of the key transit agency officials they deal with have a clear understanding of how CASD systems function. They did recommend, however, that key officials improve their knowledge of products by observing software demonstrations, that managers who procure CASD systems spend more time with their staffs to learn the fundamentals of what is most needed at the user level, and that the officials visit CASD installations at other agencies as part of their information gathering during the procurement process.

Also, vendors see a need for a greater commitment by senior-level management to CASD software acquisition from the time procurement begins, so that it is not competing for scarce resources with other aspects of agency operations once it is decided to purchase software. Vendors view it as important that key members of the transit agency staffs involved in implementation have extensive DRT experience.

Opinions were divided about whether the procurement processes that vendors have been involved with impeded overall successful implementation of CASD systems (see Table 10). Vendors favor the RFP process because it forces proposers to conform to a well-defined set of system requirements and it encourages more competitive pricing. The RFP process will yield more favorable outcomes even when agencies are undergoing system upgrades, particularly when upgrades involve new products, platforms, or system architectures.

Although supporting the RFP approach, vendors expressed some concern about the fairness of the proposal evaluation process, as well as about a lack of clarity in how the evaluation procedures operate. In particular, they questioned whether some agencies assign disproportionate weights to pricing compared with other criteria such as

TABLE 10
PROCUREMENT PROCESS AS AN IMPEDIMENT TO SUCCESSFUL IMPLEMENTATION

Extent of Impediment	No. of Software Vendors Responding (N = 4)
Very much of an impediment	1
Somewhat of an impediment	1
Not much of an impediment	2
Not an impediment at all	
Don't know	

system performance and functionality. One vendor strongly believed that the weighting of the criteria needed to be more balanced.

All of the responding vendors agreed that the development of an agency's functional specifications could be improved and made more realistic. Their view is that many agencies include everything they can think of in the bid specifications, without fully understanding the impact on cost. They suggested that agencies more thoroughly review requirements, to understand what they are buying. In some cases, according to vendors, agencies are paying for components that they do not need.

Also, respondents noted that not enough lead time was being allowed in the procurement process for installation and implementation. Too often transit agencies do not start the procurement process early enough to allow for a realistic chance for successful implementation.

The vendors reported that they are capable of performing extensive planning studies and working with agencies to develop an agency's implementation plans and schedules. From such studies, the vendors are able to gain a clear understanding of the sets of rules that govern DRT and the paratransit management systems at customer sites.

Vendors noted that they needed better communications and more complete and accurate information about an agency's current system to help them understand agency needs. This should include details about the following:

- Description of the service;
- Number of trips to be provided;
- Operating time periods;
- Subscription base and standing order goals;
- Vehicles types, capacities, and numbers;
- Types of service—ADA and other; and
- Service models—distributed, broker, and centralized.

Some vendors were only somewhat satisfied with how transit agencies sign-off on comprehensive system designs. Those that were not entirely satisfied have experienced what they call "scope creep": shifting definitions and changing expectations between the time that implementation plans were originally negotiated and agreed to and the time that implementation actually starts. Such circumstances could jeopardize the chance for success.

Vendors also pointed out that agencies that fully sign off on implementation plans can better prepare staff members for change, because the agencies will have taken ownership of their implementation processes and, as a result, the risks that come with staff resistance to change will be mitigated.

Effective project management is not only desirable, vendors noted, but it represents the best way to fight scope creep. Also, the assignment of overall management of the software implementation process to a less experienced person can be risky, and a dedicated, knowledgeable internal project manager is needed to "champion" the process.

On the topic of whether vendors found transit agencies to be flexible enough about requesting customization of their software, one respondent noted that many agencies do not understand that apparently minor customizations can have significant impacts on long-run support and costs for the system. Moreover, the time and effort involved in customization are often underestimated by agencies. Customization is best handled as part of the RFP, proposal, and negotiating processes.

HARDWARE AND DATA CONVERSION ISSUES

Because there may be constraints on resources available for new hardware, transit agencies may want to continue the use of current computer equipment even when installing a new software system. Recognizing this situation, one software vendor provides a risk assessment as part of its proposal, communicating the level of risk associated with using potentially outdated hardware. That vendor also develops mitigation plans to deal with the unknowns associated with using such hardware. However, in most submissions, vendors reported that they indicate their hardware requirements as part of their RFP proposals and refuse to implement software on outdated equipment or operating systems. Smaller agencies that do not have IT personnel on staff very often need more assistance with hardware and software issues.

Vendors confirmed what transit agencies had previously reported: that the most significant problem they encountered during implementation involved establishment of an accurate database, because a great deal more time was needed than anticipated to correct data errors and inconsistencies. Vendors usually convert from a "legacy" database; that is, the agency's historical database. In this process of converting or migrating data to new systems, most of the problems discovered by the vendors involved purging old data, automating data entry, eliminating redundancies, and

identifying unnecessary data. To overcome these problems and improve database accuracy, vendors favor contacting all customers that have not recently been using the database to confirm their profile information at the time of conversion. If an agency has queried the database in recent months to fulfill a trip request from a customer, then the data are assumed to be correct.

Software vendors pointed out that older legacy databases, in particular, were poorly designed and could cause serious conversion problems. Exception reporting supplied by the vendor should be part of the database conversion process, so that the areas in which data cleanup is necessary are identified. In these sometimes challenging situations, it is important for agencies to be prepared to mobilize in-house staff to assist with the manual reentry of data if problems arise during conversion.

In regard to subscription data, all vendors recommended rescheduling all trips to force a cleanup of the errors in the data. One respondent noted that because the scheduling algorithms and application of travel speed parameters differ from one software package to another, the pickup and/or drop-off times for a large number of subscription passengers may have to be changed. By using the new system to reschedule these riders, the staff is also becoming proficient in using the scheduling features of the new system before it goes live.

Another critical area during the conversion process involves ensuring that accurate descriptions of the vehicle fleets are loaded into the computer. A physical inventory of vehicle capacities and configurations, through the use of forms furnished by the software vendor, is highly recommended

TRAINING AND TECHNICAL SUPPORT

The respondents reported that they schedule mandatory training sessions in nonoperational settings. They recommended that agencies ensure that staffs have basic computer skills (background in the Windows operating system), that agencies work with vendors to ensure adherence to the training schedule, and that agencies allow staff to learn without interruption. That is, when key user personnel are called out of training sessions for several hours, they are set back in their learning.

When conducting training sessions at smaller agencies, however, greater flexibility is called for, including the scheduling of night and weekend training classes, if warranted. Vendors recommended that smaller agencies, in particular, identify a staff member for train-the-trainer training. That individual would then be primarily responsible for training new employees.

The amount of technical support during the start-up week depends on the level of funding specified in the contract. Most of the software vendors reported that they include an appropriate staffing level in their proposals, and they strive to maintain provision of sufficient resources in the contract during the negotiations.

According to the respondents, post-implementation, follow-up training in the form of seminars and conferences is important. One vendor recommended that agencies earmark funding for training sessions 3 months after the system started. That recommendation echoes one proposed by transit agency respondents.

BUY-IN FACTOR

The term buy-in is used here to mean that key players involved in implementing a project are informed about the goals and plans, and that they have agreed to work in a cooperative, coordinated manner to achieve them.

When asked about the impact on implementation by the lack of a buy-in, or a lukewarm buy-in, respondents stated that there could be an adverse affect pertaining to delaying implementation. Having all stakeholders at the table—contract service providers, managers, dispatchers, schedulers, drivers, and possibly union representatives—means that all have acquired “ownership,” which, according to one vendor, is essential to success.

It was also pointed out that informing service providers at an early stage about what changes are in store enables them to evaluate how changes will affect their operations—affording them ample time to implement changes to accommodate the new system. One change requiring sufficient time could be the hiring and training of personnel to replace those staff members whose skills may not be suitable for the new operating environment.

The vendors expressed their opinions about whether staff members of service providers should play a role during implementation. All of the respondents felt that some service provider participation could foster successful implementation, but that participation depends on the relationship of the service provider with the agency. If service providers do have a role, the extent should be controlled by the transit agency. Agencies that seek contractor involvement to help them understand the procurement process and to prepare them for implementation could form a committee consisting of several service providers.

EXPECTATIONS

Do transit agencies and vendors have a different understanding about what the agencies can and should expect

from their new software systems? The vendors stated that there are often misunderstandings about costs, particularly when agencies procure a low-priced, low-budget system while expecting the performance results of a more expensive system.

Misunderstandings may result if the personnel who negotiate the contracts with the vendors are not the same staff members who implement and use the software systems. This situation highlights once again the vendors' belief that key agency officials may have unreasonable expectations involving cost, resources, specifications, functionality, and ongoing support. Furthermore, it supports the vendors' viewpoint on buy-in, which calls for the end users to have early involvement in the RFP process and in negotiations.

The vendors also stated that some transit agencies believe that the software can be implemented within a relatively short period of time following the execution of the contract. Agencies may not realize that vendors often have other projects already scheduled for implementation and, therefore, the precise scheduling may have to be calculated to fit within an overall workload. In cases of dire need, some shortening of the time frame may be possible.

Although such statements may reflect the real operating environment for companies that develop and install new software, they appear to contradict other statements made by vendors—that agencies should control the implementation process.

BUSINESS AND OPERATING PRACTICES

The respondents all indicated that in some instances they have modified software to accommodate specific agency business limitations, as well as to overcome obstacles that agencies have encountered in working with the software products. Examples include modifications for complex billing rules, specialized reports and charts, appearance of screens, and customizing geographic information system data for unique geography. To accommodate the reporting needs of agencies that have complaints about the formats and adequacy of primary reports or about some of the add-on reporting modules, vendors stated that such elements can be removed from software

One vendor reported that it usually proposes to undertake business and requirements analyses for its clients to learn more about business operating practices and how its software will have to be modified. An agency that did not previously have batch reoptimization of its schedules, for example, was helped to develop new business practices and staffing to handle the ramifications of reoptimization.

Another example involved an agency that had been using a brokerage model for scheduling. When that agency changed its business practice by contracting directly with service providers, it was necessary for its vendor to convert the software to a standard scheduling module.

It was suggested that some transit agencies might need to learn more about the impact of their business and operating policies on scheduling and DRT system performance. As a rule, centralized call taking provides better service to customers and permits greater control over customer service activities than does spreading responsibility for customer reservations and service among several service providers. Similarly, centralizing scheduling operations for a single, shared fleet of vehicles increases productivity, because the scheduling software is designed to optimize the schedules for a shared vehicle fleet rather than for separate fleets belonging to individual contractors.

Among the other observations that were made were that some agencies need to organize their operations to optimize their schedules as late as possible on the evening before the service day to produce schedules that optimize service hours and vehicle miles. This approach produces more precise schedules and better groupings of trips. Schedules can be even more accurate and effective if experienced schedulers are assigned to review the optimized schedules to eliminate any obvious errors that result from erroneous data.

Most agencies now have strengthened their business policies and practices designed to discourage no-shows and late cancellations. Ensuring that service is available to those clients who can actually use the trips, and not wasting capacity as a result of no-shows and cancellations, is one of the most important policy areas that agencies should continue to address.

Any review of business practices should include an evaluation of the benefits of new technologies such as AVL and MDCs. Dispatch operations can be efficient and productive if dispatchers have the proper tools for resolving problems. AVL and MDCs can also be used to help agencies and/or their contractors hold drivers accountable for their performance and activities, according to one vendors.

The respondents stated that it is important for DRT managers to participate in additional training, user conferences, APTA and Community Transportation Association of America training, and to study, through in-house personnel or independent consultants, the impacts of policies and business practices on schedules, schedule adherence, and vehicle utilization.

SUMMARY

According to software vendors, transit agencies can improve the chances for successful acquisition of CASD software by becoming more knowledgeable about what features and capabilities are needed at the user level for their reservations, scheduling, and dispatching operations. Such an approach would ensure that performance specifications in bid documents are more realistic and that agencies are not paying for software features and modules that they neither need nor will use.

One respondent offered this succinct advice: "Know what you have, know where you are headed, know how best to get where you need to be and, finally, know what you are buying (e.g., a 'free' upgrade is never free)."

There is an underlying belief among software vendors that the proposal evaluation process is skewed toward price as the dominant criterion. However, functional performance of software ought to be given greater weight to make the evaluation more balanced.

Vendors stated that when transit agencies change the comprehensive system design and requirements between the time a vendor's proposal is accepted and converted into a contract and the time when implementation actually is in progress, successful implementation can be jeopardized. That is, vendors find it difficult to do installation in the face of changes in the project scope.

Respondents reported that the problem that most often disrupted the implementation process, however, involved the conversion of data. Vendors warned that a great deal more time is needed to correct data errors and inconsistencies than is usually anticipated.

Finally, vendors have experienced misunderstandings with transit agencies in regard to expectations about costs, overall time frame for implementation, who should control the implementation process, various software features and functionalities, and ongoing maintenance support. The lesson learned is that all of the potential areas for misunderstanding should be expressed and resolved early in the procurement and implementation processes.

CHAPTER EIGHT

RESULTS OF SURVEYS OF DEMAND-RESPONSIVE TRANSIT SERVICE CONTRACTORS

BACKGROUND

The viewpoints of four selected DRT contract service providers were received in the form of completed surveys that included specifically tailored questions. These four national companies have had extensive experience in providing paratransit or DRT services to the transit industry. The average number of years of providing DRT service is 20. Two of the four respondents have had contracts with 75 or more paratransit and DRT sites since 1990. They have had experience with a variety of different CASD software types and brands, as well as experience in performing all DRT functions—reservations, scheduling, and dispatch operations.

INVOLVING SERVICE CONTRACTORS IN THE PROCESS

The service contractors have been involved in the development and planning of transit agency CASD specifications and needs or in the implementation of CASD software only some of the time or hardly at all. The companies consider that approach to be a mistake, because they believe they could contribute substantially to the success of the procurement and implementation processes. In addition, they noted that it is important for their staff members to understand what to expect from any new system early in the acquisition process, so that they can prepare for changes in their operations.

Because all or most DRT managers employed by the contractors understand how CASD systems work and have had experience with a variety of scheduling and dispatching software tools, they believed that transit agencies could benefit by having them participate as advisors in the acquisition process.

Among the ways in which they believed that they could make a contribution are the following:

- Sharing their personal knowledge of and relationships with key individuals in the DRT software industry;
- Advising on the pros and cons as well as capabilities and limitations of the different types of CASD software they are familiar with;
- Helping agency officials understand the real-world challenges inherent in the DRT service operating environment; and
- Offering their technical knowledge about those software functions that are most likely to be effective and improve efficiency in an agency's DRT service.

They also implied that they can help an agency distinguish between the "gee whiz" software functions and those that are really necessary.

Contractor personnel at all of the responding companies receive formal training and orientation in the characteristics of CASD software, as well as on-the-job computer training. The companies stated that, in their experience, one of the greatest challenges during implementation is that of migrating to a new software system while ensuring the accuracy and integrity of databases. They emphasized that even the best-planned conversions require much more time, additional staff, and greater monitoring than agencies realize to accomplish the job of evaluating the current data and expunging invalid data. All have had disastrous experiences in coping with lost data, poor conversions, lack of data integrity, and nonstandard inputs. Because data migration is critical to successful implementation, service providers urged that transit agencies carefully evaluate the effort needed and that they allocate sufficient time accordingly.

TRANSIT AGENCY BUSINESS RULES AND POLICIES

Contractors that are charged with implementing an agency's DRT rules and policies often find that such practices have existed since the time when the agency first started to provide DRT services. It was their opinion that this situation may simply be a result of inertia. They also reported some of the rules and policies to be based on perceived "political" requirements (e.g., a perception that some rules are needed because they render DRT services more customer-friendly). Two examples of customer-friendly rules were mentioned:

1. Drivers may be instructed to wait beyond the required dwell time if a passenger is late.
2. Vehicles may be directed to return to pick up a passenger who was not ready when the vehicle first arrived at the scheduled pickup time.

As new interpretations of ADA requirements, regulations, and rulings have been promulgated, it became evi-

dent to many DRT service operators that some existing business practices were counterproductive in terms of optimizing system performance and efficiency. For the areas of phasing in changes to rules and balancing service needs, in the process, contractors expressed their belief that they have unique experience and that they could help with. They believed that their wide range of clientele and experience in different types of DRT operations give them a unique perspective.

The bottom line is that they believe they should be consulted before serious problems arise owing to business rules and policies. They also pointed out that some rule changes affect operating efficiency, in turn affecting the operating economics for the contractor.

Respondents indicated that, in their experience, every installation site has its own definitions. They believed that measures should be taken to ensure that agencies and contractors are speaking the same language when it comes to definitions of terms used in paratransit and DRT operations, and that these terms should be spelled out clearly and completely in the RFP specifications. There may need to be a greater nationwide effort to create standard definitions and industry cross references for the DRT and paratransit industry.

Respondents addressed the subject of whether accuracy in defining the vehicle fleet (which the contractors operate) in the CASD environment is sometimes an obstacle to successful performance. It appeared that the parameters for vehicle descriptions (vehicle capacities, loading issues in a multiload situation, changes in fleet mix and equipment) need to be improved, in turn to improve the operation of CASD in terms of scheduling for different types of vehicles.

TRAINING PROGRAMS

The respondents offered some suggestions for improving the training provided for their personnel. Because contractor personnel have many tasks to perform during the period when conversion to a new CASD system is taking place, the companies would prefer that training held before a system goes live focus primarily on the basics. Follow-up training would then be offered 6 to 10 weeks after going live. Moreover, they assumed that once the dispatchers and other users have had hands-on experience with real applications, their questions would be more pertinent than questions they may have asked during basic training.

The respondents stated that more training was needed in the area of understanding the impacts of changing the system parameters, such as average travel speed, time of day adjustments, and geographic sectors—something that is otherwise learned through experience. It appears that transit agencies and service providers alike wish to see more attention paid to that important topic. At a minimum, follow-up training should thoroughly address the subject of system parameters, a very genuine concern for all.

BUY-IN FACTOR

The service providers believed that this is a major failing in most implementations. They reported that few of the stakeholders are involved at early stages and that they are brought in only after it is costly and/or difficult to make substantive changes. Also, they pointed out the greater likelihood of successful implementation when all parties believe that they have a voice early in the process.

Ultimately, if the transit agency and its contractor(s) are in agreement about the manner in which the major CASD elements are implemented and perform from an operational standpoint the chances of successful implementation are greatly enhanced.

OPERATING ENVIRONMENT

Operationally, the features that are most needed by service providers pertain to knowing where the drivers are, what their vehicle capacity is, and how long it is to the next pickup/drop-off point. Having software that frequently updates pickup and drop-off times throughout the day, and that can clearly present the information to dispatchers in a sensible, user-friendly way, helps the contractor dispatch staff make informed service decisions. Service status updates can be done manually or by integrating new technology, such as AVL and MDCs, with CASD systems.

As for reporting, the most important reports pertain to data validation and error checking, exceptions, complaints, and performance. The service provider staffs usually include an analyst to review reports and to monitor trends.

Most of the operators meet with transit agency staffs on a regular basis, reviewing performance and discussing areas for improvement. They typically make recommendations for improving the CASD systems (e.g., changing software to produce better ways of optimizing results) or for special reports needed for analysis.

One respondent maintained that many transit agencies do not anticipate the amount of ongoing work involved in managing a CASD system on a day-to-day basis. A prevalent expectation appears to be that the scheduling and dispatching processes can be fully automated when, in reality, a great deal of manual effort is needed for reviewing, editing, and tweaking schedules and manifests.

CHANGES IN COMPANY BUSINESS AND OPERATING PRACTICES AND/OR MANAGEMENT TECHNIQUES

The companies reported that they have modified their practices, but that the extent of the adjustments required varies from site to site. In particular, changes in communications technology (cell phones, push-to-talk, the Global Positioning System, MDCs, and AVL) has profoundly altered techniques of managing.

All of the companies have found that they had to make personnel changes when their workers could adjust to new technological developments. In addition, in some cases, transit agency personnel are not able to keep up with current knowledge about the opportunities for applying new tools and the gains in service quality and efficiency that could be realized as a result.

SCHEDULING PRACTICES AND POLICIES

One respondent argued that whereas CASD systems can produce rather complicated routings of vehicles, agencies that operate these systems have lagged behind in understanding the human dimension—that is, the central roles that drivers play in actually operating computer-generated schedules. The unpredictability of the human element needs to be addressed whenever agencies and contractors meet to review any driver shortcomings and examine approaches for improving the manner in which drivers perform on their routes.

A lack of accuracy in defining the available fleet capacity is sometimes an obstacle to achieving successful scheduling performance. The solution is for agencies and contractors to conduct a joint audit of the fleet from time to time.

One contractor held to the opinion that there are times when software products require the collection of "needless information," tying up data entry and engaging other staff members, which has an adverse impact on productivity. Another company was so dissatisfied with an agency's new software that it provided its own proprietary software for call taking and scheduling. The company was required to download its information to the agency's system.

Service providers would like to see streamlined reporting, perhaps blending performance, quality of service measures, and financial results into one report so that trends can be compared. If analyzed methodically, these reports can provide powerful insights into the operational health of a system, enhancing their usefulness as a decision-making tool for allocating limited resources.

Finally, the contractors believed that the complexity of paratransit operations requires an ongoing, cooperative effort. There should be a dialogue between agency and contractor staff members aimed at fixing service and performance problems. Analysis of management data should form the basis for implementing improvements that can make the CASD system operate more successfully.

SUMMARY

The responding contract service providers have had experience in operating DRT services in several hundred sites and they have used a wide variety of types of CASD scheduling and dispatching software. They reported that if they were provided a role to play in planning and implementation, given their extensive knowledge of CASD systems capabilities and pricing, as well as real-world operating conditions, they could make a significant contribution to the success of agency procurement processes.

One of the most important issues for contract service providers is their need to have transit agencies provide them with detailed information about new CASD systems in a timely manner. A sufficient amount of time is required to plan changes in the companies' business and operating practices. Sharing of information early in the implementation process would help service providers avoid serious organizational and staffing problems.

The accuracy of agency databases is another key implementation issue for service providers. As the end users of schedules produced by CASD software, the companies' operations can most certainly be disrupted if there are widespread data integrity problems. According to the respondents, it is therefore critical to the success of their operations for agencies to provide enough time and resources to ensure successful data conversion.

Finally, the service providers believed that not enough effort is being made by transit agencies to understand the shortcomings and impediments that arise owing to what they called the human element. In particular, they felt that agency and contractor staff members should work closely together to improve scheduling in a way that reduces possibilities for driver errors.

CHAPTER NINE

CONCLUSIONS

In recent years, many transit agencies have procured and implemented new computer-aided scheduling and dispatch (CASD) software systems. Among the principal reasons for upgrading or implementing a new system were to keep up with growth in demand, take advantage of the latest products available on the market, improve scheduling and dispatching of demand-responsive transit (DRT) trips, and improve productivity. Interpretations of the requirements and provisions of the American with Disabilities Act by the FTA and federal courts have also provided added impetus for upgrading systems. Agencies found that they needed to have better ways of averting trip denials, tracking customer trip records, and improving overall customer satisfaction.

The information presented in this synthesis was collected from the responses of 21 selected transit agencies, 4 selected software companies, and 4 selected service providers that are involved in the development, procurement, implementation and operation of CASD systems.

Conforming to the national trend, nearly two-thirds of the large agencies responding to the survey rely on contractors for service delivery. Only 7% operate all DRT functions in-house. However, 43% of the large agency respondents operate in-house reservation systems and one-third perform the scheduling for service providers—part of a national trend.

Most of the agencies reported having experience with more than one CASD system, and two had experience in implementing four systems.

One of the most important findings was that the success of the implementation process often hinged on decisions made and actions taken (or overlooked) early in the procurement process. Transit agencies believed that they had not acquired all of the information they needed to make rational decisions about their CASD requirements. They may not have had in-house information technology specialists and operating personnel who were familiar with and understood CASD software applications on their procurement teams.

Agencies reported that a critical area they often overlooked was the impact of a new system's operating characteristics and operating environment on internal business and operating procedures. An early effort to identify the rules and procedural changes needed could have enhanced their opportunities for successful implementation.

Agencies unanimously believed that the selection of experienced transit agency managers (with previous CASD experience) to be in charge of the procurement and installment was very important or somewhat important to the ultimate success of CASD software. Software vendors concurred. They also found that although most of the key transit agency officials they deal with have a good understanding of how CASD systems function, senior decision makers could improve their knowledge by observing product demonstrations.

Many of the respondents also would have retained an outside consultant to design all or parts of the procurement if they were to start the acquisition process over again. Only one, the New Jersey Transit Corporation, contracted with a large management consulting firm with DRT implementation experience to oversee its entire implementation. At a minimum, it was suggested that transit agency specifications for the interfaces between CASD software with software for automatic vehicle location and mobile data computers should be developed by consultants.

One part of the bid evaluation process that agencies considered to be extremely important was the background and experience of the personnel who constitute the software vendor's implementation team. Commenting on the bid evaluation process, software vendors expressed the view that CASD system selections by transit agencies are often based solely or disproportionately on price, rather than on detailed reviews and evaluations of a system's functionality.

From the vendors' perspective, agencies sometimes throw everything into their specifications without fully understanding the costs. Vendors also reported that when every installation site has its own definitions, the vendor's understanding of agency needs is restricted. Perhaps a nationwide effort to standardize definitions and terms used in the paratransit and DRT industry is called for. In addition, vendors responded that the procurement process should be started enough in advance ensure successful implementation if the agencies have deadlines for transition to a new system.

Respondents found that the milestone dates they had set were unrealistic, particularly for the time allowed for customization of software, acceptance testing, and training. Also, they found that more time was needed for addressing unexpected issues that arise.

From the viewpoint of the software vendors, agencies sometimes do not understand how their particular projects fit into the vendors' overall schedule for implementation at various sites where they have active contracts. The expectation on the part of agencies, they noted, is that new software can be implemented within a relatively short time following execution of the contract, but that agencies need to realize that the implementation schedule has to fit into the vendor's overall workload at the time the contract is signed. Nevertheless, adjustments in the implementation schedule may be possible in some instances.

There was a great deal of dissatisfaction with both the acceptance testing and the training programs. Agencies observed that the software products being installed were not adequately tested or developed beforehand by some software vendors. Beginning training before full testing and acceptance could result in the repetition of some training if software bugs have not been eliminated. This in turn could disrupt an agency's DRT operations.

Basic training courses should be given as close to the "go live" date as possible. Training in the more complicated or esoteric features of CASD software would be more effective if it takes place after the staff have had weeks, or even several months, of operational experience. Even for staff members who are computer savvy, the basics may need to be repeated before training on advanced functions takes place. Software vendors reported that they support follow-up training, but they find that most agencies do not set aside sufficient funding for this purpose.

Some respondents reported dissatisfaction with vendors' training staffs. They reported that their knowledge varied, and in a few cases the instructors were not well-versed in either the version of the software that was being installed or in agency DRT policies and practices. Another criticism was the lack of up-to-date materials to distribute to new users of the systems.

Given the differences involving quality of software, acceptance testing, and training, it was not surprising to find that only two agencies reported outstanding rapport with their software vendors. All in all, indications are that improvements in many areas are warranted.

In the literature review, studies of CASD implementation cited migration of so-called "legacy," or historical, databases to a new system as one of the most critical activities during the implementation process. Most agencies were very satisfied or somewhat satisfied with the results in this area. Notwithstanding, agencies cautioned against taking this phase too lightly by not leaving enough time for identifying and removing errors and inconsistencies and by not having sufficient staff resources ready to perform manual corrections.

Software vendors noted that they were aware of the criticality of the conversion process and that they were prepared to assist agencies. They stressed that agencies should be prepared to invest additional human resources, depending on the extent to which databases needed to be cleansed, to minimize problems.

Furthermore, the contract service providers are particularly sensitive to the need for rigorous audits to expunge invalid data and ensure data integrity. The potential for disruption of their operations can be great if they have to deliver service in systems that do not have accurate databases. Examples they gave involved vehicles going to wrong addresses, drivers having incorrect information about whether clients use wheelchairs and/or aides, and drivers having to operate poorly structured, circuitous routes.

Most of the software vendors believed that internal transit agency project management of the implementation process could be improved. They stated that they would like to see agencies assign knowledgeable internal project managers, especially administrators who will be dedicated to taking ownership of the process. The vendors were particularly concerned that what was originally negotiated at the contract stage sometimes has changed as implementation advanced.

Most agencies agreed that it was desirable to give a role to their private service contractors in the implementation process. One-third believed that contractors should participate only after the design and testing phases are completed. However, three agencies sought the advice of contractors on operational impacts, development of training programs, and in testing and evaluation of software. Service providers, on the other hand, believed that they could play a larger role. They maintained that their involvement in the early phases of implementation would afford them opportunities to address and plan for changes in staff and operating practices that they would need to institute.

Once implementation issues were resolved, most of the agencies were pleased with the performance of their new CASD software features, particularly with improved efficiency and accuracy in the reservations process. Being able to offer more scheduling options at the time of a client's request for service, having the capability to process large numbers of transactions, and handling reservations for multiple contractors more easily all contributed significantly to quality improvements. Advances in scheduling algorithms used by newer systems produced better, more accurate schedules. One agency also noted fewer conflicts between dispatchers and drivers, as well as less stress on drivers.

However, software features did not meet all agency expectations. Problems with the accuracy and adequacy of

reports have plagued some agencies. Also mentioned were difficulties in the structure of data files, which hindered data retrievals and the export of data to spreadsheet programs for further analysis. Some users found that the procedures for changing and adjusting system parameters and evaluating the effects of such changes were confusing. They wished that more time had been spent in their learning about these and other system capabilities.

Agency expectations about reducing staff costs and easing billing and trip reconciliation requirements have not been generally met. However, it was clear that the preparation and finalization of the next day's schedules could be accomplished with fewer personnel. Software vendors explained that some of the gaps between what agencies expect in terms of performance and what the vendors understand to be their responsibility results from, in some agencies, the staff who negotiate the contracts are not the same individuals who must work later to implement and use the features of CASD software systems.

Agencies have found it necessary to modify business and operating practices during implementation of new CASD systems. The areas that were most profoundly affected were reservations and customer service functions, especially among those agencies that had been keeping manual records for reservations and customer service lookups. In converting to fully automated functions, however, some found that a few of their personnel could not acquire computer skills or adjust to the new operating environment; therefore, some agencies had to replace or reassign some staff. Also, agencies had to reorganize their staffs to cope with the greater workloads required for trip reconciliation and other computer data entry tasks.

The software vendors all indicated that they have modified software to accommodate specific agency business limitations, as well as to overcome obstacles that agencies have encountered in working with the software products. Two examples of the areas that have been addressed include complex billing rules and customizing geographic information systems to deal with unique geography.

As with the transit agencies, service providers have faced the problem of having to make personnel changes when their workers could not adapt to new technological developments. The contractors found that changes in communications technology—cell phones, push-to-talk, the Global Positioning System, mobile data computers, and automated vehicle location) have profoundly altered the procedures in their dispatch operations and their techniques of managing.

The service providers surveyed asked whether steps could be taken in scheduling to allow for some unpredictability among drivers and dispatchers. They stated that the challenge of getting operating staff members to adhere to optimum schedules as devised by CASD software is sometimes not fully understood by transit agencies.

To address issues raised by this synthesis, the following suggestions are presented:

- The many CASD-related technological developments and software applications that are reported in the literature review have the potential for favorably affecting the efficient scheduling of high-quality DRT services. Such techniques merit consideration by both transit agencies and software vendors; however, first the technical information must be disseminated more widely in a form that can be clearly understood. Technical committees most concerned with these areas of research could undertake a review to determine how more CASD users can be made aware of the latest technical developments.
- Larger transit agencies that operate DRT services could employ personnel who are technically proficient in CASD and able to keep abreast of software developments.
- Representatives from transit agencies, software companies, and service providers should be mindful of some of their contradictory perceptions. It might help if they met occasionally at colloquia, conferences, and workshops to address some of the issues and differences discussed in this synthesis.
- There were positive responses to a survey question about whether CASD software users would be helped by a website featuring information about various systems, available training courses, current sources of information about CASD, and a directory of software suppliers. Such a mechanism might be created to disseminate information about systems and products and enable transit agencies to exchange information.
- The impact of new technology on small and rural DRT systems, discussed only briefly in this report, could be the subject of a future study.

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GLOSSARY

Accessible—Extent to which transportation vehicles are free of barriers and usable by persons with disabilities.

Algorithm—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.

American with Disabilities Act of 1990 (ADA)—Federal civil rights law that enables persons with disabilities to participate fully in society, live independently, and be economically self-sufficient.

Automatic vehicle location (AVL)—Electronic communication system for tracking and reporting the location of vehicles to a central dispatching center.

Call taking—Function of recording a passenger's request for a trip and the details of the trip; a part of the trip reservation function that also includes eligibility checking.

Computer-aided scheduling and dispatch (CASD) system—Demand-responsive transportation service in which some, but not all, control center functions are performed with the use of a computer.

Database—Collection of information, organized for easy analysis and retrieval, consisting 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."

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. It implies existence of a coordinated dispatching service.

Dial-a-ride—Demand-responsive system in which curb-to-curb transportation is provided to patrons who request service by telephone, either on an ad hoc or a subscription basis.

Dispatcher—In demand-responsive transportation, the person who assigns the vehicles to customers and notifies the appropriate drivers, and who may schedule and route vehicles and monitor their operation.*

Dispatching—(1) In DRT systems, the process of assigning a sequence of trips to a vehicle; (2) relaying service instructions to drivers.*

Door-to-door service—Service that picks up passengers at the door of their place of origin and delivers them to the door of their destination.*

Drop-off—Vehicle stop to allow a passenger to disembark.*

Dynamic dispatch—Transferring trips from one vehicle to another or inserting trips in vehicle manifests based on real-time information during the service day.

Efficiency—Ratio of output (e.g., level of service provided) to input (e.g., cost or resource usage) that is providing the desired result with a minimum of effort, expense, waste, and so forth.*

Geocoding—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.*

Intelligent transportation system—Use of one or more microelectronics-based technologies to enhance a transportation system for the convenience of the rider or the efficiency of management.*

Legacy database—Information in the CASD system being replaced or upgraded that forms the basis for scheduling and dispatching customer trips. Data usually encompass the customer database, historical trip and billing information, subscription rider database, complaints, no-shows, and denials. Vendor installing a new system usually converts the data for use by the new software.

Mobile data computer (MDC)—In-vehicle piece of equipment that receives and sends digital messages and displays messages on a screen.*

Pickup—Vehicle stop to allow passenger to board the vehicle.*

Request for Proposal (RFP) process—Procurement approach in which multiple criteria (e.g., experience of proposer's firm and management personnel, financial ability) are used to evaluate a proposal, as contrasted with selecting a vendor based on lowest responsive price.

Route—Fixed path traversed by a transit vehicle in accordance with a predetermined schedule; the combination of street and road sections connecting an origin and destination.*

Schedule—Listing of every trip provided on a transit route during the hours of service, including specific stopping points or major loading areas.*

Scheduling—Giving a request for a trip an estimated time of pickup and/or drop-off.*

Scheduling, real-time—DRT service providing an immediate (as soon as possible) response to a request for service, usually within an hour.*

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

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

Vehicle miles—Total number of miles traveled by transit vehicles in a given period of time.*

Vehicle service hours—Total number of hours that each vehicle is available and ready to respond to trip requests, including layover time.*

Windows, pickup—Period of time usually provided to passengers making trip reservations; the "window" in which passengers should be ready for pickup, such as plus or minus 15 min. Some operators provide only the window information and not a precise scheduled time.

Source: *TCRP Report 18: A Handbook for Acquiring Demand-Responsive Transit Software* (*3*).

APPENDIX A

Survey Questionnaires

Transit Cooperative Research Program
Project J-7, Topic SA-15

Use of Computer-Aided Scheduling and Dispatch (CASD) for Demand-Response (DR) Transit Service*

Synthesis Questionnaire for Transit Agencies

Purpose of this Survey: Syntheses are "brief state-of-the practice reports," which are designed to provide facts and knowledge about current practices in transit. The aim of this Synthesis, SA-15, is to summarize and document transit agency, software vendor, and contract service provider experiences implementing and utilizing computer-aided scheduling and dispatch (CASD), the use of computerized information systems to aid in scheduling and/or dispatching paratransit, dial-a-ride, or other demand-response (DR) trips. The synthesis will examine both successful installations and instances where CASD systems did not perform according to expectations. With the growth of demand for DR transit service, CASD is a critical component of the overall DR transit service delivery system because of its central role in maintaining service and performance standards on the one hand and controlling costs on the other.

Analysis of responses to this Survey Questionnaire will form the basis for a TCRP Synthesis Report, which will combine information from surveys, a literature review, and follow-up telephone and on-site interviews with selected respondents. Through an evaluation of the "best practices" discovered through this study, the final recommendations will indicate how CASD might be used more effectively. Please note that this is not a study/evaluation of any agency, system, or software product. All individual ratings of the implementation results of CASD systems will be kept strictly confidential.

Your agency's input on this topic is important! Therefore, your timely attention to this survey is greatly appreciated. Please return this questionnaire by February 2, 2004, to the attention of David S. Kessler, 288 Lexington Avenue, New York, N.Y. 10016. If you have any questions, please e-mail Mr. Kessler at dsk15@cornell.edu. Include a phone number where you may be reached.

*Demand response service (U.S.DOT definition): Service provided upon request to pick up and transport passengers to and from their destinations. Typically, a vehicle may be dispatched to pick up several passengers at different pick-up points before taking them to their respective destinations and may be interrupted en route to these destinations to pick up other passengers.

Transit system: _____ Department: _____

Your name and title: _____

Address: _____

Telephone: _____ E-mail address: _____

I. Description of Your Transit System

Transit System Size

Population of Service Area (Check one.)

- ☐ Under 50,000
- ☐ 50,000–199,999
- ☐ 200,000–999,999
- ☐ 1,000,000 or greater

Type of Community/Area (Check one.)

- ☐ Urban
- ☐ Suburban
- ☐ Metropolitan (urban + suburban)
- ☐ Rural
- ☐ Other _____

Demand-Responsive Transit Services

Number of DR Vehicles in Daily Maximum Peak Service as of 12/2003:

	In-House	Dedicated Contract Service (incl. dedicated taxis)	Non-Dedicated Contract Service (incl. non-dedicated taxis)
W/C-equipped vehicles	_____	_____	_____
Ambulatory vans	_____	_____	_____
Sedans	_____	_____	_____
Totals	_____	_____	_____

Total Passenger Trips and Vehicle Hours Operated/Projected, 2003. (Indicate calendar year or agency fiscal year.)

	In-House	Dedicated Contract Service	Non-Dedicated Contract Service
Passenger trips	_____	_____	_____
Vehicle hours	_____	_____	_____

Types of Services/Passenger Eligibility (Check all that apply.)

- ☐ ADA paratransit
- ☐ Additional disabled per local policy
- ☐ Senior (eligible age =_____)
- ☐ Social service agency trips
- ☐ Medical trips
- ☐ General market suburban or rural area service
- ☐ Other _____

No. of persons registered to utilize your DR and Paratransit services: _____

Reservations Service Model—Who operates the call taking/reservations center? (Check all that apply.)
- ☐ In-house
- ☐ Service contractor(s)
- ☐ Broker
- ☐ Taxi company
- ☐ Other (specify) _____

Service Delivery Model—Who delivers the service? (Check all that apply.)
- ☐ In-house
- ☐ Service contractor(s)
- ☐ Broker
- ☐ Taxi company
- ☐ Other (specify) _____

Trip Scheduling Model—Who schedules the trips? (Check all that apply.)
- ☐ In-house
- ☐ Service contractor(s)
- ☐ Broker
- ☐ Taxi company
- ☐ Other (specify) _____

Dispatch/Service Control Model—Who monitors and controls service? (Check all that apply.)
- ☐ In-house
- ☐ Service contractor(s)
- ☐ Broker
- ☐ Taxi company
- ☐ Other (specify) _____

For service models other than "in-house," how are trips paid?
- ☐ Per mile
- ☐ Per trip
- ☐ Per hour

Do you fill requests for same-day service? Yes _____ No _____

If Yes, how many hours in advance must a user call? _____

II. Procurement and Implementation of Current CASD System

How many different models/brands of software has your agency used? _____

In what year did you acquire your first software model for use in DR scheduling and/or dispatching? _____

In what year did you initially acquire your current software for use in DR scheduling and/or dispatching? _____

Check reasons for upgrading from previous system or procedure. (Check all that apply.)
- ☐ Growth in demand/outgrew system
- ☐ Changed from manual scheduling
- ☐ Unsatisfactory performance of previous system
- ☐ New, improved product on the market
- ☐ Previous system too expensive to maintain
- ☐ Reduce staff workload

- ☐ Reduce overall costs
- ☐ Improve productivity
- ☐ Improve scheduling (e.g., on-time performance)
- ☐ Improve dispatch operations (e.g., control of vehicles/trips)
- ☐ Other _____

Type of system:

- ☐ Basic system (e.g., spreadsheet format for recording reservations only)
- ☐ Computer-assisted (i.e., record and sort requests, provide some reporting capability, but no scheduling/ dispatching modules)
- ☐ Purchased full-feature system (i.e., reservations, scheduling, dispatching, reporting)
- ☐ Other (describe) _____

How many major **software upgrades** have you implemented since the initial purchase (e.g., upgrade to Windows OS or conversion of software for brokerage operations)? _____

How many major **hardware upgrades** have you implemented since the initial purchase? _____

Is it capable of providing manifests, billing, etc. for a brokerage system (multiple service providers)?
Yes _____ No _____

Functionalities of current system. (Check all that are available.)

- ☐ Client registration and file
- ☐ Trip reservations/requests
- ☐ Scheduling
- ☐ Dispatch controls
- ☐ Billing
- ☐ Management reporting/operational statistics
- ☐ Mapping
- ☐ Interactive voice response
- ☐ Automatic dialing with canned messaging
- ☐ Software interface for automatic vehicle locator (AVL) and mobile data terminal (MDT) applications
- ☐ Web trip booking
- ☐ Other _____

Cost of Initial Software and Annual Maintenance Costs

Estimated cost for initial purchase of software (including customization), hardware, training, and implementation:

Software = $_____ Year _____

Hardware = $ _____ Year _____

Training costs by vendor for initial implementation = $ _____

Annual vendor charges for maintenance = $ _____
Additional vendor charges for after-hours support? Yes _____ No _____

Did the cost of installation significantly exceed your budget expectations? Yes _____ No _____
Please explain:

_____

_____

Did annual maintenance exceed your budget expectations? Yes ____ No _____

Please explain:

_____

_____

Number of FT equivalent IT **in-house** staff members for system maintenance in 2003: _____

Number of FTE **contract broker/service** provider IT staff members required in 2003: _____

Are you satisfied that the current system can handle both current and projected demand, assuming expected costs for modifications and upgrades? Yes _____ No _____

Please explain:

_____

_____

Procurement Process

Procurement method/type of bid for your last **initial installation of a new CASD system:**

- ☐ Competitive low price
- ☐ RFP process
- ☐ Negotiated single source
- ☐ Best responsive bid
- ☐ If bid, how many bids did you consider? _____

If applicable, did you purchase software for use by a coordinated service for a consortium of transit operators?

Yes _____ No _____

Did you require customization? Yes _____ No _____

Who developed the specifications and needs for software acquisition?

- ☐ In-house (procurement staff working with DR operations staff)
- ☐ Utilized outside consultant
- ☐ Adopted specifications proposed by software vendors
- ☐ Don't know
- ☐ Other (describe) _____

How did you identify software products available? (Check all that apply.)

- ☐ Consulted with APTA and/or another transit agency
- ☐ Trade publications
- ☐ Word-of-mouth
- ☐ Transit exhibitions
- ☐ Internet search
- ☐ Personal contact with vendors
- ☐ Don't know
- ☐ Other _____

Whether you hired an expert in CASD software or not, please indicate how important you now feel it is to seek independent professional advice on CASD software:

- ☐ Very important
- ☐ Somewhat important
- ☐ Not so important

- ☐ Not important at all
- ☐ Don't know

As part of the procurement process, did you:

- ☐ Request vendors to provide you with software for testing and evaluation purposes?
  Yes _____ No _____
- ☐ If yes to previous question, did they comply?
  Yes _____ No _____
- ☐ Require on-site demonstrations of the software?
  Yes _____ No _____
- ☐ Have the software vendor use your site data for the demonstration?
  Yes _____ No _____
- ☐ Complete a thorough reference check of vendors?
  Yes _____ No _____

Implementation

Did you use an outside project management consulting service for the implementation process?
Yes _____ No _____

Did you develop a detailed plan with the vendor for installation, training, and testing of your new system? Describe the extent to which you prepared with the vendor for installation. (Check one.)

- ☐ Extensive study and implementation plan
- ☐ Less extensive study, but developed tasks and timetables
- ☐ Relied primarily on vendor
- ☐ Did not conduct study
- ☐ Don't know

Comments:

Did your plan call for a timed phase-in of the CASD system? Yes _____ No _____. Whether you used this approach or not, discuss your specific recommendations regarding planning for implementation:

If your system utilizes private service contractors, or other entities external to your agency, did they play a role in the planning process?

- ☐ Involved in most aspects of planning process
- ☐ Had input in implementation process, such as advising on establishment of service policies and system parameters
- ☐ Provided advice on operational impacts of scheduling and dispatching modules as part of design
- ☐ Helped to develop training programs
- ☐ Helped to test system and evaluate results
- ☐ Participated only after design and testing was completed and preparations were being made for training and "going live" on start date

Based on your experience, how important is it for a transit agency manager in charge of a CASD installation or upgrade to have had previous experience in implementing CASD?

- ☐ Very important
- ☐ Somewhat important

- ☐ Not so important
- ☐ Not important at all
- ☐ Don't know

Establishment of database: Were you satisfied with the implementation in terms of transfer/development of your system's database (i.e., accuracy and/or timeliness)?

- ☐ Very satisfied
- ☐ Somewhat satisfied
- ☐ Not very satisfied
- ☐ Not satisfied at all
- ☐ Don't know

Comments:

_____

_____

Testing of software: Were you satisfied with the phase that involved testing of software before "going live"?

- ☐ Very satisfied—sufficient time allowed
- ☐ Somewhat satisfied
- ☐ Not very satisfied
- ☐ Not satisfied at all—not enough time allowed
- ☐ Don't know

Comments:

_____

_____

Training

Please indicate the basic level of computer familiarity of the average agency staff member or contractor staff member who would be utilizing CASD:

	Agency Staff Member	Contractor Staff Member (if applicable)
Very knowledgeable		
Somewhat knowledgeable		
Not very knowledgeable		
Not knowledgeable at all		
Don't know		

How many hours of training were provided to each of your agency personnel or contractor personnel, if applicable?

Type of Employee	Agency Staff	Contractor Staff
☐ Management	_____	_____
☐ Reservationists	_____	_____
☐ Dispatchers	_____	_____
☐ Schedulers	_____	_____
☐ Administrative personnel	_____	_____
☐ Technical support personnel	_____	_____

Please evaluate whether your staff training programs met your expectations?

- ☐ Very satisfied
- ☐ Somewhat satisfied
- ☐ Not very satisfied
- ☐ Not satisfied at all
- ☐ Don't know

Please indicate what changes you would recommend in the area of training for transit systems implementing CASD systems:

_____

_____

Who conducted the training programs?

- ☐ Vendor
- ☐ Transit agency staff
- ☐ Consultant/contractor
- ☐ Train the trainer
- ☐ Other _____

Was someone in management present at all training sessions to address policies? Yes _____ No _____

In retrospect, would you have allowed more time for installation/implementation, including training and data development? Yes _____ No _____

Comments:

_____

_____

III. Evaluations of Results of Implementation

How would you describe the vendor/agency relationship during the implementation process?

- ☐ Outstanding synergy (capabilities of software clearly explained, all questions answered realistically, realistic timetable)
- ☐ Somewhat successful (most concerns were promptly addressed)
- ☐ Partially successful (problems arose during implementation)
- ☐ Not at all successful (expectations not clearly met at all, difficulties in setting policy parameters, database problems, GIS data problems)
- ☐ Don't know

Please compare your overall expectations with what was accomplished during the implementation phase:

- ☐ Very satisfied
- ☐ Somewhat satisfied
- ☐ Not very satisfied
- ☐ Not satisfied at all
- ☐ Don't know

To what extent did you rely on the software vendor regarding incorporation of agency DR policies and report design into system design?

- ☐ Completely
- ☐ Somewhat

- ☐ Not very much
- ☐ Not at all
- ☐ Don't know

During implementation, did you experience any of the following problems or impediments that caused delays?

- ☐ Database accuracy and/or conversion problems
- ☐ Extensive software bugs
- ☐ Hardware and network difficulties
- ☐ Accurate GIS coding for your jurisdiction (if applicable)
- ☐ Extensive delays (comment on causes below)
- ☐ Developing standardized management and billing reports
- ☐ Others (please comment)
- ☐ Don't know

Comments:

_____

_____

Performance of features of your current system. We wish to know how satisfied you are with the individual features of your current CASD system. Rate the following areas in terms of benefits and problems you have experienced.

	Very Satisfied	Somewhat Satisfied	Not Very Satisfied	Not at all Satisfied	Don't Know	Don't Utilize
Facilitates reservations (e.g., automatically displays all information necessary to book trips + real-time confirmations)						
Provides accurate, reliable schedules						
Ease of transforming manifests into driver tours and schedules						
Optimizes vehicle utilization						
Flexibility to modify scheduling parameters (e.g., by time of day, geography)						
Flexibility to modify scheduling weights (deadhead, directness of travel)						
Improves on-time performance						
Facilitates dynamic dispatching/trip insertions						
Facilitates provision of same-day service (if applicable)						
Ease of learning						
Quality of training program						
Intuitive, easy to learn and user friendly						
Impact on morale (e.g., less hectic work environment)						
Improved productivity						
Reduction in cost per trip						
Workload reduction						
Reduces staffing levels						
Cost of maintaining CAD system						
Management reports/record keeping						
Provides real-time customer information						
Billing, trip reconciliation and financial reports						
NTD reporting						

Very Satisfied = fully met expectations; Somewhat Satisfied = partially met expectations; Not Very Satisfied = met only a small part of expectations; Not at All Satisfied = did not meet expectations.

Final Question: Would you favor the development of an independent website that provides a "newsgroup" for CASD users and vendors to share information, such as access to a directory of software vendors, information about systems and users, information about available training courses, and a current bibliography of CASD resources and research?

- ☐ Extremely helpful
- ☐ Somewhat helpful
- ☐ Not very helpful
- ☐ Not helpful at all

****

Return by February 2, 2004 to:

David S. Kessler
288 Lexington Avenue,
New York, N.Y. 10016
Voice: (212) 696-9203
Fax: (413) 604-0124
E-mail: dsk15@cornell.edu

THANK YOU FOR YOUR COOPERATION!

NOTE: The following pages contain supplemental (optional) questions designed to permit you to amplify your views on actions you would take to improve the opportunity for a successful implementation of a CASD system, and other related topics. Your answers may help guide other agencies in addressing some of the key issues and/or point out pitfalls to avoid along the way to implementation.

Supplemental Questions (Optional)

Looking back at your last initial installation of a new CASD system . . .

Describe which steps/actions taken during implementation worked well and produced the most successful results:

1. _____

2. _____

3. _____

In retrospect, what are some of the questions you should have raised, or actions you could have modified or reconsidered in order to avoid pitfalls and ensure a successful implementation (e.g., more time, better planning, more consultation)?

1. _____

2. _____

3. _____

Looking back at your experience with major upgrades . . .

Discuss what you would do differently to ensure success of your upgrade implementation:

_____

_____

_____

Additional comments on performance of current system

Please elaborate on the most important principal features that have met your agency's expectations (e.g., enhanced service delivery, efficiency, provide for smooth operations) and contributed to the success of your program. (Use additional sheets, if necessary):

_____

_____

_____

Please elaborate on the principal features that have not performed as expected (or only partially met your agency's expectations), and which, in your opinion, need to be improved in order to make your program more successful. (Use additional sheets if necessary):

_____

_____

_____

What have you learned about scheduling policies and their impacts/tradeoffs . . .

On productivity?

On call-taking operations?

On dispatch operations?

On management reporting?

On financial reporting?

Business and operating practices/changes in management techniques (e.g., workload distribution, use of data for decision making, tracking schedule adherence, monitoring contractor performance).

In your experience, what are the specific limitations and obstacles you have encountered in working with CASD software in terms of having to change your organization and your operating practices? (Use additional sheets, if necessary.)

Please describe how you have modified your operating practices/policies to work within software limitations. Indicate if you have stopped using parts of the software.

Impact on controlling contractor performance: Please comment on ways in which your CASD system has helped you improve your capability to control private contractor performance. Also, are there features which you would like to have incorporated in your system that would improve your monitoring and control capability?

To what extent do you feel that the software controls the operation vs. management's ability to set software parameters?

- ☐ Somewhat controls
- ☐ Controls to some extent
- ☐ Doesn't control very much
- ☐ Doesn't control at all
- ☐ Don't know

General Comments: Please discuss any final thoughts you have for achieving successful implementation of a CASD system. Would your agency have approached the process differently? What have you learned about budgeting for such systems? Would you have interacted differently with your software vendor? What can software vendors do to facilitate successful implementation? What advice do you have for planning for and managing system upgrades?

Thank you for responding to the Supplemental Questions

Transit Cooperative Research Program
Project J-7, Topic SA-15

Use of Computer-Aided Scheduling and Dispatch (CASD) for Demand-Response (DR) Transit Service*

Synthesis Questionnaire for Software Vendors

Purpose of this Survey: Syntheses are "brief state-of-the practice reports," which are designed to provide facts and knowledge about current practices in transit. The aim of this Synthesis, SA-15, is to summarize and document transit agency, software vendor, and contract service provider experiences implementing and utilizing computer-aided scheduling and dispatch (CASD), including both successful installations and instances where CASD systems did not perform according to expectations. With the growth of demand for demand-response (DR) transit service, CASD is a critical component of the overall DR transit service delivery system because of its central role in maintaining service and performance standards on the one hand and controlling costs on the other.

Analysis of responses to this Survey Questionnaire will form the basis for a TCRP Synthesis Report, which will combine information from surveys, a literature review, and follow-up telephone and on-site interviews with selected respondents. Through an evaluation of the "best practices" discovered through this study, the final recommendations will indicate how CASD might be used more effectively. Please note that this is not a study/evaluation of any agency, system, or software product. All individual responses will be kept strictly confidential.

Your company's input on this topic is important! Therefore, your timely attention to this survey is greatly appreciated. Please return this questionnaire by February 2, 2004, to the attention of David S. Kessler, 288 Lexington Avenue, New York, N.Y. 10016. If you have any questions, please e-mail Mr. Kessler at dsk15@cornell.edu. Include a phone number where you may be reached.

*Demand response service (U.S.DOT definition): Service provided upon request to pick up and transport passengers to and from their destinations. Typically, a vehicle may be dispatched to pick up several passengers at different pick-up points before taking them to their respective destinations and may be interrupted en route to these destinations to pick up other passengers.

Company name and address: _____

(As you wish it to be listed among respondents in final publication by TRB.)

Name of individual completing the questionnaire and title: _____

Telephone: _____ Fax: _____ E-mail address: _____

I. Description of Your Transit-Related Software Products

1. For how many years has your company been providing software products to the transit industry?

   No. of years _____

2. Types of transit-related software products in your product line?

   _____

   _____

   _____

3. Demand-responsive software

List the different DR software products that you currently offer, indicating the scope of operations for which they are best suited.

Name of software	Suitable for these ranges of operations (e.g., no. of trips, no. of vehicles)
_____	_____
_____	_____
_____	_____
_____	_____

4. What is the breadth of your company's experience since it was established, as indicated by the total number of DR software installations/sites since 1990?

   No. of small sites _____ No. of medium-sized sites _____ No. of large sites _____
   (Small < 500 trips per day, Medium = 501–1,000 trips per day, Large ≥ 1,000 trips per day)

   How many transit or other (e.g., social service) agencies are **currently** utilizing your CASD DR software?

   _____

5. Check the DR service delivery models that your company's software provides applications for. (Check all that apply.)

	Advanced Reservations	Scheduling	Dispatching	Same-Day Service Requests
☐ In-house				
☐ Contractor(s)				
☐ Broker				
☐ Taxi companies				
☐ Other (specify)				
☐ All of the above				

6. In your experience, what are principal reasons cited by transit agencies for changing/upgrading their DR software (rank top five in order of importance)?

_____ Growth in demand/outgrew system
_____ Unsatisfactory performance
_____ New, improved product on the market
_____ Too expensive to maintain
_____ Reduce staff workload
_____ Reduce overall costs
_____ Improve productivity
_____ Improve scheduling (e.g., on-time performance)
_____ Improve dispatch operations (e.g., control of vehicles/trips)
_____ Other(s) _____

Please specify the threshold (i.e., no. of trips/weekday) at which manual scheduling systems break down and CASD becomes necessary:
_____ trips/weekday

7. Procurement methods: Types of bids you have participated in

☐ Competitive low price
☐ RFP
☐ Negotiated single source
☐ Other_____

II. Working with a Transit Agency That Is Acquiring Your Software

Specifications: In your experience, who generally develops the specifications and needs for software acquisition?
☐ In-house (procurement staff working with DR operations staff)
☐ Outside consultant
☐ Adopted specifications proposed by software vendors
☐ Other (describe) _____

Software Products: In your experience, how do transit agencies learn about software products available?

- ☐ Consulted with APTA and/or another transit agency
- ☐ Trade publications
- ☐ Word-of-mouth
- ☐ Transit exhibitions
- ☐ Internet search
- ☐ Contacted by sales representative
- ☐ Other_____

Understanding of CASD: Do most of the key transit agency officials that you deal with have a good understanding of how CASD systems function?

Yes ____ No _____

What recommendations would you have for improving their understanding?

_____

_____

Procurement Process: Do agencies generally provide enough lead time for this process? Describe the extent to which the procurement processes of agencies have been an impediment to the overall successful implementation of your CASD systems. (Check one.)

- ☐ Very much an impediment
- ☐ Somewhat of an impediment
- ☐ Not much of an impediment
- ☐ Not an impediment at all
- ☐ Don't know

Enough lead time? Yes _____ No _____

Do you feel that having more time for the actual installation/implementation would lead to a more successful installation?

Yes _____ No _____ No impact _____

What major changes in agency procurement practices would you recommend that could facilitate the successful implementation of CASD?

_____

_____

_____

Planning and Preparation: Describe the extent to which you plan and prepare with a transit agency for installation. (Check one.)

- ☐ Extensive study and implementation plan
- ☐ Less extensive study, but developed tasks and timetables
- ☐ Agency relies primarily on vendor
- ☐ Detailed review of customization requirements prior to implementation

Can you recommend one or two actions which could significantly improve this phase?

_____

_____

Experience: How important do you feel having transit agency staff with extensive transit experience is to the success of a project?

- ☐ Very important
- ☐ Somewhat important
- ☐ Not very important
- ☐ Not important at all
- ☐ Don't know

System Design: Are you satisfied with the manner in which transit agencies "sign off" on a comprehensive system design (e.g., step-by-step description of what each party is expected to do, time frame, and costs) that is part of the preparation and planning process?

- ☐ Very satisfied
- ☐ Somewhat satisfied
- ☐ Not very satisfied
- ☐ Not satisfied at all

Would you recommend any changes in the way transit agencies approach this step?

_____

_____

Customization: Have you found that transit agencies are flexible enough when it comes to requesting customization of your software (e.g., accepting a canned report that differs slightly in format from the current report), and do they understand the time and money implications of customization requests?

- ☐ Very flexible and understanding
- ☐ Somewhat flexible and understanding
- ☐ Not very flexible and understanding
- ☐ Not flexible and understanding at all

Comments:

_____

_____

_____

Hardware Specifications: Do you advise transit agencies about the minimum specifications for equipment that is required to run software as well as equipment that will ensure operation at peak performance?
Yes _____ No _____

Comment on whether agencies, in general, understand the implications of utilizing non-conformant configurations, outdated equipment, unauthorized server software, etc.

Comments:

_____

_____

_____

Migration to a New Software System and Data Development: How important is this area, and do you have any recommendations that will promote more successful implementations (e.g., purging client data for those customers who have not used the DR system for a long time, automatic vs. manual re-entry of data, eliminating duplication or other unnecessary data, reports)?

Comments:

_____

_____

_____

Please comment on issues related to integration of databases of legacy software if an agency is converting to a new CASD system, and appropriate integration with legacy accounting system. How can these conversions be made more successful?

Comments:

_____

_____

_____

Common Definitions and Terms: When defining terms such as passenger miles, vehicle hours, reporting parameters, and billing and reimbursement methodology, what steps should be taken to ensure that agencies and vendors are "talking the same language?"

_____

_____

_____

Currently Booked Subscription Trips: Do you generally recommend that transit systems reschedule current subscription trips when migrating to new CASD software (to maximize efficiency)? Yes _____ No _____

Is this typically done? Explain.

_____

_____

_____

Business Rules: Do you typically have a clear idea of what sets of rules govern DR or paratransit management systems at a customer site for which you are submitting a bid?

Fare structure	Yes _____ No _____
Performance and scheduling windows	Yes _____ No _____
Other system parameters	Yes _____ No _____
Billing practices	Yes _____ No _____
Methodology for payment to subcontractors	Yes _____ No _____
Other _____	Yes _____ No _____

Upon implementation, are they typically the same rules as those specified in the contract? Yes _____ No _____

What steps would you recommend that would lead to clearer articulation of the rules? _____

Description of Vehicle Fleet: Accuracy in defining the available fleet capacity is sometimes an obstacle to achieving successful performance of the scheduling module. What steps would you recommend to improve the data furnished by agencies in terms of vehicles types, wheelchairs that can be accommodated, rules for ambulatory vs. wheelchair vehicles, etc.?

Training: Is your training program formally scheduled and mandatory, in a non-operational setting?

Yes _____ No _____
Are staff members usually available for training purposes? Yes _____ No _____

On a scale of 1 to 5, indicate whether agencies place enough emphasis on support and training. (1 = hardly any emphasis, 5 = great emphasis.)

_____

What measures, if any, would you recommend to improve the training of agency/contractor staff members during the implementation/installation phase and/or to improve the ease of learning the use of the CASD software?

Technical Support: Do you usually have staff on site during the week before start-up? Yes _____ No _____
Are there limitations that may preclude you from providing enough technical support during this period (e.g., budget constraints)?
Explain.

"Buy-in Factor": Have you ever experienced a diminished opportunity for successful CASD implementation due to the lack of a "buy-in factor" (or a "lukewarm" buy-in) among all parties (e.g., transit agency personnel, vendor, contractor service provider, managers, drivers, and dispatchers)? If you feel that improvements are warranted in this area, explain what steps could be taken by transit agencies.

Contract Service Providers: What role, if any, do you feel that the managers and technical staffs of contract service providers should play in the following aspects of CASD implementation?

CASD planning process _____

_____

System implementation design (including operational parameters) _____

_____

Design of training programs _____

_____

Any other areas in which you feel they should participate _____

_____

Would their participation enhance successful CASD implementation? Yes _____ No _____ In what ways?

_____

_____

_____

Use of Features and Reporting Capabilities: Please elaborate on the principal features that transit agencies successfully implement and utilize in order to meet their DR system objectives.

_____

_____

_____

Please elaborate on the features that transit agencies do not utilize and which, in your opinion, would make their programs more successful if utilized.

_____

_____

_____

Expectations: Based on your experience, indicate the principal areas in which there may be misunderstandings or misimpressions between vendors and transit agencies regarding expectations (e.g., overall system performance, scheduling and/or dispatching modules, time frame for installation/testing, performance of individual features, costs and benefits).

_____

_____

_____

_____

Business and Operating Practices/Changes in Management Techniques (e.g., workload distribution, use of data for decision making, tracking schedule adherence, monitoring contractor performance).

Have you modified your software to accommodate specific business limitations and obstacles that transit agencies have encountered in working with your products? Yes _____ No _____ If so, provide one or two examples.

_____

_____

_____

_____

Have transit agencies stopped using parts of your software? Please give some examples and the reasons cited.

_____

_____

_____

_____

In utilizing your software products to achieve the goal of maximizing service quality and efficiency, do you have any recommendations that would improve the knowledge among transit agencies regarding scheduling practices and policies and their impacts/tradeoffs on:

- ☐ Productivity
- ☐ Schedule adherence
- ☐ Call-taking operations
- ☐ Dispatch operations
- ☐ On management reporting
- ☐ Billing and financial reporting

_____

_____

_____

_____

Key Problem Areas: If we have failed to address any key element or activity that affects whether CASD is successfully implemented or not, please give some examples of critical areas that vendors and/or transit agencies need to pay more attention to.

1. _____

2. _____

3. _____

4, _____

Final Question: Would you favor the development of an independent website that provides a "newsgroup" for CASD users and vendors to share information, such as access to a directory of software vendors, information about systems and users, information about available training courses, and a current bibliography of CASD resources and research?

- ☐ Extremely helpful
- ☐ Somewhat helpful
- ☐ Not very helpful
- ☐ Not helpful at all

****

Return by February 2, 2004 to:

David S. Kessler
288 Lexington Avenue
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Voice: (212) 696-9203
Fax: (413) 604-0124
E-mail: dsk15@cornell.edu

THANK YOU FOR YOUR COOPERATION!

Transit Cooperative Research Program
Project J-7, Topic SA-15

Use of Computer-Aided Scheduling and Dispatch (CASD) for Demand-Response (DR) Transit Service*

Synthesis Questionnaire for Contract Service Providers

Purpose of this Survey: Syntheses are "brief state-of-the practice reports," which are designed to provide facts and knowledge about current practices in transit. The aim of this Synthesis, SA-15, is to summarize and document transit agency, software vendor, and contract service provider experiences implementing and utilizing computer-aided scheduling and dispatch (CASD), including both successful installations and instances where CASD systems did not perform according to expectations. With the growth of demand for demand-response (DR) transit service, CASD is a critical component of the overall DR transit service delivery system because of its central role in maintaining service and performance standards on the one hand and controlling costs on the other.

Analysis of responses to this Survey Questionnaire will form the basis for a TCRP Synthesis Report, which will combine information from surveys of transit agencies, software vendors, and contract service providers, a literature review, and follow-up telephone and on-site interviews with selected respondents. Through an evaluation of the "best practices" discovered through this study, the final recommendations will indicate how CASD might be implemented and used more effectively. Please note that this is not a study/evaluation of any agency, system, or software product. All individual responses will be kept strictly confidential.

Your company's input on this topic is important! Therefore, your timely attention to this survey is greatly appreciated. Please return this questionnaire by February 2, 2004, to the attention of the Synthesis Consultant: David S. Kessler, 288 Lexington Avenue, New York, N.Y. 10016. If you have any questions, please e-mail Mr. Kessler at dsk15@cornell.edu. Include a phone number where you may be reached.

*Demand response transit service (U.S.DOT definition): Service provided upon request to pick up and transport passengers to and from their destinations. Typically, a vehicle may be dispatched to pick up several passengers at different pick-up points before taking them to their respective destinations and may be interrupted en route to these destinations to pick up other passengers.

Company name and address: _____

Name of individual completing the questionnaire and title: _____

Telephone: _____ Fax: _____ E-mail address: _____

I. Description of Your Company's Demand-Responsive Transit Services

1. For how many years has your company been providing paratransit and/or other demand-responsive transit services to the transit industry?

   No. of years _____

2. What is the breadth of your company's experience with DR transit service since 1990, as indicated by the total number of paratransit and/or DR sites (i.e., different transit and/or social service agencies you have had contracts with)?
   - ☐ Less than 25
   - ☐ 25 to 50
   - ☐ 51 to 75
   - ☐ More than 75

   Current number of transit or other (e.g., social service) agencies at which you currently contract to provide DR transit services? _____

3. How many different types/brands of CASD software products has your company utilized since 1990 (include both DOS and Windows)? At your option, list the different types/brands.

   _____

   _____

   _____

4. Check the DR service delivery models that your company has had experience with:
   - ☐ Perform all functions (reservations, scheduling, dispatching, operations)
   - ☐ Transit agency operates call center; contractor performs other functions
   - ☐ Transit agency operates call center and scheduling; contractor performs other functions
   - ☐ Transit agency performs all functions, except operation of service
   - ☐ Other (specify) _____

II. Working with a Transit Agency That Is Acquiring CASD Software (or undertaking a major upgrade)

Specifications: In your experience, do transit agencies that you contract with involve your on-site managers or your corporate experts in the development of the specifications/needs, as well as planning for CASD software acquisition?
- ☐ In all installation of CASD software
- ☐ Most of the time
- ☐ Some of the time
- ☐ Little of the time, or hardly at all
- ☐ Other (describe) _____

Do you feel that your company could contribute to successful implementation should you have input into this process? Yes _____ No _____

If yes, specifically how?

_____

_____

_____

Understanding of CASD: Do your key managers and officials assigned to DR transit services understand how CASD systems function?

- ☐ All personnel
- ☐ Most personnel
- ☐ Some personnel
- ☐ Few personnel

Explain: _____

_____

Software Products: How do your personnel learn about the characteristics and capabilities of CASD software products available? (Check all that apply.)

- ☐ Company's formal training programs
- ☐ On-the-job training
- ☐ From APTA sources
- ☐ Trade publications
- ☐ Word-of-mouth
- ☐ Transit exhibitions
- ☐ Internet search
- ☐ Other _____

Procurement Process: In general, describe the extent to which you are asked by a transit agency to provide advice or input in the procurement of CASD software.

- ☐ All of the time
- ☐ Most of the time
- ☐ Some of the time
- ☐ Little of the time, or hardly at all

Do you feel that your company's participation or input in this would be beneficial? Yes _____ No _____
If yes, how?

_____

_____

In your experience, would it help if agencies provided more lead time for this process? Yes _____ No _____

Please explain: _____

_____

Based on your experience, are there any significant changes in agency procurement practices that you would recommend to facilitate the successful implementation of CASD?

_____

_____

_____

Migration to a New Software System and Data Development: In installations you have been involved with, have there been issues involving the accuracy and integrity of databases that are developed or migrated from another system. Do you have any suggestions vis-a-vis implementation of client and other databases that would promote more successful implementations?

Comments:

Common Definitions and Terms: When defining terms such as passenger miles, vehicle hours, reporting parameters, and billing and reimbursement methodology, do you believe that there are measures that could be taken to ensure that agencies and vendors are "talking the same language?" Please provide specific examples.

Business Rules: Do you typically have a clear idea of what sets of rules govern DR or paratransit management systems? Are you consulted by the transit agencies on the development of the rules? Should you be consulted (e.g., fare structure, performance and scheduling windows and other system parameters, billing practices, and methodology for payment to subcontractors)? Can you recommend any steps that would lead to clearer articulation of the rules?

Description of Vehicle Fleet: Accuracy in defining the available fleet capacity is sometimes an obstacle to achieving successful performance of the scheduling module. In your experience, what measures could be taken to improve the operation of CASD in terms of scheduling for different vehicles types, different wheelchairs that can be accommodated, rules for ambulatory vs. wheelchair vehicles, etc.?

Training: Are the typical training programs you participate in formally scheduled and mandatory, in a non-operational setting? Yes _____ No _____

Are your staff members generally freed up for training purposes? Yes ____ No _____

Do agencies, in general, place enough emphasis on support and training? Yes _____ No _____
What measures, if any, would you recommend to improve the sufficiency of training and the ease of learning during the implementation/installation phase?

Technical Support: Do you usually have your own IT technical support staff on site at any time prior to start-up? To what extent is their presence maintained or necessary following start-up?

"Buy-in Factor": In general, is it your view that there is sufficient "buy-in" among all parties (e.g., transit agency personnel, vendor, contractor service provider, managers, drivers, dispatchers) to ensure successful implementation? If you feel that improvements are warranted in this area, explain what steps could be taken by transit agencies.

Use of Features and Reporting Capabilities: Please elaborate on the principal CASD features that you feel are most useful and beneficial for the successful operation of the contract paratransit and/or DR transit services that you provide.

Expectations: Based on your overall experience, indicate the principal areas in which there may be misunderstandings or misimpressions among transit agencies, software vendors, and service providers regarding expectations (e.g., overall system performance, scheduling and/or dispatching modules, time frame for installation/testing, performance of individual features, costs and benefits).

Input in CASD Decisions During <u>Operational</u> Phase: In a typical operation, do your managers and other knowledgeable staff members meet with transit agency officials on a regular basis to discuss modifications of CASD rules, parameters, etc.? Are you generally satisfied with these relationships, or would you recommend changes in the interest of improving the effectiveness of CASD?

Business and Operating Practices/Changes in Management Techniques (e.g., workload distribution, use of data for decision making, tracking schedule adherence, monitoring contractor performance):

Have you noted any issues with CASD software that specifically required you to alter your business practices and management techniques? Are there features not currently offered that would help you from a business or operating standpoint? Provide examples.

Scheduling Practices and Policies: In utilizing the CASD software products provided to your company by transit agencies to achieve the operational goal of maximizing service quality and efficiency, have you any suggestions for expanding the understanding among transit agencies, service contractors, and vendors as regards scheduling practices and policies and their impacts/tradeoffs on:

Productivity:

Schedule adherence:

Call-taking operations:

Dispatch operations:

On management reporting:

Billing and financial reporting:

Key Problem Areas: If we have failed to address any key element or activity that affects whether CASD is successfully implemented or not, please give some examples of critical areas that vendors and/or transit agencies need to pay more attention.

1.

2.

3.

Additional Comments or Recommendations:

Comments:

Final Question: Would you favor the development of an independent website that provides a "newsgroup" for CASD users and vendors to share information, such as access to a directory of software vendors, information about systems and users, information about available training courses, and a current bibliography of CASD resources and research?

- ☐ Extremely helpful
- ☐ Somewhat helpful
- ☐ Not very helpful
- ☐ Not helpful at all

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Return by February 2, 2004 to:

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THANK YOU FOR YOUR COOPERATION!

APPENDIX B

Survey Respondents

Transit Agencies

Access Services, Inc., Los Angeles, California
Brazos Transit District, Bryan, Texas
Broward County Division of Mass Transit, Pompano Beach, Florida
Capital District Transportation Authority, Albany, New York
Charlotte Area Transit System, Charlotte, North Carolina
Delaware Transit Corporation, Dover, Delaware
King County Department of Transportation, Seattle, Washington
Madison Metro, Madison, Wisconsin
Metropolitan Transit Authority of Harris County, Houston, Texas
Metropolitan Transit Authority, Nashville, Tennessee
Metropolitan Transportation Authority Long Island Bus, Garden City, New York
New Jersey Transit Corporation, Newark, New Jersey
Orange County Transportation Authority, Anaheim, California
Pace Suburban Bus, Arlington Heights, Illinois
Redding Area Transit, Redding, California
Regional Transportation District, Denver, Colorado
Southeastern Pennsylvania Transportation Authority, Philadelphia, Pennsylvania
Tompkins Consolidated Transit, Ithaca, New York
Transit Authority of River City, Louisville, Kentucky
Utah Transit Authority, Salt Lake City, Utah
VIA Metro Transit, San Antonio, Texas

Contract Service Providers

Laidlaw Transit Services, Inc., Overland Park, Kansas
LogistiCare, Inc., Atlanta, Georgia
MV Transportation, Inc., Fairfield, California
Yellow Transportation, Inc./Connex, Baltimore, Maryland

CASD Software Vendors

Mobilitat, Green River, Wyoming
RouteMatch Software, Inc., Atlanta, Georgia
StrataGen Systems, Inc., Kirkland, Washington
Trapeze Software Group, Scottsdale, Arizona

Abbreviations used without definition in TRB Publications:

AASHO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
APTA	American Public Transportation Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
CTAA	Community Transportation Association of America
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
IEEE	Institute of Electrical and Electronics Engineers
ITE	Institute of Transportation Engineers
NCHRP	National Cooperative Highway Research Program
NCTRP	National Cooperative Transit Research and Development Program
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
SAE	Society of Automotive Engineers
TCRP	Transit Cooperative Research Program
TRB	Transportation Research Board
U.S.DOT	United States Department of Transportation