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16. Abstract:

The ability of transit service providers in small urban areas and rural communities to meet increasing demands generated by welfare-to-work customers and other social agencies depends on their ability to make best use of available resources through efficient scheduling and service delivery. Scheduling trips and dispatching vehicles are critical functions in operating any transit system. Scheduling, in general public and special paratransit systems, refers to the matching of vehicles and trip requests. Collecting and managing rapidly changing data is essential for efficiency and effectiveness of these functions, as are the decisions involved in vehicle assignment and routing. Effective use of modern information technology can help address this issue. In these systems, data management is complicated by the fact that clients of several external agencies contribute to system demand.

The primary goals of this project are to investigate the technical problems associated with integrating data from several external agencies, and to recommend (1) an existing commercially available dispatching and scheduling system that can be used by all Texas paratransit systems and (2) implement improvements for the transit agencies and their external partners that will enable them to realize the full benefits of the new system.

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Evaluation of Software Solutions for Transit Scheduling and Data Integration Needs

by

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Research performed in cooperation with the Texas Department of Transportation and the U.S. Department of Transportation, Federal Highway Administration.

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Implementation Recommendations

The primary goals of this project are to investigate the technical problems associated with integrating data from several external agencies, and to recommend (1) an existing commercially available dispatching and scheduling system that can be used by all Texas paratransit systems and (2) implement improvements for the transit agencies and their external partners that will enable them to realize the full benefits of the new system.

The research team neither recommends nor endorses any of the currently available packages identified and reviewed in this project. The team believes a more flexible, Web-enabled, less expensive software solution could be customized for paratransit applications, offering greater ease of use and flexibility. The research team's recommendation is to conduct procedural audits similar to those done in this project at the other paratransit agencies, and to identify low-cost improvements that minimize disruptions to existing operations and that increase the service effectiveness and operational efficiency of these organizations. However, in some instances, more extensive re-engineering might be called for, especially when major technological and software introduction is contemplated, as the latter would provide a catalyst for doing things better. In any case, each agency is different, and one-size-fits-all solutions would not be appropriate.

Abstract

The ability of transit service providers in small urban areas and rural communities to meet increasing demands generated by welfare-to-work customers and other social agencies depends on their ability to make best use of available resources through efficient scheduling and service delivery. Scheduling trips and dispatching vehicles are critical functions in operating any transit system. Scheduling, in general public and special paratransit systems, refers to the matching of vehicles and trip requests. Collecting and managing rapidly changing data is essential for efficiency and effectiveness of these functions, as are the decisions involved in vehicle assignment and routing. Effective use of modern information technology can help address these problems. In these systems, data management is complicated by the fact that clients of several external agencies contribute to system demand.

The primary goals of this project are to investigate the technical problems associated with integrating data from several external agencies, and to recommend (1) an existing commercially available dispatching and scheduling system that can be used by all Texas paratransit systems and (2) process improvements for the transit agencies and their external partners that will enable them to realize the full benefits of the new system.

Executive Summary

This report documents the findings of the project team regarding integrated scheduling of paratransit operations. The ability of transit service providers in small urban areas and rural communities to meet increasing demands generated by welfare-to-work customers and other social agencies depends on their ability to make the best use of available resources through efficient scheduling and service delivery. Scheduling trips and dispatching vehicles are critical functions in operating any transit system. Scheduling, in general public and special paratransit systems, refers to the matching of vehicles and trip requests. Collecting and managing rapidly changing data is essential for efficiency and effectiveness of these functions, as are the decisions involved in vehicle assignment and routing. Effective use of modern information technology can help address these issues. In these systems, data management is complicated by the fact that clients of several external agencies contribute to system demand.

While software and data processing automation are integral elements in efforts to achieve such integration, important changes in the agencies' operational procedures could greatly contribute to this objective.

The project team's review of available software options revealed several critical limitations of off-the-shelf software targeted at the paratransit market. Most available software has developed from an earlier era of hardware platforms and software models. As a result, off-the-shelf targeted software lacks many desirable features for this type of operation and, more importantly, seems to lack the desired flexibility and ease of use in this context. Furthermore, vendors tend to be very "possessive" of the software and reluctant to reveal much about its intervals, forcing the users to accept a de-facto "black box" product for an application that requires the utmost transparency. For these reasons, the project team neither recommends nor endorses any of the currently available packages identified and reviewed in this report. In particular, user experience with deployed packages in Texas was not positive, suggesting that a different approach should be sought. The project team believes that a more flexible, Web-enabled, less expensive software solution could be customized for paratransit applications, offering greater ease of use and flexibility. Furthermore, in the course of our in-depth interaction with selected agencies, several potential procedural improvements were identified. The improvements summarized in this report indicate the types of changes that could improve operational efficiency.

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Chapter 1. Introduction

Paratransit services are demand-responsive public transportation services for people who meet special eligibility requirements, such as the disabled and the elderly. The primary objective of this project is to characterize the operations of paratransit systems in the state of Texas, especially those situated in small urban and rural communities, and to determine appropriate software capabilities to support the dispatching and scheduling functions. The project team worked with transit managers and clients to ascertain their goals, customer demands, resources, processes, and future plans.

The project team investigated the technical and operational problems faced by several representative small paratransit providers in Texas so as to identify and recommend improvements. To that end, the team studied planning and scheduling software and performed assessments. The most widely used paratransit software in Texas is the Trapeze system, the most current version of which is TRAPEZE PASS 4.0. Some operators have purchased such new hardware as Mobile Data Terminals (MDTs) to make communication easier.

This report is organized as follows. Chapter 1 compares the characteristics for 24 rural transit operators in Texas counties. Some of these operate some type of fixed route services, however the majority do not. The salient features examined are areas served, hours of operations, number of employees, fleet characteristics, total one-way trips, total budget, and the software used for routing and scheduling. Eleven transit providers were short-listed on the basis of service area, budget, fleet size, and level of automation. Several of these agencies were visited for in-depth examination of operational problems and software use.

Chapter 2 outlines some important characteristics of a demand-responsive paratransit system and provides a comprehensive checklist of important paratransit software functional capabilities. Chapter 3 describes the operations of the systems observed and recommends additional features that would improve the software's role in actual operations. Chapter 4 compares paratransit software currently available on the market. Comparisons are based on initial configuration and data requirements, system maps, billing, scheduling method, dispatching, and functions related to other transit system operations and their operator's use of software. Chapter 5 discusses data-integration issues in paratransit agencies, while Chapter 6 offers conclusions and makes recommendations to transit providers regarding operations and the use of software.

Description of Typical Paratransit Operation

The process starts when a passenger calls to reserve a trip. At that time, the passenger's eligibility to receive the service is verified. The passenger may reserve one or more trips up to 14 days in advance. This request is then either fed into the paratransit software or scheduled manually. On the day of the trip, the dispatcher creates a log sheet with the trip information for the driver, and the pick-ups and drop-offs are made. The information obtained by the project team from the paratransit agencies surveyed is summarized in the following flowcharts. The chart shown in Figure 1.1 outlines the basic workings of a paratransit system. The flowchart in Figure 1.2 illustrates the corresponding data flow.

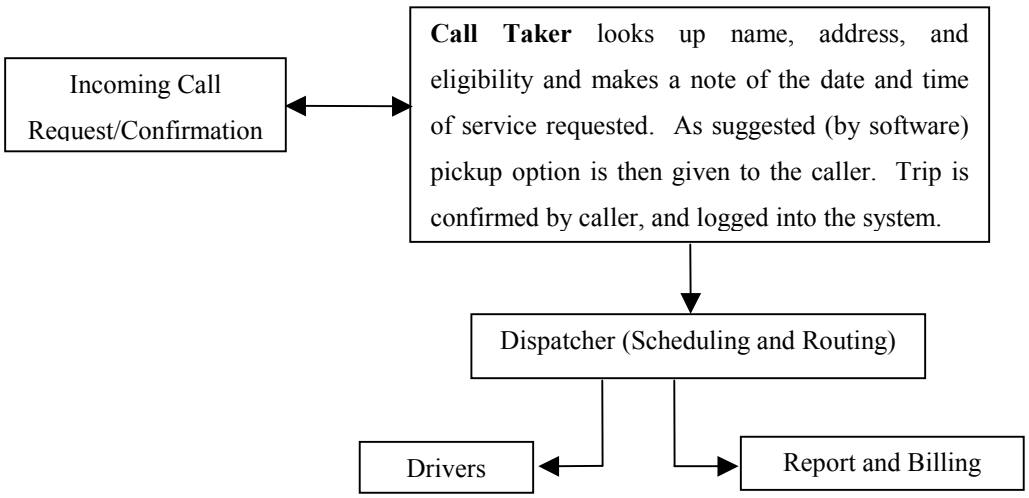


Figure 1.1 Request Processing in Paratransit Operation

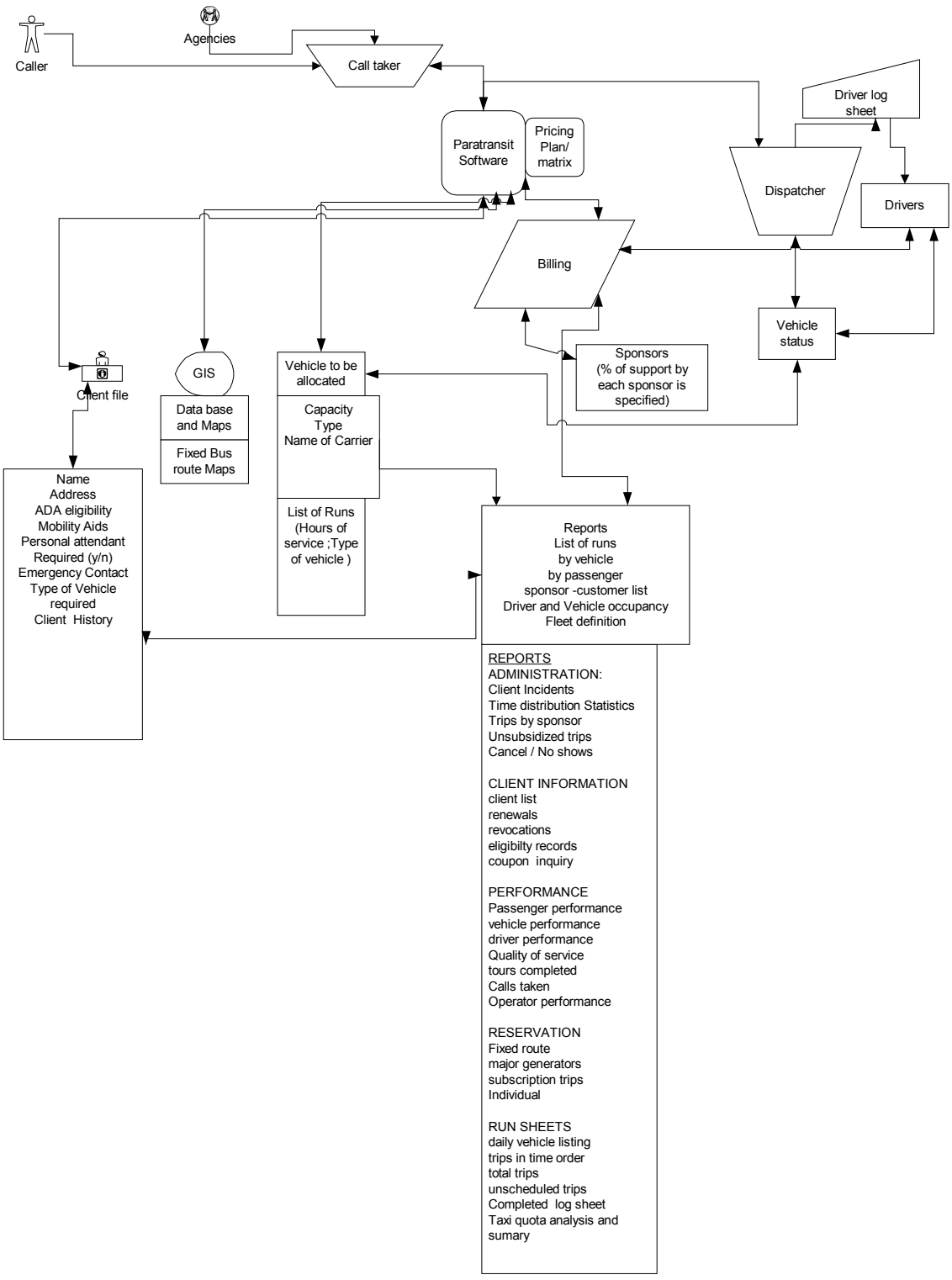


Figure 1.2 Typical Data Flow in Paratransit System

Survey of Texas Paratransit Systems

The 24 paratransit systems operating in Texas counties were surveyed and compared using the same criteria (see Table 1.1). In consultation with the TxDOT project advisor, the UT team selected eleven paratransit systems for further study (see Table 1.2). Three systems were visited in order to investigate their operational problems.

The forty-one paratransit operations were characterized on the basis of

- area of service (square miles),
- hours of operations,
- number of employees,
- fleet characteristics,
- total one-way trips, and
- total budget (excluding capital).

Comparison of the 24 paratransit operations in the Texas counties led to the identification of those counties presently using some form of paratransit software for scheduling and billing purposes. The comparision also provided estimates of the productivity of each system based on the number of trips made, the number of vehicles, the number of reservations, and the number of dispatchers required for the work at hand. Based on these numbers, it is evident that the transit providers using some paratransit software exhibit improved efficiency compared to those who rely exclusively on manual scheduling. Tables 1.1 and 1.2 are based on work performed by Stone, Navelonko, and Gilbert (Ref 1).

Table 1.1 Comparison of Paratransit Systems in Texas Counties

Name	System Characteristics	Employees	Fleet Characteristics	Total Budget (excluding cap) 1997	Comments
Panhandle Community Services – Panhandle Transit	• Service Area - 25,825 Square Miles • Year - 1997 • Estimate of Population - 404,888	Full Time - 23 Part Time - 58	Revenue Vehicles - 45 Lift-Equipped Vehicles - 9 Support Vehicles - 3 Number of Vehicles Required at Peak - 48	$793,864	• Demand-response basis, operating out of thirteen centers located throughout the service area. • Contract services Department of Health; several local school districts; Department of Mental Health and Mental Retardation; the Commission for the Blind. • Coordination of services is very complex owing to the enormous size of the service area. • Panhandle Transit often picks up as many as twenty-two clients, as far as 150 miles away with one bus.
South Plains Community Action Association Inc., - SPARTAN	• Service Area - 8,807 Square Miles • Year - 1997 • Estimate of Population - 336,908	Full Time - 15 Part Time - 11	Total Revenue Vehicles - 29 Lift-Equipped Vehicles - 16 Vehicles Required at Peak - 29	$1,260,731	• Over fifty fixed and scheduled routes. • Demand-response service is available. • Revenue vehicle capacity ranges from seven to twenty-two passengers, with and without wheelchair lifts. • Vehicles, transportation centers equipped with two-way radios.
Caprock Community Action Association – CAP-TRANS	• Service Area - 5,702 Square Miles • Year - 1997 • Estimate of Population - 56,322	Full Time - 9 Part Time - 35	Total Revenue Vehicles - 23 Lift-Equipped Vehicles - 4 Vehicles Required at Peak - 23	$521,764	• Fixed and scheduled routes and demand-response service. • Revenue vehicles vary in size and range from seven to twenty-two passenger capacity.
Aspermont Small Business Development Center, Inc. Double Mountain Coach	• Service Area - 5,421 Square Miles • Year - 1997 • Estimate of Population - 34,324	Full Time - 7 Part Time - 7	Total Revenue Vehicles - 13 Lift-Equipped Vehicles - 4 Total Support Vehicles - 5 Vehicles Required at Peak - 8	$53,151	• DMC operates demand-responsive service with 24-hour advance notice. The six county service area covers 5,442 square miles and has a poverty population of 6,759 persons. The service area encompasses an extremely rural countryside comprising many farms and ranches and twenty-seven small towns, many without a municipal organizational structure. • Elderly and disabled and low-income households with young children benefit most.

Table 1.1 Comparison of Paratransit Systems in Texas Counties *(continued)*

Rolling Plains Management Corporation, Sharplines	• Service Area - 6,605 Square Miles • Year - 1997 • Estimate of Population - 188,746	Full Time - 13 Part Time - 10	Total Revenue Vehicles - 17 Lift-Equipped Vehicles - 8 Total Support Vehicles - 6 Vehicles Required at Peak - 14	$699,502	• The majority of trip destinations is associated with employment, education, shopping, recreation, and healthcare. Out-of-county medical transportation is available. • SLPT provides demand-response service and transportation for Head Start, Title XX day care facilities, and approved Medicaid passengers.
Texoma Area Paratransit System - TAPS Public Transit	• Service Area - 5,634 Square Miles • Year - 1997 • Estimate of Population - 232,861	Full Time - 18 Part Time - 14	Total Revenue Vehicles - 27 Lift-Equipped Vehicles - 11 Vehicles Required at Peak - 24	$451,806	• Demand-response service in the six county areas is provided weekdays from 8:00 a.m. to 5:00 p.m. Transit service requests outside those times are provided as schedules and funding permit. TAPS centralized scheduling and dispatching; maintenance and operations. • The combination of centralized control and decentralized operation has proved to be the most efficient use of vehicles, personnel, and resources. • Provides near real-time backup capability for all areas of the 5,634 square mile transit district. • Practice of forwarding calls from a central telephone number to cellular telephones. This allows the senior driver on duty to also serve as dispatcher during off-peak periods while enabling passengers to use the main dispatch telephone number.
Service Programs for Aging Needs - SPAN	• Service Area - 889 Square Miles • Year - 1977 • Estimate of Population - 358,957	Full Time - 27	Total Revenue Vehicles - 17 Lift-Equipped Vehicles - 14 Total Support Vehicles - 24 Vehicles Required at Peak - 14	$471,167	• In 1981, SPAN implemented a computerized dispatch system, thus becoming the first small transit system in the nation to use microcomputers in dispatching operations. • SPAN subcontracts for the fixed-route and demand-response services. • SPAN is a participant in a coordination demonstration pilot project for the Office of Community Transportation Services (OCTS). During the monthly meetings of the group, named the North Texas Transit Cooperation Association, transit issues and coordination efforts and successes are highlighted.

Table 1.1 Comparison of Paratransit Systems in Texas Counties *(continued)*

Collin County Committee on Aging, Collin County Rural Transit	• Service Area - 848 Square Miles • Year - 1997 • Estimate of Population - 386,875	Not available	Total Revenue Vehicles - 26 Lift-Equipped Vehicles - 8 Vehicles Required at Peak - 21	$319,533	• Efficiency has increased by using an "open window" or time slot reservation system. More passengers to board the vehicle and travel to a common destination. • To arrange for a single pick-up point for their clients to travel to a common destination.
Hunt County Committee on Aging, Inc. - The Connection Transit System	• Service Area - 970 Square Miles • Year - 1997 • Estimate of Population - 105,180	Full Time - 6 Part Time - 3	Total Revenue Vehicles - 12 Lift-Equipped Vehicles - 7 Total Support Vehicles - 3 Vehicles Required at Peak - 9	$183,792	• Provides demand-response curb-to-curb transportation services. • Use of transportation programs and the pooling of trips controls costs. • Advance scheduling of trips out of the service area and of trips in the rural service areas.
ARK-Tex Council of Governments, TRAX	• Service Area - 5,704 Square Miles • Year - 1997 • Estimate of Population - 207,808	Full Time - 34 Part Time - 8	Total Revenue Vehicles - 29 Lift-Equipped Vehicles - 14 Total Support Vehicles - 6 Vehicles Required at Peak - 35	$639,959	• Currently subcontracts for service. • An urban transit system is proposed by the year 2000. The urban system will be interlined with the rural system for maximum productivity. • The urban system began operations in October 2000.
West Texas Opportunities, Inc., TRAX	• Service Area - 21,659 Square Miles • Year - 1997 • Estimate of Population - 148,383	Full Time - 23 Part Time - 24	Total Revenue Vehicles - 38 Lift-Equipped Vehicles - 11 Total Support Vehicles - 2 Vehicles Required at Peak - 35	$476,718	• Worked closely to create software customized for their specific needs. The software has been provided to all the service subcontractors, thus increasing efficiency. Within the next year the agency should be able to conduct all reporting through the Internet, thus saving time and increasing efficiency.
People for Progress, Inc. - STAGE Transportation	• Service Area - 2,738 Square Miles • Year - 1997 • Estimate of Population - 153,858	Full Time - 11 Part Time - 9	Total Revenue Vehicles - 10 Lift-Equipped Vehicles - 2 Vehicles Required at Peak - 9	$364,990	• Technical assistance is available to local community and governments that wish to expand or convert their transportation services. Over twenty-five programs are offered, serving 8,000 persons per month.

Table 1.1 Comparison of Paratransit Systems in Texas Counties *(continued)*

Central Texas Rural Transit District, City and Rural Rides	• Service Area - 7,840 Square Miles • Year - 1997 • Estimate of Population - 119,407	Full Time - 19 Part Time - 8	Total Revenue Vehicles - 17 Lift-Equipped Vehicles - 5 Vehicles Required at Peak - 17	$493,709	
Palo Pinto County Transportation Council, Inc.	• Service Area - 1,817 Square Miles • Year - 1997 • Estimate of Population - 56,700	Full Time - 13	Total Revenue Vehicles - 11 Lift-Equipped Vehicles - 2 Vehicles Required at Peak - 11	$247,649	• Flexible route service requires passengers to make arrangements through a dispatcher to receive service. Passengers are picked up and dropped off at a designated time and location each day. • The agency contracts to provide transportation.
Parker County Transportation Service, Inc.	• Service Area - 904 Square Miles4 • Year - 1997 • Estimate of Population -75,071	Full Time - 9 Part Time - 13	Total Revenue Vehicles - 22 Lift-Equipped Vehicles - 4 Total Support Vehicles - 3 Vehicles Required at Peak - 19	$530,637	• On-call staff members are given radios for after-hours passenger service requests. This allows the drivers to access any information they may need to better serve their passengers afterhours and on weekends. A staff person is on-call at all times to give information and to handle problems as they arise.
The Transit System, Inc.	• Service Area - 609 Square Miles • Year - 1997 • Estimate of Population - 40,028	Full Time - 18 Part Time - 3	Total Revenue Vehicles - 17 Lift-Equipped Vehicles - 4 Total Support Vehicles - 3 Vehicles Required at Peak - 15	$643,454	• TTS operates a well-rounded transportation service in a rural setting, providing demand-response, flexible routes, shuttle, airport, and agency contract service. Local demand-response service does not require advance notice.
Community Services Inc., - Community Transit Service	• Service Area - 2,011 Square Miles • Year - 1997 • Estimate of Population - 140,480	Full Time - 11 Part Time - 4	Total Revenue Vehicles - 17 Lift-Equipped Vehicles - 6 Total Support Vehicles - 1 Vehicles Required at Peak - 10	$401,522	
City of Cleburne - Cletran Transportation System	• Service Area - 27.3 Square Miles • Year - 1997 • Estimate of Population - 24,037	Full Time - 7 Part Time - 1	Total Revenue Vehicles - 7 Lift-Equipped Vehicles - 4 Total Support Vehicles - 7 Vehicles Required at Peak - 5	Not available	• A time slot reservation system is used. Passengers call in several hours in advance to schedule their rides for the day. They are given a pick-up time span of 30 minutes.

Table 1.1 Comparison of Paratransit Systems in Texas Counties *(continued)*

Kaufman County Senior Citizens Services, Inc. -Kaufman Area Rural Transportation (KART)	• Service Area - 786 Square Miles • Year - 1997 • Estimate of Population - 63,401	Full Time - 7 Part Time - 10	Total Revenue Vehicles - 12 Lift-Equipped Vehicles - 4 Total Support Vehicles - 1 Vehicles Required at Peak - 8	$277,500	• The Advanced Information Management (AIM) is the user-friendly computer software recently purchased to track operating data. Data is collected by the driver with a wand and hand-held scanner and later downloaded into the dispatcher's computer for analysis. Information such as passenger names, destination, and mileage is easily recorded and used to generate billing for each contract for a given period of time. KART is serving as a pilot agency for the software manufacturer and is actively involved in product development. In essence, AIMS is being developed as though it were a custom computer program for the agency.
East Texas Council of Governments, East Texas Rural Transit	• Service Area - 9,722 Square Miles • Year - 1997 • Estimate of Population - 710,783	Full Time - 50 Part Time - 10	Total Revenue Vehicles - 59 Lift-Equipped Vehicles - 15 Total Support Vehicles - 17 Vehicles Required at Peak - 49	$1,010,128	
Concho Valley Council of Governments, Thunderbird Transit	• Service Area - 15,293 Square Miles • Year - 1997 • Estimate of Population - 57,554	Full Time - 11 Part Time - 21	Total Revenue Vehicles - 18 Lift-Equipped Vehicles - 17 Vehicles Required at Peak - 18	$399,555	• Thunderbird Transit is developing software in-house to track preventive maintenance, dispatching, data, and driver training. The system uses an 800 MHz trunked two-way radio that accommodates voice, data dispatch, and cellular telephone functions while adding an element of safety for drivers traveling long distances. The system will complement future plans to centralize portions of the dispatching function. Coordination with several agencies and local governments has maximized passenger delivery resources and made service available to a larger percentage of the general public than ever before.
Hill Country Community Action Association, Inc. - Hill Country Transit District	• Service Area - 8,426 Square Miles • Year - 1997 • Estimate of Population - 377,937	Full Time - 23 Part Time - 27	Total Revenue Vehicles - 42 Lift-Equipped Vehicles - 6 Total Support Vehicles - 1 Vehicles Required at Peak - 30	$781,376	

Table 1.1 Comparison of Paratransit Systems in Texas Counties *(continued)*

City of Del Rio	• Service Area - 15 Square Miles • Year - 1998 • Estimate of Population - 38,721	Full Time - 5 Part Time - 3	Total Revenue Vehicles - 7 Lift-Equipped Vehicles - 5 Vehicles Required at Peak - 5	$372,313	• Demand-Response • Fixed-Route
Heart of Texas Council of Governments, Heart of Texas Rural Transit District	• Service Area - 5,556 Square Miles • Year - 1997 • Estimate of Population - 307,867	Full Time - 8 Part Time - 55	Total Revenue Vehicles - 40 Lift-Equipped Vehicles - 7 Vehicles Required at Peak - 38	$696,149	

Table 1.2 The Eleven Identified Paratransit Systems

Name and address	Characteristics	Budget (in US $)	COMMENTS
Aspermont Small Business Development Center, Inc., Double Mountain Coach 613 South Washington Street, Aspermont, TX 79502 PO Box 188, Aspermont, TX 79502 Phone: 940.989.3538 Fax: 940.898.3445 E-mail: asbdc@westex.net **TxDOT District: Abilene**	• Is a private nonprofit corporation assisting low income residents. • Has passenger/dispatch facility and two satellite dispatch stations. • Operates demand-response service with 24-hour advance notice. • Extremely rural countryside.	$53,151	• It seems that the dispatch facility is being operated to a major extent manually.
Kaufman County Senior Citizens Services, Inc. **-Kaufman Area Rural Transportation *(KART)*** 200 South Virginia Street, Terrell, TX 75160 PO Box 836, Terrell, TX 75160 Phone: 972.563.5875 Fax: 972.563.1491 E-mail: KARTTRANSP@AOL.COM **TxDOT District: Dallas**	• KART has no subcontractors. • Advanced Information Management (AIM) is the computer software purchased to track operating data. Data is collected by the driver with a wand and hand-held scanner and later downloaded into the dispatcher's computer for analysis. • Information regarding passenger is easily recorded and used to generate billing for each contract for a given period of time.	$277,500	• KART is serving as a pilot agency for customized software. • This would be a good option to compare results and take useful inputs from the software being tested.

Table 1.2 The Eleven Identified Paratransit Systems *(continued)*

Concho Valley Council of Governments, Thunderbird Transit 5002 Knickerbockers Road, San Angelo, TX 76906 PO Box 60050, San Angelo, TX 76906 Phone: 915.944.9666 Fax: 915.944.9925 E-mail: rob@cvcog.org **TxDOT District: San Angelo**	• Non-emergency medical transportation services to eligible Medicaid clients. • The transportation system operates on a demand-response basis. • On a fixed-route schedule for out of county service. • Passengers are picked up at their homes and transported to various locations, such as medical facilities, nutrition centers, shopping centers, social service agencies, and places of employment. • Thunderbird Transit is developing software in-house to track preventive maintenance, dispatching, data, and driver training. • The system accommodates voice, data dispatch, and cellular telephone functions. • Plans exist to centralize portions of the dispatching function.	$399,555	• The dispatch facility uses a centralized number whose benefits would be an interesting feature to observe.

Table 1.2 The Eleven Identified Paratransit Systems *(continued)*

Texoma Area Paratransit System – TAPS Public Transit 6104 Texoma Parkway, Sherman, TX 75090 Phone: 903.893.4601 Fax: 903.893.4766 E-mail: tapsinc1@airmail.net **TxDOT District: Paris**	• Demand-response service. • Centralized scheduling and dispatching; maintenance and operations. • The combination of centralized control and decentralized operation has proved to be the most efficient use of vehicles, personnel, and resources. • Service is accessible to those with disabilities and provides near real-time backup. • TAPS is completing a 2 year program to improve the communication, computer, and control systems. • One example is the practice of forwarding calls from a central telephone number to cellular telephones. This allows the senior driver on duty to also serve as dispatcher during off-peak periods while enabling passengers to use the main dispatch telephone number. • Plans exist to rewrite scheduling and dispatch programs, and to streamline reports, data, and billing functions.	$451,806	• The centralized and decentralized control lends itself to a good comparative study.

Table 1.2 The Eleven Identified Paratransit Systems *(continued)*

Services Programs for Aging Needs – SPAN 1800 Malone Street, Denton, TX 76201 Phone: 940.382.2224 Fax: 940.383.8433 e-mail: sharono@span-transit.org **TxDOT District: Dallas**	• SPAN implemented a computerized dispatch system, thus becoming the first small transit system in the nation to use microcomputers in dispatching operations.	$471,167	• Computerized dispatch system resulted in improvements. Would be useful to study.
West Texas Opportunities, Inc. TRAX 604 N. 4th Street, Lamesa, TX 79331 PO Box 1308, Lamesa, TX 79331 Phone: 806.872.8354 Fax: 806.872.5816 E-mail: wto@pics.net **TxDOT District: Odessa**	• Worked closely with a consultant to create software customized for their specific needs. • Within the next year the agency should be able to conduct all reporting through the Internet, thus saving time and increasing efficiency.	$476,718	• Internet applications may be observed.
South Plains Community Action Association Inc., - SPARTAN 1105 W. Hwy 114, Levelland, TX 79336 PO Box 610, Levelland, TX 79336 Phone: 806.894.3800 Fax: 806.894.2759 E-mail: spartan@llano.net **TxDOT District: Lubbock**	• Over fifty fixed and scheduled routes as well as demand-response service. • Vehicles and transportation centers are equipped with two-way radios.	$1,260,731	• This system has a medium budget allocation and would be a good option for testing of selected software.

Table 1.2 The Eleven Identified Paratransit Systems *(continued)*

Capital Area Rural Transportation System - CARTS 2010 East 6th Street, Austin, TX 78702 PO Box 6050, Austin, TX 78762 Phone: 512.389.1011 Fax: 512.478.1110 E-mail : dave@rideCARTS.com **TxDOT District: Austin**	• CARTS operates fixed-route and demand-response service, as well as commuter service from limited points in the service area. • CARTS has made pioneering efforts in the integration of private inter-city bus operations and community transportation services through facility development.	$2,787,664	• On May 31, 2000, CART upgraded to the Windows version of Trapeze 4.0. Still has to procure Mobile Data Terminals for maximum utilization of the software. CARTS was previously working with the DOS version of Trapeze.
Brazos Valley Community Action Agency - Brazos Transit System 1759 N. Earl Rudder Freeway Bryan, TX 77803 Phone: 409.778.0607 Fax: 409.778.3606 E-mail: transit3@tca.net **TxDOT District: Bryan**	• Budget and number of vehicles very large. • No specific technological advancement mentioned.	$7,306,189	• Has the largest budget in the list. The application of the selected software will be important here because of the larger size of the fleet, which totals eighty-nine vehicles.
Hill Country Community Action Association. Inc. - Hill Country Transit District 2905 West Wallace, San Saba, TX 76877 PO Box 217, San Saba, TX 76877 Phone: 915.372.4677 Fax: 915.372.6110 Contact: Carole Warlick, Transit Manager E-mail: hctd@hcca.centexnet.com **TxDOT District: Brownwood**	• Until recently, Hill County Paratransit was being operated by the city hospital. • Now the City of Temple has taken the responsibility of the paratransit as well as transit service. • They recently have procured the Trapeze Windows version paratransit software for dispatching, billing, and scheduling.	$781,376	• A big operational problem faced by this county is the operation and utilization of their mobile data terminals. • This would give the team an opportunity to solve their operational problems.

Table 1.2 The Eleven Identified Paratransit Systems *(continued)*

Collin County Committee on Aging, Collin County Area Rural Transit P.O. Box 396 McKinney, TX 75070-0396 Phone: 972.562.6996 Fax: 972.562.0308 E-mail: coxg@ccartcc.com Contact Person: Glen Cox **TxDOT District: Dallas**	• This agency is currently doing most of its scheduling and dispatching manually.	Not available	• The team hopes to help in the selection/implementation of the paratransit software. This would help in optimization of routing.

Chapter 2. Functional Specifications for Scheduling Software and Interfaces

The research team identified several characteristics of demand-responsive transit systems as relevant to the operational performance of paratransit systems, and hence to the role that scheduling software could play in these operations. These characteristics are described below:

1. Size measures
   - Number of vehicles dedicated to paratransit operations

     Based on discussions with paratransit software vendors, system operators as well as guidelines suggested in the literature (Ref 5), agencies can be classified as follows:

     Small – (10 -15 vehicles)

     Medium – (15 - 50 vehicles)

     Large – (more than 50 vehicles)
   - Total vehicle miles per day
   - Average rider time
   - Variability of promised pick-up and arrival times
2. Number of riders (as a measure of demand)
   - Total number of customers served per day
   - Trips per day or per year
3. Demand density (number of trips per square mile per hour)
4. Measure of scheduling effort (dependent on whether the trip booking is immediate, advanced, or a subscription reservation)
5. Trip pattern (governs the paratransit software needed for the system)
6. Available fixed-route service
7. Reporting requirements

Important Paratransit Software Features

The desirable features of paratransit operational software have been previously documented (Refs 1-5). These include

1. Retrieval of passenger data from database and automatic insertion in reservations form
2. Recent ride history
3. Multiuser reservation processing
4. Rider eligibility check
5. Software completion of information when entering only partial information (such as name and address)
6. Geocoded addresses (physical address associated with special map codes)
7. Key word and common characteristics search-and-sort capability
8. Frequent destination list (speeds up the reservations process)
9. Manual override of the computer-generated schedule
10. Name recognition of common places
11. User-defined fields (to tailor service and perform special analysis)
12. Operator name and date stamping (for identifying and rectifying errors and need for training)
13. Performance data collection and calculation (to evaluate the paratransit systems)
14. On-line pick-up time estimate, with or without vehicle assignment
15. On-line address verification (to provide better guidance for pick-up drivers)
16. ADA eligibility check
17. Duplicate reservations warning
18. Variable vehicle-parameter display for proper accounting during dispatching
19. User-defined report formats
20. Batch scheduling/dispatching
21. Access rights to functions and databases
22. User-defined performance characteristics
23. Actual historical loading-time accounts for known passengers (for use when estimating trip time for scheduling process)
24. Automatic billing calculations (based on the parameters defined by service provider)
25. Available on-line help
26. Billing codes (for easy summary of cost, trip frequencies, etc.)

27. Problem-passenger warning (allows reservations agent to warn driver to make specific seating arrangement)
28. Pop-up activities menu
29. Automatic vehicle selection (determined by specific passenger needs)
30. Real-time reservations and scheduling
31. Elimination of inactive customers over a period of time
32. Detailed computerized vehicle route selection
33. Import/export capabilities to/from spreadsheet software
34. Ability to allocate group trips
35. Trips displayed on layered maps
36. Confirmation callback list generation (for reducing no-shows)
37. Section 15 reports (to be generated to receive federal funding)
38. Flexible invoice formats
39. TIGER file compatibility
40. Passenger prioritization
41. Zonal systems
42. Capability of use by several operators
43. Customized split-billing
44. Simulation training capability
45. Permits 'What if…' questions (allows easy testing resulting from altered parameters)
46. Paratransit transfers
47. Indication of costly trips
48. Fixed-route transfers (incorporated while planning trip transfers between paratransit and fixed-route services)
49. Vehicle location on layered maps
50. Federal Health and Human Services
51. Automatic callback confirmation and change of schedule/pick-up time
52. Automatic in-vehicle data capture
53. Electronic document interchange

Chapter 3. Analysis of Selected Systems

In order to determine the role of scheduling and operations management software in paratransit systems, the team performed in-depth analyses of the processes currently underway at representative paratransit agencies across the state. As noted in Chapter 1, the agencies were selected through consultation with TxDOT personnel, in order to provide a representative subset of paratransit operations in Texas. As a result, the team analyzed the following paratransit agencies

- Capital Metro — Austin
- Capital Area Rural Transportation (CARTS) — Austin
- Hill Country Transit Agency (HCA) — Temple
- Services Program for Aging Needs (SPAN) — Denton
- Kaufman Area Rural Transportation (KART) — Terrell
- Texoma Area Paratransit systems (TAPS) — Sherman

The principal elements of paratransit system operations addressed in the analysis included the following:

- Resources — Fleet size, drivers, reservation agents
- Scheduling agent, types of vehicles
- Number of calls attended, capacity of the system, training practices
- Major operating costs
- Frequency of service
- Operational problems
- Dispatching and scheduling method
- Steps towards improvement

Capital Metro — Austin

The first meeting took place with Jan Johnson, director of operations at Capital Metro's Special Transit Service (STS) on December 17, 1999. The chief points addressed during the meeting included:

The Fleet Size and Other Resources of Special Transit Service

STS is a mid-sized provider — somewhat large in relation to the city size.

- STS has 103 vehicles.
  - Fifty-two sedans (Ford Crown Victoria - seating capacity for four passengers and one driver)
  - Fifty-one vans (fourteen seated passengers and three wheelchairs)
- One hundred thirty-two drivers are available for service.
- There are six full-time and one part-time dispatchers.
- STS operates on two radio frequencies, one for the sedans and one for the vans.
- The system handles an average of 750 calls per day.
- STS has fifteen call-takers.
- It takes about 3 – 4 minutes to process each call.
- STS uses the Trapeze PASS DOS software for its scheduling, dispatching, and billing.
- STS has an annual budget of $7 million (for 1999).

The research team noted that because of the volume of calls handled, good scheduling and dispatching software is essential in processing standby and immediate requests.

Special Transit Service Riders

Five to 7% of riders are dialysis patients who require special trips 3 days per week. Thus, the scheduling of subscription trips is a primary need.

Current System Capacity

In fiscal year 1999, disabled passengers on Capital Metro's fixed-route system accounted for a total of 2 million passenger-trips. The STS provided 0.5 million-passenger-trips. The entire fleet of buses is accessible to passengers in wheelchairs.

Driver Training

Van drivers receive 6 weeks of training, while sedan drivers receive 5 weeks of training.

Missed Calls

Five to 7% of the total number of incoming calls are missed. The application of Mobile Data Terminals (MDTs) and more advanced dispatching software are potential solutions to this problem. Further, the improvement of radio communication between dispatcher and driver is expected to increase the number of immediate requests that can be handled.

Major Operating Costs of the System

The principal cost components for the STS operation consist of the following:

- Maintenance of vehicles
- Fuel
- Driver salaries and benefits (60% of the operating budget)

Operational Problems Facing Special Transit

- No-shows and cancellations consume valuable resources of the STS system.
- Communication of cancellations remains a long procedure. The procedure is described below.
    - Caller calls a reservation agent.
    - Information is then passed on to the dispatcher.
    - Dispatcher communicates this cancellation to a driver in one of two ways:
        1. The dispatcher completes cancellation forms for the drivers to read at the STS station.
        2. Voice transmission of cancellation through radios.

In this process there is a time lag of 10 minutes for calling the driver on the radio. This results in 75% of the dispatcher's time being spent on voice transmission.

This kind of communication problem can be solved by using MDTs where information regarding pick-ups, drop-offs, and cancellations are exchanged instantly while the driver is in transit.

Steps Taken to Improve the System

To reduce the need for voice transmission, an MDT will be installed in each of the cars and vans by the end of fiscal year 2001. Each MDT will cost approximately $2,000. The introduction of MDTs is expected to reduce the need for two full-time data entry operators.

The advantages of using MDT include

- same-day service will be possible, and
- reduction of load on dispatchers

Performance of Paratransit Routing/Scheduling Software

Installed in 1994, Trapeze has failed (i.e., crashed) only once.

Dispatching and Scheduling Method

For advance reservations the call-taker is prompted for suitable options by the software. The vehicle match is done according to the caller's ability to ride in a car or a van. Finally, the day before the scheduled trip, manual reviews are completed and optimum routes and optimal usage of vehicles are finalized.

Advantages of This Type of Manual Review

- Many times pick-ups are scheduled in the same area and within the same time frames.
- Last-minute road condition changes may be incorporated.
- Additional trips may be added.

Performance Criteria Used to Evaluate the Special Transit Service System

- Productivity (passengers/vehicle hour)
- Time performance
- Customer complaints
- Cancellations
- No-shows
- Denials

Note that while cancellations and no-shows are an operational reality, they constitute a drag on service productivity. Excessive numbers of cancellations and no-shows might therefore trigger a closer look aimed at controlling these phenomenon and their impact.

Suggestions Made During the Meeting

- The STS application form (a questionnaire assessing eligibility of STS candidates) could be made available on the Internet.
- The recertification process, revised/updated every two years, could also be made available on the Internet.
- Advance reservations/bookings and cancellations could be done through the Internet.

Subsequent follow-up meetings with the Capital Metro STS staff generated the following information.

Meeting with the Reservation Agent

Capital Metro's STS reservations agents receive an estimated 280 calls per day, or about 20 calls per hour. Nine reservation agents work from 7:00 a.m. to 9:00 p.m.

The principal tasks of the reservations agent are

- Reservations
- Cancellations
- Voucher allocations
- Confirmation of standby client requests
- Denial of requests

Potential Problems Arising from the Partial Utilization of the Trapeze Software

It is important to note that Capital Metro's STS is not realizing the full potential of the Trapeze software. The fixed-route and STS are using different components of the same software, resulting in the duplication, or partial utilization, of certain services because the scheduler is not privy to complete information when trip-planning. In fact, Capital Metro's STS is only using the PASS module (not integrated with the rest of the Trapeze system), while the fixed-route division is using the rest of the Trapeze system, without the PASS module. While this may not be strictly a software issue, but rather a service delivery and/or process design issue, the design of the software and the interfaces between its components are often a factor in the manner in which the software is used to support operational decisions.

The following example illustrates the problem outlined above: Client A, having special transit needs, wishes to go to destination X. While it is possible for Client A to be transported to the nearest bus stop where a wheelchair fixed-route vehicle can transport him to destination X, lack of information regarding fixed-route vehicles prevents this. Instead, an independent trip — one ignoring existing fixed-route trip — is booked for Client A. While assignment of a given trip to fixed-route service may not always be more desirable than use of STS trips, the software should allow comparative assessment to be made of alternative assignment decisions.

Observed Software Problems Reducing Reservations Agent Efficiency

- The time required for entering a client's data after the call is received is about 30 seconds. The processing time after data input is about 1 minute. If this processing time can be shortened, abandoned calls could be significantly reduced.

- Entering a wrong date of travel causes the software to go into an inactive phase, thereby causing a major loss in useful time.
- The number of address/destination options (frequently visited addresses by the client) provided by the software is ten. Currently there are only five address options used by the software.
- There is no provision in the software to prevent overloading of a particular cab company in the city.
- The process of incorporating a new address for a client is not a user-friendly option.
- An added feature of the software, and one that could increase customer satisfaction, is non-overburdening of a particular cab company. Cab vouchers should be awarded to cab companies in a sequence. This software feature is available in Multisystems' MIDAS PT software.

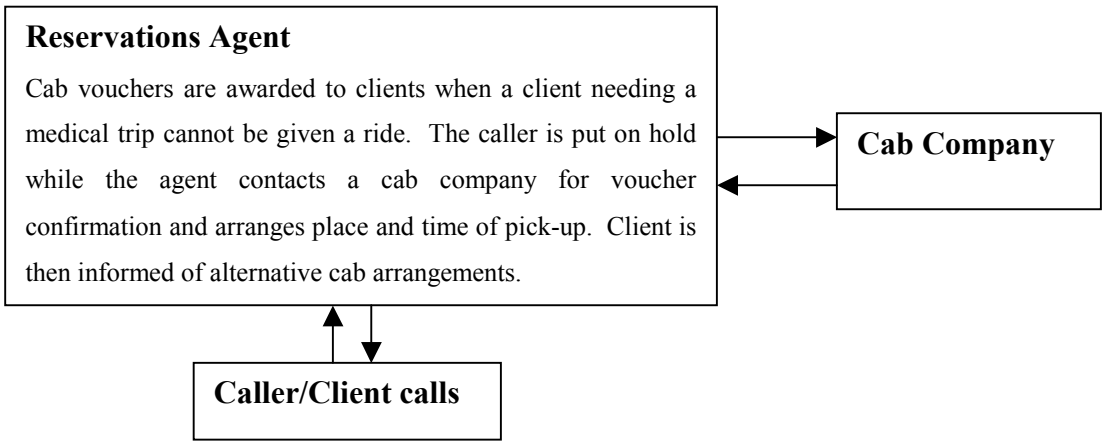


Figure 3.1 Operational Problems Arising from Cab Voucher Allocations.

Meeting with the Dispatching Team

The principal work of the dispatching team involves

- creating daily time sheets/log sheets for drivers for their daily operations,
- scheduling open-routing and pick-ups (from medical appointments, airports, etc.),
- calling in trips,

- subscription trips,
- accommodating standby trips, and
- informing drivers via radio of new pick-ups (generally on their way) and the time allotted for pick-up.

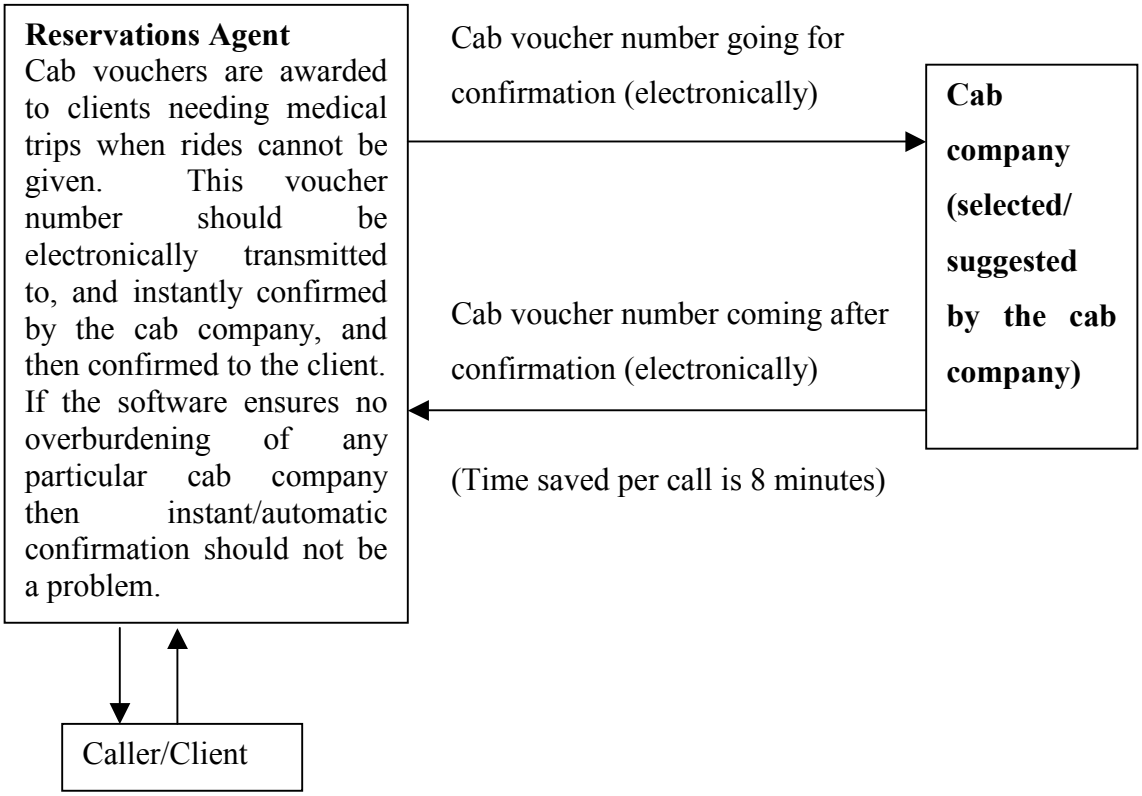


Figure 3.2 Possible Solution to Voucher Problem

The following are suggestions for improving the efficiency of the paratransit operations.

- Capital Metro's STS allows reservations to be made only 8 days in advance. A screen displaying all the days with dates would help identify and subsequently correct errors resulting from entering the wrong date.
- On-line confirmation of cab vouchers awarded to clients by reservations agents would save time.

Notes:

- There is no performance evaluation data available on the STS workforce.
- Reservations agents request supplemental information not already in the client file, i.e., door or curb pick-up, if an attendant is with client, and other special comments.

Capital Area Rural Transportation Systems (CARTS) — Austin

The Capital Area Rural Transportation System (CARTS) is located at 2010 East Sixth Street in Austin, Texas. It is a community-based transportation provider serving the counties of Bastrop, Blanco, Burnet, Caldwell, Fayette, Hays, Lee, and the nonurbanized areas of Travis and Williamson counties.

Attending the first meeting held on February 9th were:

- Dave Marsh (Executive Director)
- Carol Zachary (Director of Operations)
- Glenda Zuniga (Manager, IS)
- Garry Barrett (Director of Service Development)
- Vivian Jackson

CARTS services are supported by thirty-two local government agencies, federal and state transit assistance from USDOT and TxDOT, customer fares, service contracts, fund-raisers, private donations, advertising revenues, intercity bus terminal agency fees, interlocal agreements with Capital Metro, the City of San Marcos, and other ancillary revenues.

CARTS Routes

CARTS operates primarily on the following three routes:

- The Blue Route service — Bastrop, Fayette, Lee

- The Green Route service — Caldwell, Hays, Travis
- The Red Route service — Blanco, Burnet

Fleet Size and Other CARTS Resources

- CARTS has a fleet of eighty vehicles.
- The system is manned with five reservation agents and two dispatching agents.
- CARTS has an annual budget of $3 million.
- Service is provided to 133 communities.
- CARTS serves a 7,500 square mile region surrounding Austin.

CARTS Riders

Sixty to 70% of trips are demand-responsive. CARTS services are open to the general public. It is worth noting that CARTS is using Trapeze PASS software for fixed-route and demand-responsive trips.

Major Operating Costs

About 65 % of the operating costs support drivers' salaries.

Operation Details

- Operates through nine centers.
- Certain routes run only on fixed days.
- Eighty vehicles serve 133 communities.
- Some routes can be as long as 60 – 70 miles one-way.
- CARTS covers 7,500 square miles.

Dispatchers currently create assignment log sheets for the drivers to carry with them. Drivers report, via the Lower Colorado River Authority (LCRA) radio service, the miles traveled between each trip, and communicate pick-ups as a plus symbol (+) and drop-offs as a minus symbol (–). While the LCRA's radio service facilitates the communication between the driver and dispatcher, improvements to this service are needed, as noted hereafter.

CARTS Operational Problems

- COMMUNICATING MESSAGES FROM DISPATCHERS SEEMS TO BE A PRONOUNCED PROBLEM FOR CARTS.
- The Texas Health Services currently does the booking for Medicaid customers, i.e., a reservations agent outside CARTS handles reservations on behalf of CARTS. CARTS would prefer Medicaid customers to book rides on their own.

Data Integration Issues Facing CARTS

NURSING HOMES

Oaklins, Trinity, Morning Star, located in Round Rock, and Austin.

These trips are booked on the nursing home's identity and in the comments section the patient's name is written. CARTS has contracts with these nursing homes, however the nursing homes do not have access to the CARTS Trapeze System. The nursing home calls CARTS with each request and CARTS confirms the trips it will be able to handle. CARTS bills the nursing homes at the end of each month for the total number of trips.

It is advised to create a Web site which displays the booking status of each seat available during a particular period of the day

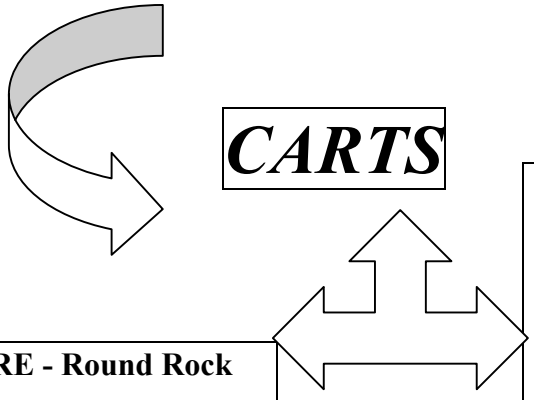
The percentage of seats that are full can be displayed warning the outside agents to book early.

It is recommended that these agencies communicate their bookings through a voice mail system, thus reducing the work load of the call agents at CARTS. In addition, if clients would like to individually communicate messages, they could also send e-mail.

There are two problems faced by CARTS while dealing with nursing homes.

First, many clients coming through these nursing homes are such that they would need escorts with them. It is recommended that the nursing homes send escorts with their patients whenever necessary.

Secondly, it is also advised that these agencies call to reserve their trips at least two days in advance.



DAY CARE - Round Rock

Bus interaction to a certain extent exists between the two agencies; further interaction is encouraged.

MHMR:

Each Client is registered individually in the CARTS System and added/deleted by the MHMR representative mentioned in the contract between CARTS and MHMR. Here, too, the client trips are billed to MHMR at the end of the month.

It is noticed that although each client comes through the contract between the two agencies, these clients have the privilege to book their trips by calling CARTS on their own. Also, there is no common location from where these clients are picked up. In fact, some are picked up from their respective homes.

Figure 3.3 Data Integration Issues Facing CARTS

Steps Taken to Improve the System

- CARTS is planning to incorporate MDTs in order to improve communication between driver and dispatcher. This plan should also improve the number of demand-responsive trips.
- CARTS recently installed the Trapeze PASS Windows 4.0 version, which is now ready for MDT applications.
- Software and hardware had to be upgraded to prepare it for the new version of PASS.
- Migrating all the necessary data to a new system was completed using SQL 7.0.
- Trapeze itself is being encouraged to make a Web-based module. This module would allow interactive booking between the customer and the service provider over the Internet.
- Incorporation of Automatic Vehicle Location (AVL) packages is also being planned, as this would improve the dynamic scheduling to a great extent.

Future Goals

An important goal of CARTS is to offer services over the Internet. CARTS plans to begin by placing existing services on the Web. Booking of rides over the Internet is also being considered.

Subsequent follow-up meetings with CARTS for Trapeze PASS Windows training generated the following information:

- The project team underwent Trapeze PASS 4.0 software training along with the CARTS staff.
- The transition from the Trapeze DOS version to the Trapeze Windows version was smooth.
- The only major areas where some extra effort was required
  - The mapping system was upgraded. CARTS incorporated the latest maps of their area of service by using the 911 MAP repositories. These maps were then formatted and input into the new Trapeze PASS system to be used by CARTS.

- All the client data files subscription trips had to be input into the new software.
- New and revised schedules were generated on the basis of the subscription and group-trip data available. These trips were then input into the trip wizard.
- Although many addresses were geocoded automatically from the DOS version, many pick-up, drop-off, and client addresses had to be geocoded before complete installation and usage.
- The knowledgeable TRAPEZE staff provided very thorough training to the CARTS reservations and dispatching agents. The training spanned 4 days so as to make the DOS users proficient in using the new Windows application.

The project team felt that the following changes could make the software more user-friendly.

- The call-booking agent would prefer entering the city first, and then looking at the range of street addresses made available by the software. Entering the range of streets first may sometimes lead to an error in booking.
- A call-identifying feature could aid the reservations agent in locating the caller with greater ease.
- Different colors for drop-off and pick-up points on the map would benefit the dispatcher.
- Cancellation of a return trip should take place automatically in the event of a no show.
- The dispatching screen of the DOS version had more colors — enabling the dispatcher to at-a-glance look at the progress and status of trips.
- Trip ID number assignment was a useful feature of the DOS version. Although the Client ID booking number is available in the Windows version, the Trip ID number is considered more useful.

Role of Independent Agencies with Respect to CARTS

The research team analyzed the number of trips generated by independent agencies. The analysis was performed to estimate how many of CARTS' trips are generated by independent agencies. The results of the analysis may assist in deciding the efforts needed to improve

communication and data transfer between CARTS and the independent agencies. The results are shown in Table 3.1.

Table 3.1 Total Trips Generated by Independent Agencies for CARTS

ABBREVIATIONS FOR INDEPENDENT AGENCIES	April	May	June	Total trips in 3 months by individual agencies
TRT	366	675	736	1,777
BRN	20	44	45	109
GRT	13	40	76	129
RRK	157	486	371	1,014
TYL	105	88	68	261
BAS	98	0	0	98
SMT	44	552	2	598
LCK	1	0	0	1
LGR	1	0	0	1
MBF	1	0	6	7
ELC	0	19	37	56
ELG	0	0	1	1
LSC	0	0	1	1

Total trips made for agencies each month	806	1,904	1343
Total trips made by CARTS in each month	22,745	22,880	NA
% Clients of CARTS in terms of trips	3.54%	8.32%	NA

Table 3.1 reveals that the independent agencies comprise a very small percentage of clients of CARTS as compared to the individual clients. Figure 3.4 depicts the number of monthly trips generated by each agency. The efforts made toward improving the data transfer and communication between CARTS and these agencies may not be justifiable.

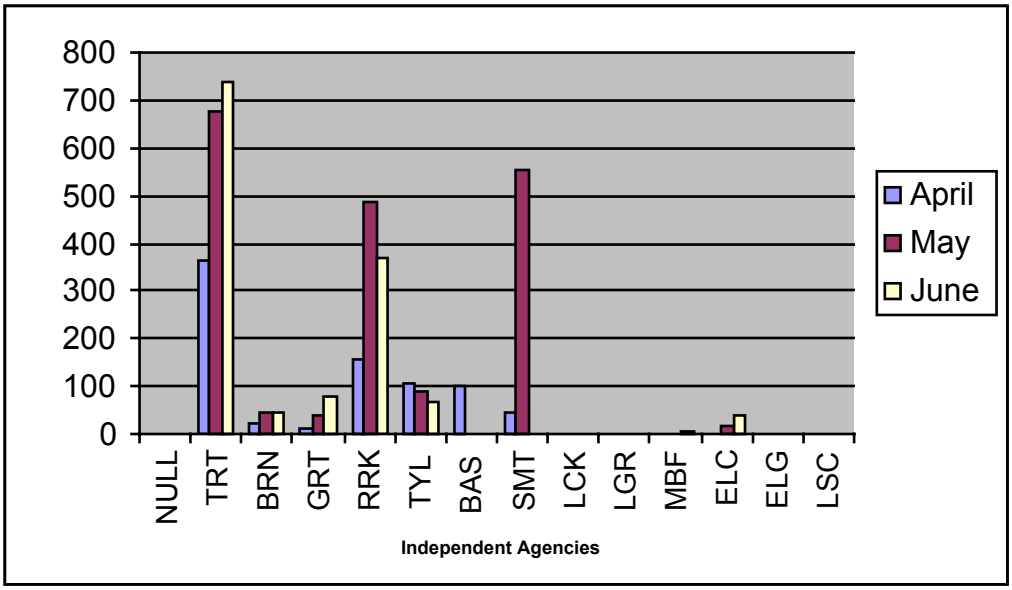


Figure 3.4 Number of Monthly Trips Generated by Independent Agencies

Hill Country Transit District Agency (HCT) — Temple

Hill Country Transit District Agency (HCT) is a private nonprofit company that manages transit operations in several central Texas regions under contract to city or county agencies. HCT manages paratransit operations for the City of Temple (population about 55,000). Until October 1999, HCT was located at the Scott and White Clinic and the transit service was being run under a contract with Scott and White. HCT is now located in a small building in downtown Temple, about a block from City Hall, at 15 North Second Street. They have a contract with the City of Temple to manage paratransit services. The city pays $7.50 per ride, thus providing the incentive to increase the number of riders and trips. Glenda Moseley serves as the operations manager. Jake Salazar is the dispatcher who handles day-to-day operations.

Resources

Temple has five vehicles dedicated to paratransit operations. Two of the vehicles are station wagons without wheelchair capability. Three are minivans that can each hold up to three wheelchairs. The Temple agency operates from Monday to Wednesday, 7:00 a.m. to 7:00 p.m. and Thursday and Friday, 7:00 a.m. to 10:00 p.m. The agency is closed on Sunday. There are two reservations and dispatching agents. Each agent answers calls for service, talks to drivers,

and enters and views information on a computer screen. All agents use the Trapeze software, and vehicles are equipped with MDTs that have two-way communication with the Trapeze software. Temple operations began using the Windows version of Trapeze in November 1999. Prior to 1999, trips were scheduled manually. Two Killeen dispatching reservations agents, who share office space with HCT, still manually handle scheduling and other related operations for the Hill Country operations in neighboring areas.

The team briefly discussed the possibility of using a paratransit Web site to communicate with clients. The transit manager expressed concern that many clients do not have a computer or Web access. The possibility of using an automated telephone system for reserving trips was also discussed.

Ridership

The approximately 1,600 riders include the elderly, the handicapped, and some students with disabilities. When HCT used manual scheduling, they handled 64–80 clients/day. With the aid of the Trapeze software, they now handle about 150 clients/day and travel about 800 miles/day, averaging four clients/hour/vehicle. Clients are encouraged to call 7 days in advance, but same-day callers are served if a vehicle is available. According to Mr. Salazar, 90% of same-day calls are currently not served. HCT rarely calls clients to reschedule. HCT's clientele includes many regularly scheduled clients, e.g., those undergoing dialysis.

Ride on a Vehicle to Observe the Operation Using a Mobile Data Terminal (MDT)

The team and Mr. Salazar took a one-hour ride in a MDT-equipped large paratransit van, equipped for wheelchairs and eight passengers. The MDT is a small device located near the driver; its small screen displays the clients to be picked up on the route, their addresses, time of pick-up, and destination. The MDT has several touch keys for scrolling, entering numbers and letters, sending, and a device to read a swipe card. Each authorized rider has a card that is swiped on entry. Three stops were made during the test ride. The first was for a wheelchair client and an accompanying family member. It took about 10 minutes to load and secure the chair in the van, with a similar off-loading time. After on-loading, the driver either enters the card number using his keypad or swipes the card. He also enters the odometer reading (this is used to check the mileage for the trip), which is computed by Trapeze. The driver then sends the message to the Trapeze unit at the dispatching center and the arrival time is automatically recorded. When the client arrives at their destination, the driver again enters the odometer

reading and sends a message indicating delivery of the client. We were told that most pick-ups are followed immediately by delivery of the client picked-up, before another passenger is picked-up. The next stop was for pick-up of an elderly couple. The driver sounded the horn, waited a few minutes, then went to ring the doorbell. Evidently no one was home, so this was recorded as a no-show. The final stop was to pick-up an elderly woman waiting in her driveway. The driver helped her into the van and then drove her a short distance to a beauty salon. We then returned to the dispatching center.

Potential Problems

- Mr. Salazar indicated that the software sometimes suggests inefficient routes. We were not able to explore this issue further.
- In the early stages of system operation, communication with the MDTs failed frequently, as did the card-swiping system. The MDTs communication system appears to be improving. A back-up voice communication system had to be installed, even though the MDTs include voice communication.
- The MDTs could be distracting to the drivers because the system signals the arrival of a message while the driver is en-route. However, most professional drivers adjust to this situation, and no major safety issues have been reported.
- The team observed that after batch scheduling, client pick-up times are sometimes pushed by the software by 4 – 5 hours. This time lapse between the scheduled pick-up time and the actual pick-up time of the ride remains a problem.
- In some instances, a subscription ride or trip is booked 7 days in advance. When the software is batch scheduling the night before the trip, this subscription trip is treated as a demand-responsive trip and is sometimes canceled.
- HCT in Temple sometimes does not maintain clients' phone numbers.
- It appears that real-time contact with clients is minimal; improvements here could make service more efficient.
- There was an instance when a trip was scheduled by the software at a starting time prior to the driver's starting time.
- The team was not able to determine that Trapeze can adjust the estimated arrival and delivery times on a route when unexpected delays occur along a

route. It would be helpful if clients would be informed that their pick-up will be delayed.

- Although the MDT system allows voice communication, this feature fails when the MDT system goes down.
- On some occasions, trips already made reappear on the small MDT screen. This duplication is confusing to the driver and clutters the screen, and may be indicative of more serious processing errors.

Summary

Mr. Salazar indicated that Temple's transit system under the management of HCT is much more efficient using Trapeze than the older manual system. Temple's transit system can now handle many more riders, with the same set of vehicles, drivers, and reservations agents. They would not consider returning to manual scheduling, despite the initial problems with Trapeze. Mr. Salazar believes that these problems can be overcome and will not consider switching to another paratransit management software system. The Killeen dispatching operation, which occupies the other side of the room, is considering acquiring paratransit software.

Services Program for Aging Needs — Denton County

The Services Program for Aging Needs (SPAN) is a private nonprofit organization established in 1974 to provide various services including transportation in Denton County.

SPAN enjoys a high level of community support and volunteerism. SPAN has 9 board directors, 23 advisory council members, 120 volunteers at senior centers, and 162 volunteers assisting with home-delivered meals.

Individuals, 60 years of age or older, qualify for benefits from the support services of SPAN. SPAN typically services clients who fall in the low-income minority category. SPAN operates a transit system in Denton County that includes fixed-route, flex-routes and demand-response services. They are subcontractors for the cities of Denton and Lewisville and a contractor with the TxDOT for rural public transportation.

The service area for this agency is Denton County (population: 204,300). Cities served within the county include Argyle, Aubrey, Carrollton, Corinth, Denton, Flower Mound, Hickory Creek, Highland Village, Justin, Krum, Lake Dallas, Lewisville, Little Elm, Pilot Point, Ponder, Trophy Club, Roanoke, Sanger, Shady Shores, and The Colony.

The team met with Sharon Olufsen, transportation coordinator, and Marry Ann Michelle-Scheduler on July 10, 2000.

Agencies Using Services Program for Aging Needs (SPAN) Services

- Texas Workforce Commission
- Fire department
- Nursing homes

Eligibility of the Riders

All residents of Denton County are eligible to avail SPAN's demand responsive services. Payment for the services is possible either on an individual level or through one of the funding organizations.

Routes Run by Services Program for Aging Needs (SPAN)

SPAN runs eight fixed-route services, and offers flex-route and demand-responsive services as well. A flex-route is one that accommodates a passenger through minor deviation from its fixed itinerary, without missing its regular stops. All the buses and vans are wheelchair accessible.

Software Usage

The Trapeze PASS software is being used for the paratransit operations. No transportation software is being used to run SPAN's fixed-route services.

Available Resources

- City of Lewisville has seven buses
- City of Denton has ten buses
- Denton County has twenty buses including the fixed-route fleet
- Eight call-takers

SPAN subcontracts for the fixed-route and demand-responsive services within the cities of Denton and Lewisville. Currently, SPAN subcontracts transportation services with the North Central Texas Council of Governments, the Area Agency on Aging, Texas Department of Health, Medical Transportation Services, United Way, and forty-two other social and governmental state and federal agencies in Denton County.

Desired Resources

SPAN does not have MDTs and AVLs in their vehicles. They plan to acquire the MDT systems in the near future.

Problems with the Trapeze software identified through the interaction between SPAN and the team:

- It does not seem possible to delete records of clients by specifying conditions. For example, trying to locate clients who have not used transit services after a specified date. This capability is especially useful for removing clients who no longer use SPAN services or are deceased.
- Duplicate trips made by the same client need to be identified individually by the dispatcher (the software does not flag duplicate trips).
- Although a particular client may be temporarily ineligible for SPAN services, the software still permits the client's trips to be entered and scheduled. Thus, a client who has been temporarily suspended by SPAN owing to a large number of no-shows or cancellations can still manage to get a booking without any difficulty.
- The scheduling and dispatching functions of the software do not always suggest efficient trip itineraries.
- Each time a new vehicle is added the system crashes.
- The default year is 2000. Thus, when a date of birth is entered as "09 Jun 76" it is interpreted as "09 Jun 2076."
- SPAN staff were not satisfied with Trapeze product support.

Kaufman Area Rural Transportation (KART)

Kaufman Area Rural Transportation (KART) service is a demand-responsive service operating between 6:00 a.m. - 12:00 midnight. KART operations began in 1989. More than 30,000 people use KART each year. Primary passenger destinations include medical centers, local businesses, educational facilities, area employers, and senior citizen centers. Medical transportation is provided into Dallas and adjoining counties. KCSCSI has contracted with the Area Agency on Aging and the Texas Department of Health to provide Title XIX medical transportation for Medicaid clients. The KART agency has agreements with the North Central Texas Council of Governments for the purchase of transportation services and with several local nursing homes to provide service for their clients. KART is currently negotiating with the Terrell State Hospital to provide transportation for their clients. KART has no subcontractors.

KART has been automated for the last 10 years and was the first in Texas to have an automated data management package for their paratransit operations.

The team met with Omega Ann Hawkins, executive director of KART, on July 10, 2000.

Current Service Delivery

Although KART encourages booking of rides at least 24 hours to 2 weeks in advance, they do try and accommodate same-day requests as well.

Ridership

About 7% of the riders are ADA clients.

KART vehicles usually do not cater to mobility-impaired passengers, since KART has few wheelchair-lift equipped buses and vans.

The agency has agreements to provide transportation for many clients of north central Texas (local nursing homes and Terrell nursing home, etc.).

The nursing homes fax and sometimes telephone KART for the trips. The contract requires patients be accompanied by an escort (who travels free of charge).

Medicaid Clients

Clients usually have to call Medicaid to receive a three-digit confirmation number before they can call KART. The client then gives the trip information to KART via telephone. Medicaid then calls KART back to verify the three-digit confirmation number of the client and the trip is scheduled.

KART has no eligibility criteria for their customers. Basically, any person living in Kaufman County can use KART's services. KART has a policy that each customer needs to call for their trip personally, thereby ensuring that the client is mentally competent.

Fares range between $1.00–$2.00. Many ride the service to work. Others use it for their medical visits and for trips to Dallas.

Mode of Communication Used

- Through fax transmissions and phone lines.

Funding Sources

- Federal funding
- Local funding
- County money
- United Way funds

Resources

Thirteen vehicles. Peak demand need is ten. Maintenance is subcontracted. KARTS operates with one trip administrator and one trip co-coordinator.

Major Operating Costs

- Fuel
- Driver salaries

Software

The Advanced Information Management (AIM) software was recently purchased to track operating data. Data is collected by the driver with a wand and hand-held scanner and later downloaded into the dispatcher's computer for analysis. Passenger names, destination, and mileage are easily recorded and used to generate billing for each contract for a given period. KART is a pilot agency for the software manufacturer and is actively involved in product development. AIM was developed and deployed statewide to provide client service reports for Area Agencies on Aging.

The AIM sytem has two essential parts:

- the software located at the base station and
- the scanning and recording devices for each vehicle.

The driver log sheet is generated through the bar code scans of each trip. Each time a pick-up/drop-off is made, the driver scans the bar code with the scanner. The following information is recorded in the device attached to the scanner:

- actual time,
- mileage or odometer reading of the vehicle,
- passenger name and destination confirmation,
- no-shows, and
- billing information about the trip.

Last-minute trips, which are not included on the driver's manifest, are noted by the driver at the bottom of the sheet as a special trip with the relevant details. This device along with the log sheet is submitted at the end of the day and the information from the device is downloaded into the software on a daily basis.

Advantages of the Software

- Data entry is greatly reduced.

- Customized report generation, especially for billing purposes.
- Work activity increased by 37%.
- Hand-held scanner's large storage capacity permits once a week downloading.
- Scanning technology is less problematic than smart cards as the cards can be misplaced and difficult to reproduce.

Disadvantages of the Software

- No dispatching or scheduling feature is present in the software.

Price of the Software

- $12,000 - including the thirteen scanners.
- Additional costs involved were for two new laser printers.
- AIM has been in use for the past 3 years. The users of the software are happy with customer support**.**

Texoma Area Paratransit System (TAPS)

Texoma Area Paratransit System (TAPS) is a nonprofit public transportation system providing transportation to persons of all ages. TAPS is a demand-responsive transportation system. Riders are encouraged to book their trips at least 1 day in advance. Trips are scheduled mainly for medical needs, nutritional needs, social service agencies, business, education, employment, and shopping.

TAPS operates Monday through Friday from 8:00 a.m. to 5:00 p.m. Transit service requests outside those times are provided as schedules and funding permits.

TAPS operates administrative and financial offices and performs centralized scheduling and dispatching, maintenance, and operational activities from offices located in the cities of Sherman and Denison. Vehicles and operators are located throughout the service area in sixteen locations, according to local demand. The combination of centralized control and decentralized operation has proved to be the most efficient use of vehicles, personnel, and resources. Service is accessible to those with disabilities and provides near real-time backup capability for all areas of the 5,634 square mile transit district.

TAPS gives priority to clients having special transportation needs, such as the elderly, the disabled, and human service agency clients. Trip destinations include after-school programs;

physical, vocational, or speech therapy; job training; Medicaid appointments; senior nutrition centers; work locations; grocery stores; and adult education programs.

The agency has agreements to provide transportation for clients of the Texas Department of Health, U.S. Department of Education, Area Agency on Aging, and the local Workforce Commission Board.

The team met with Pat Ridenour, Information Systems Manager, on July 11, 2000.

Funding Sources

- Federal Transit Administration
- TxDOT
- Texoma Council of Governments
- City of Bonham
- City of Denison
- City of Gainesville
- City of Sherman
- City of Whitesboro
- Honey Grove Community
- Texoma and Nortex Area Agencies on Aging
- Donations

Resources

TAPS has a fleet of fifty-one vehicles operating in the following counties: Cooke, Grayson, Fannin, Montague, Clay, and Wise. The fleet consists of seven passenger minivans and thirty-three buses, out of which twenty-seven vehicles are equipped to accommodate wheelchair passengers.

There are four telephone lines and three call-takers. The call volume handled is several hundred/day.

Major Operating Costs

- Driver salaries
- Maintenance of vehicles

Software

TAPS is completing a 2-year program to improve the communication, computer, and control systems. This program includes upgrading desktop computers, a local area network, Internet

access, facsimile (fax) uses, the dispatch system; and cellular telephone use for distant and night operations. One example is the practice of forwarding calls from a central telephone number to cellular telephones. This practice allows the senior driver on duty to also serve as dispatcher during off-peak periods while enabling passengers to use the main dispatch telephone number. A request for transportation received by 4:00 p.m. can be faxed to the appropriate location and scheduled for the following day on a near real-time basis. There are also plans to rewrite the scheduling and dispatch programs and to streamline reports, data, and billing functions over the next few years.

The software is a homegrown product developed by the TAPS information systems manager.

Features of the Software

- DOS-based system.
- Written in the Dbase 4 database language.
- Implemented on 100 MHz PCs.
- The software does not have any scheduling and dispatching features or algorithms for scheduling trips. The dispatcher performs this operation manually.
- The software is primarily database software and is useful for performing the following tasks:
  - Recording trips by name and Social Security number.
  - Inputting trip details like pick-up and drop-off address location.
  - Inputting of subscription trips one month in advance.
  - Identifying specific trips by date, vehicle, passenger, driver, etc.
  - Recording regularly scheduled trips one month in advance.
  - Dumping/canceling trips.
  - To generate log sheets revealing information tips about passenger, time of pick-up, location of pick-up and drop-off but no information about the time of drop-off.
  - No funding information is provided in this version.
  - To generate county dispatch schedules using the following information: vehicle number, ID number, name of driver, hours of operation of the driver, destination address, type of trip, pick-up time requested by the client, and name of dispatcher.

- Drivers report activity by vehicle number: trips undertaken month-wise and site-wise, five-year comparison of trips with month-wise split-ups, demographic analysis of trips and sites, the total miles for trips of each vehicle in each site, type of ridership analysis, performance review, type of passengers and their activity list, and contracted service monthly statements.
- Vehicle maintenance reports such as mileage reports, fuel consumption reports, repair cost details, maintenance schedules, and checklists for daily and weekly maintenance checks.

The drivers and station managers-in-charge complete the driver activity reports and fax them back to the TAPS office.

Future Improvements and Goals

TAPS is interested in making further improvements in the software by introducing newer technology (like smart cards and scan technology).

The information systems manager has come up with a new 32-bit version of her older software. This version permits queries and has many more report generating functions.

TAPS recently purchased five AVLs.

Features of the Automatic Vehicle Locator (AVL)

- After installation TAPS can log on to the Internet and go to the Web site http://www.atroad.com/. Utilizing their individual log-in and password, TAPS personnel can view the status of TAPS vehicles equipped with AVLs. Data on street location, mileage, stops, and speed is provided.
- AVL also provides instant messaging/alphanumeric paging service between dispatcher and the driver.

Costs Involved for the AVL

- Installation cost: $350 per AVL box
- Service fees: $40 per month per AVL box
- Software used by @Road is called "Fleet*ASAP*"

Chapter 4. Survey of Software Vendors

A basic description of the features of each software system is presented below (Ref 4). A tabular summary of key features of the software considered is presented in Table 4.1.

Mobility Master from Intelitran

- Menu-driven, Windows-based software.
- The software uses telephony and remote connectivity.
- Its computer/telephone integration provides access to features like Caller ID, automated voice response, and predictive dialing — features that can vastly increase customer service.
- Its support of onboard vehicle computers provides real-time, two-way mobile data communications, which allows instantaneous data collection, dispatch, vehicle rerouting and spontaneous rescheduling; and communication with multiple service providers without the use of multiple radio systems.

Client Management Database

- User-configurable client master files
- On-line trip histories
- Integrated client and cost data

Reservation Tools

- Easy entry of repeat trips
- Flexible fare calculation
- System-wide and client-specific common destination lists
- Simple entry of round-trips or three-way trips
- On-screen memo pads

Computer-Assisted Scheduling

- Integrated geographical information systems (GIS) for instant geocoding, address location, and on-screen and printable map displays
- Real-time and batch scheduling for both demand-response and standing-order trips

- "What-If" scheduling to determine and implement best options

Additional Features

- American Disabilities Act (ADA) trip-eligibility verification.
- Fixed-route availability search
- Accounts payable and receivable
- Section 15 reporting
- Over seventy-five reports (plus custom reports) available to user

SMV WI from Kernel Software

- SMV WI is primarily a paratransit software for specialized medical vehicle transportation providers.
- It is an Access-based software (thus, report-generating capabilities are particularly high). It is primarily a database application.
- SMV WI software allows per-vehicle licensing rates.
- Dial-in remote support for installation training and troubleshooting.
- Supports branch offices as separate dispatch points with consolidated accounting.

RightCAD from Pinpoint Technologies

Feature Index

- RightCAD is a Windows application
- Easy and flexible call-taking.
- Standing orders made easy.
- Dispatch information at your fingertips.
- Fully geobased for finding addresses easily.
- Superior mapping using quality Etak maps.
- Allows paging.
- Has dispatch "filters."
- Comprehensive reporting.
- On-line help systems present.
- Integrated system administration.

- Real-time traffic updates.
- User-defined zoning.
- Mobile data.
- Advanced System Status Management (SSM).

RightCAD has features like mapping, telephony and advanced user configuration. RightCAD also supports a suite of products such as Mobile Data Terminals (MDTs), Global Positioning System (GPS) and SSM.

New Features of the Upgraded Version

- 100% 32-bit technology
- Multiple copies of RightCAD and Sanitas (the accounting software) can be run on the same machine.
- Entering the "approximate age" helps reach customer records quicker.
- The point-and-shoot and drag-and-drop features at the click of a mouse make it a very user-friendly program.
- Object Linking and Embedding (OLE) is a technology that allows applications to interface with data elements from other Windows programs. This feature will also allow RightCAD to share data and functionality with future applications.
- Open Database Connectivity (ODBC) enables applications to access a large number of database services through a single interface.
- Telephony Application Programming Interface (TAPI) enables an application developer to add elements of telephone control to a Windows application. RightCAD takes advantage of such TAPI services as integrated faxing and automatic dialing of numbers in the system. Results of calls are recorded in the trip history.

Special Features of RightCAD

- On-screen calendar.
- Flexible standing orders — standing orders that are configurable by day of week, end dates, alternating weeks, first week of the month, and more.
- The TAPI allows the computer dial-out for the agent.
- Candidate rankings: Each time you highlight a trip in dispatch, RightCAD automatically ranks candidate vehicles, letting the dispatcher know which is the

closest appropriate vehicle. RightCAD also ensures that only appropriate vehicle types are selected for each cell.

- Multiloading: RightCAD allows vehicles to be multiloaded, based on user-defined vehicle capabilities, and will warn a dispatcher of an attempt to overload a vehicle.
- Overdue checking: RightCAD allows the user to set up time limitations based on call type and priority that check to see if a vehicle is operating within preset time limits. This feature ensures the best response times and warns the dispatcher if a vehicle is outside the limits.
- Pre-assign: Standing orders can be permanently pre-assigned to vehicles based on trip-leg and day of the week so that they are routed ahead of time.
- Vehicle statistics available in graphical format.
- Filtering: RightCAD allows dispatcher to filter work by company, call types, priorities, or dispatch zones, allowing them to view only their individually assigned work.
- User-defined bill configuration.
- Reporting options: There are fifteen standard reports.
- Multiple system interfaces:
    - MDT application programming interface.
    - GPS/AVL application programming interface.

TRANWARE from Surfside Software

Surfside is an IBM business partner.

Key Features

- Complete staff file and programmable authorization levels for all sections of the system.
- Custom reporting.
- Minimal hardware and operating system requirements.
- Single-user, multi-user network and multiple site configurations.

Special Features

- Industry-standard database formats make transferring of information into other computer programs for analysis easy.

- Integrated internal e-mail.
- Training and configuration via telephone and computer link-up.
- Customizable and fully supported 24 hours a day.

MIDAS PT from Multisystems

MIDAS PT is Windows-based paratransit software.

Feature Index

- The ability to handle a mixture of both demand-responsive and flex-route services.
- MIDAS PT allows creation of scheduled stops and then schedules dynamically in the slack time between those time points.
- Mobile data communications for vehicle messaging.
- Geographic data and map displays.
- Supports all kinds of rider eligibility, including ADA, medical assistance, seniors, and general public.
- Flexible scheduling, including at least four different ways to schedule while the customer is on the phone. MIDAS PT also features powerful batch-scheduling tools that may be used to schedule (or cancel) all or any subset of the trips as needed.
- Extensive dispatching tools for managing same-day services. The dispatcher is automatically alerted anytime there is a same-day cancellation or add-on, and reservations agents automatically see if a trip is running late when they answer a "where's my ride?" call.
- Brokerage features such as multiple operators and sponsors, including calculation of rider fares, billing charges, and vendor costs.
- The ability to use interactive voice response to provide automatic call-backs, trip confirmations, or even automated trip reservations.
- Extensive reporting capabilities. In addition to the many standard reports, one can do ad hoc queries.

Trapeze PASS from Trapeze Software

Trapeze PASS is a demand-responsive scheduling and dispatching software system. Trapeze system is a true 32-bit software application built for Windows 98/NT.

The software allows

a. registering passengers,
b. creating bookings,
c. scheduling passengers to vehicles,
d. dispatching vehicles and drivers,
e. recording trip events, and
f. geocoding locations.

One can choose to manually schedule passengers and dispatch vehicles or to have the system automatically perform both functions. Trapeze PASS is a Windows-based software, incorporating a graphical user interface and drag-and-drop function that is easy to learn.

Functionality

- System map.
- Colorful mapping tool enables easy geocoding — the longitude and latitude coordinates are automatically calculated.
- Customize the map to show specific map colors, route colors, and street names.
- Client registration.
- Apply eligibility programs to paratransit service and track passengers' certification status.

Trip Booking

- Book subscription or demand trips with full access to passenger and trip data as well as passenger history.
- Multiple comment fields for storing additional reservation's information.
- Passenger suspension notification.

Scheduling

- Automatic assignment of recurring subscription trips (batch mode).
- Automatically match subscription clients on the same recurring trips (match mode).
- View multiple scheduling itineraries and runs interactively on the map.

- Drag-and-drop manual scheduling.
- Dispatching.
- Monitor vehicles, runs, and trips.
- Identify and adjust service by responding to situations as they occur.
- Record incidents detailing any changes that happen to street itineraries.
- Track multiple funding sources by customer and trip.
- MDT.
- Connect dispatchers and drivers for live communication.
- Update route progress enables dispatchers to take corrective action where needed.
- Automatic Vehicle Location (AVL).
- View vehicles on the system map in real-time using GPS technology.
- Re-assign vehicles based on vehicle locations and schedule adherence.
- Computerized voice.
- Support trip confirmations, cancellations, bookings, and passenger call-outs without human intervention at the reservations center.

Table 4.1 Comparison of Available Software Features

Software Vendor Name	Software Name	Operating System	Hardware Requirement	Base Price S=single M= multi user In $	Cost of Training
Surfside Software Systems	TranWare	DOS On a Windows system the software runs on a DOS Window.	Pentium class PC	Base price of software is $2,950 plus additional users-costs $ 1,250.	N A
Intelitran	Mobility Master	Windows	PC	Up to 200 trips /day the license fee is $19,500 201 – 500 it is $26,000 501 – 1000 It is $37,000 1,001 – 1500 it is $48,000	NA
Kernel Software	SMV WI	Windows 95	Pentium class II or III PC (200-400 MHz)	Price per vehicle over base number 1-10: $300 11-20: $ 250 + Base price of $ 3000	Training /technical support is available at a rate of $55 /hour.
Pinpoint Technologies	RightCAD	Windows NT server 4.0	PC Pentium II 350 MHz or better	NA	NA

Table 4.1 Comparison of Available Software Features *(continued)*

Multisystems	MIDAS PT	Windows 3.1 or higher (Windows for work groups Windows 95 ,Windows NT) Windows NT 3.51 or later or Novell NetWare 3.11 or later.	PC with 32 MB RAM (suggested) Pentium Processor 166 MHz or better (suggested)	The package cost would start at $50-55K for a single user and includes installation, training, one-year warranty, etc. Multiple users can be added for $2,500/user.	NA
Trapeze software	PASS	32-bit software application built for Windows 98/NT	Pentium class PC	Software cost is around $100 k. License fees $3,000	NA

Table 4.2 Initial Configuration and Data Requirements

MIDAS PT	TRANWARE	SMV WI	TRAPEZE PASS 4.0
This is a Windows-based software. The system administrator at beginning sets the access rights. -The client file is loaded at the time of installation. Client information data can be transferred to MIDAS PT provided an ASCII file is given. With fixed length or comma delimited format, along with a description of the length and contents of each field.	This software is entirely based on DOS. All data interaction is done using hot keys mentioned in a table. The steps involved in the initial configuration are: Company information Company codes Staff authorizations Staff file maintenance Vehicles Drivers City codes Zone codes Landmarks Account numbers and groups for billing Trip service types Zone pricing Standing orders	The software divides the access rights into 3 categories: Accountant Scheduler Supervisor The lead times used for each trip needs to be predefined. An address and phone-book access database is used to register clients and generate trip information sheets. This access file is needed during initial setup.	The software is installed with the company information on it. It also comes with a detailed customized service area map. Some of the initial information/databases needed are: Client name and ID; Address; specific service area zones; for subscription runs vehicles are assigned; space requirements of passengers; passenger with their disability types and vehicle preferences; ADA types; mobility aids; booking purpose types; booking sub-types (like demand, standby, urgent, will-call, etc); fare types; fare /pricing zones; adding vehicle providers. One of the most important initial setup work assignments is to geocode new clients' addresses and frequent destination addresses in the map.

Table 4.2 Initial Configuration and Data Requirements *(continued)*

Client details should include: • Name • Address and zip code • ADA eligibility • Mobility aids required if client requires a personal care attendant • Emergency contact • Type of vehicle required -Rules used to determine the eligibility of individual trips as well as other business rules concerning scheduling of trips.	Shift types Mode of payments to drivers		

Table 4.3 System Maps

MIDAS PT	TRANWARE	SMV WI	TRAPEZE PASS 4.0
Allows setting-up of the service-area maps; dispatch zones and travel times; client file; standing-orders file. Individual address location is possible. Driver map book needed and street database are needed for initial setup of the map. The maps to be fed are available in the following formats: • Uncompressed ESRI UNGEN • Transcad • Map Info interchange format • Tiger format – uses postal station names Other information needed for setting up the map are :	City codes can be added by going to the administration menu then table maintenance; and finally selecting city codes options and entering the information using insert, Pg-down and other hot keys.		The Street Wizard allows to geocode and find specific streets, cross - streets, street ranges and pinpointing pick-up and drop-off points on the map. The software provides system-wide bus route map for optional mile test.

Table 4.3 System Maps *(continued)*

List of zip codes for service area. Common addresses such as municipal buildings, hospitals, malls, supermarkets, etc. identified by type and with geocodable addresses. This can also be done if the transit provider provides ASCII file of a similar format as mentioned above. The software provides system-wide bus route map for optional mile test. - The Pan function allows display of different areas of the map simultaneously. -The Print command allows printing sections of the map for driver's easy location of address.			

Table 4.4 Billing

MIDAS PT	TRANWARE	SMV WI	Trapeze PASS 4.0
-It needs a specific example along with a code number for each type of pricing. (i.e., what is paid by the customer and what is paid by each type of sponsor). -Allows primary and secondary sponsors to fund trips according to % of sponsorship. - Other information needed for setting up the maps.	-Each service type is first entered according to its pricing structure for each type of trip. -The Trip Service Types are designed to allow up to eight different pricing items to be charged for each pricing structure. They are required in order for the TranWare program to properly price trips based on the company's current pricing tables. The data is entered using the hot keys.	-The pricing matrix is based on factors like unloaded mileage, loaded mileage, multiparty mileage, wait-time rates and second attendant. The rates are initially set up for computation of billing.	

Table 4.4 Billing *(continued)*

	-The Zone Pricing matrix is used after a pick-up and drop-off zone is entered and the appropriate Trip Service Type is used. It allows the operator to enter a pick-up and drop-off zone at the time the order is taken and the software automatically prices the trip based on the company's pricing structure. - The pricing matrix is built with features like flat rate, zone rate, mileage-based, and different types of service. -The drivers can be paid according to their category such as lease, salary, and hourly drivers.		

Table 4.5 Scheduling Method

MIDAS PT	TRANWARE	SMV WI	TRAPEZE PASS 4.0
Four types of methods: • Trip by trip • Batch load taxi trips • Batch load holding trips • Best feasible option Using the best feasible option forces the software to choose the best feasible option based on factors such as cost of run, percent of time which the vehicle is empty, productivity of run in passengers per vehicle hour, and number of trips which violate the window constraints placed on them when initially scheduled. - One can choose to schedule escorts as well along with the clients while scheduling trips.	Sufficient information on the algorithm was not available.	Right at the time of installation characteristics like max-unloaded time, maximum loaded miles maximum wait time, etc. are added. Any calculated values exceed their respective values the entry is disallowed. <u>Note:</u> Once the trip schedules have been distributed, one cannot reset the daily trip. This implies that trip requests coming in while driver is on route are not entertained.	Batch scheduling is possible. A subscription template is made for a particular day of the week. The batch parameters include booking with or against template; synchronizing schedule times and geocodes, and rescheduling bookings already scheduled. The scheduling solution parameters are • Expanding early/late requested time. • While scheduling batch size may be specified. • Maximum number of solutions. • Displays cost-based results while scheduling based on number of vehicles vs. street routing. • Search time for finding solutions can be specified. • Each factor can be assigned importance using a slider. • The minimum and maximum distance a vehicle will travel can be specified. • Minimize on-board time of a passenger. • Maximizes the efficiency of a trip by placing passengers with similar geocodes on the same vehicle. • Minimizes the number of vehicles being used. • Minimizes the number of violations that occur on a run. All of the above factors may be ignored at will.

Table 4.6 Scheduling Templates / Run Templates

MIDAS PT	TRANWARE	SMV WI	TRAPEZE PASS 4.0
Subscription/standby schedule Working schedules Daily dated schedules **-Eliminates double/conflicting bookings.** In case multiple trips are booked for the same client this is distinctly reflected on the "booking verification screen" -Has a special screen to manage group trips. • In case a driver or trip is running late the software makes the necessary changes in the entire run especially stop times to cover up for the lag time. • Vehicles that are on standby in a zone are flashed on dispatch monitor screen for ASAP assignments.	The program can be configured to assign trips by driver number or by vehicle number. Dispatch screen displays the orders based on priority status and pick-up time. A vehicle status screen displays the status of all vehicles. The dispatch screen displays different driver status/vehicle status. Using different colors and blinkers the status of each driver/vehicle on that day is displayed. Some of the common statuses are: Loaded, completed, no-show, cancel, and priority trips.		Master template runs specifically for a certain group of days and operates continuously throughout the year unless overridden by the daily run file and is always inserted in the system at the beginning. Single insert of casual booking for multiple days is possible. The useful dispatch function keys are: Dispatch by run on each vehicle Displays unassigned runs Incidents within a time range Send pick-up and drop-off times and location through MDT Allows display of urgent trips. (Only in terms of display) Allows voice transfer of messages.

Table 4.6 Scheduling Templates / Run Templates *(continued)*

• The software allows morning/evening peak factors to adjust the average speed of the road and aid in scheduling. **This is done by time of day and day of week, if possible, for** - residential streets, - major intersections, and - expressways or other divided highways. The software also allows morning evening peak factors to adjust the average speed of the road and aid in scheduling.	• The software does not have an interface with MDT. Thus the final status of each trip is completed after receiving the completed driver log sheet. Drivers can be paged through an alpha-numeric-paging module by the dispatcher using TranWare**.**		**In this software, average speeds on roads are adjusted based on time of day and day of week if possible for** - residential streets, - major intersections, and - expressways or other divided highways. -Actual time after a pick-up or drop-off is made is reported to the software via radio or MDT. But this time is not incorporated in the current schedule of the trip.

Chapter 5. Integrating the Paratransit Agencies

Data integration in Texas paratransit agencies was one of the important goals of this project. The question was how to do it. Our survey of the Texas paratransit agencies and the software they were using clearly revealed that such integration is possible. Designing and building the infrastructure for such integration is a crucial issue. This chapter presents a possible approach to achieving such integration. It details the software and hardware available to make such integration possible. After discussing the technologies, a plan is proposed for the integration.

Trip Reservations

Phone congestion was observed to be one the major operational problems of the paratransit agencies. The other major problem encountered was that the systems were rapidly reaching their capacity. To reduce phone congestion, other ways of reservation of trips could be used, such as

- through a direct Web reservation form,
- by fax, or
- by calling and leaving a message to an answering service.

Transit Reservations Through the Web

The use of the Internet to place requests and track status is called for to reduce phone congestion. This eliminates the need to use the phone and wait on hold. Reservations/booking of trips through the Web by logging and placing one's reservation is simple and efficient option. Such technology is being used for cab reservations services. (Reference: www.yellowcabco.com/calltaxi.asp)

A Web site could be created for the paratransit clients. The client could log in and make a reservation for their future trip. Almost all real-time reservations can be made possible by using such Web sites.

A paratransit reservations Web site should have the following fields.

Pick-Up Information

- Landmark name
- Address
- Phone number

- Client name
- Time when ride is needed
- Date when ride is needed
- Reason why ride is needed

Drop-Off Information

- Landmark name
- Address
- Type of vehicle needed
- Level of expertise needed by the driver
- Curb or door service needed
- Client ID number

Reservations through Fax

The agencies that handle caller requests from specific target populations should fax their travel needs to the paratransit agency whenever possible. Upon confirmation of the trips, the paratransit agency could fax back the document. Unconfirmed trips could later be negotiated by calling a reservations agent.

Reservations Using a Message Box

Paratransit agencies should begin using an intelligent and interactive answering machine system to record trip requests of clients. This way, a 24-hour call reservations service can be provided to the clients. Upon confirmation of the trips, an automatic call-back machine could be used to confirm the trips requested. Again, the unconfirmed trips could be negotiated later by calling the reservations agent.

The plan proposed for integration of paratransit agencies would require having a call center with the following elements:

- Call-taking division/common radio room/ common reservations room
- Integrated accounts division
- Scheduling division

Call-Taking Division / Common Radio Room / Common Reservations Room

Based on the surveys of the paratransit agencies, the team believes that having a common reservations room is an important element of the solution to the phone congestion problem. The following technologies would be needed for a common radio room.

- Computer Telephone Integration (CTI)
- Automatic Number Identification (ANI)

CTI is defined as a functional integration of business application software with telephone-based communications. It involves the connection of a computer (small or large) to a telephone system (PABX, ACD, or public network), using some form of intelligent control link to enhance telephone call handling. The resulting CTI has the effect of improving the efficiency and effectiveness of an organization that transacts business over the phone.

To satisfy today's integrated voice and data environment, substantial investments are needed. These could likely best be made when multiple transit agencies combine their resources. During peak hours, the system in use needs to handle more than 4,000 e-mail messages per day and an even greater number of calls.

A call distribution system is also required to direct incoming phone calls, e-mails, and fax messages to specific agents who can best handle that particular area if needed.

Another useful package that could be used is *eCenter* software from Servicesoft, which sells for about $15,000. This is a knowledge-driven package which provides on-line self-help for the user, including e-mail, and live chat. The software contains four integrated applications including the Web advisor. An example of how this module could be helpful is presented below.

When a customer requests confirmation of a certain reservation, the interactive database is searched for a vacancy (seat) on the required route, so the client's question can be answered. If a satisfactory answer (which is yes/no) could not be given, the question is passed to a live agent through a chat module. However, if the client prefers to speak to a live person at that time, he could call as well. The live agent could then work out a feasible trip plan for the client. However, this kind of technology comes at a price.

The Working of a Computer Telephone Integration (CTI) System

In a CTI system, the inbound calls are routed by the PABX system or ACD telephone switch to an agent. The switch passes the messages to a computer over a control link. The computer

application program then pops up an appropriate screen of data on the agent's terminal; this is referred to as intelligent answering. Similarly outbound call handling can be improved by the computer application requesting the switch, via the control link to dial one or several numbers. This could be automatic or the agent could simply initiate the calls by pressing a key on the terminal.

Automatic Number Identification (ANI)

Another important technology that is useful to this reservations operation is ANI. Such a system provides a pop-up screen when a client calls, based on the phone number of the incoming call. The computer screen which pops up can tell all about the client, funding sources available to the client, and the most frequently visited places by the client. Some of the manufacturers of CTI products include Cisco, 3Com, Adtran, Nortel, HP, NEC and Novell.

Integrated Accounts Division

Another important technological requirement for an integrated transit system is having an *integrated accounts system***.** An *integrated accounts system* would allow the paratransit agencies to focus on the scheduling and service provision aspect of the operation. The system proposed is a common payment scheme for all the paratransit agencies. The account package needs to be designed such that it is possible to operate just one account for all the cost areas while at the same time maintaining an itemized, readily accessible record for all travel expenses in addition to recording critical accounting requirements in detail. Docket/voucher numbers need to be issued to verify sufficient funding is available.

Each time a driver manifest is generated, the manifest is to have a bar code on it for each customer. Whenever the pick-up or drop-off for the customer is made the bar code is swiped and the information regarding the pick-up/drop-off is recorded into the handheld scanning device. This digital information is then fed into the computer system at the end of the day and all customer accounts are updated and ready for future use. In case the accounts need to be replenished, a flag could be instituted for this purpose to ask the accounts department to work on it.

System Advantages

- Easier and more efficient maintenance of accounts for both paying and receiving parties.
- Better handle cancellations and no-shows.

- Reservations agents would not have to designate a funding source as the accounts package would automatically determine the funding source based on the destination of the customer.

An ability to receive account details via electronic media will provide the opportunity to electronically manipulate and sort data based on a number of criteria.

A *common radio room* at each paratansit agency would reduce operating costs. However, prior to implementing this, each paratransit agency would need to be convinced that they would not lose control over their own fleet and customers.

Scheduling Division

Once the entire service area has been subdivided into a grid system and a common radio room has been established, the next step would be to set up an advanced scheduling and dispatching package, enhanced with *Global Positioning System (GPS)* and *Automatic Vehicle Location (AVL)* capabilities. GPS and AVL packages are designed to dispatch the nearest, most appropriate vehicle to the customer based on known and expected customer demands. This allows effective response to emergency situations. During one of the site visits, the research team came across a very useful package, which combines GPS and the AVL technologies.

The @ROAD package combines both GPS and AVL technologies in a Web-enabled system. The @ROAD company has come up with a new technology called *Mobile Resource Management (MRM)* software, which addresses the GPS and AVL needs by providing, location-based information services to companies involved in the transportation and distribution of services.

The @ROAD end-to-end MRM solution includes scheduling, dispatching, messaging and location of mobile resources, and the delivery of services. MRM solutions leverage location and wireless and Internet technologies to provide real-time location information and location-based services. The software provides the following solutions:

- Location information
- Dispatch applications
- Work metrics status, activity, and messaging history reports
- Instant two-way wireless messaging solutions
- Intelligent scheduled maintenance

MRM software is designed to meet the business needs of any sized fleet. Being an easy-to-use Web-based solution, there are no expensive, proprietary hardware and software systems to purchase. A PC with Internet access, Internet Location Modem (ILM) and Internet Data Terminal (IDT) for each vehicle are the principal requirements to log in, locate, and dispatch from anywhere at any time. This software enables users to be connected with their drivers and vehicles at all times.

Location and Dispatch Features of the Software

The MRM software uses GPS technology to pinpoint the location of the vehicle, wireless data technology to communicate the information to @ROAD data centers, and the Internet to give complete fleet management from the desktop PC. It helps monitor vehicles 24 hours a day, providing regularly scheduled updates that show location of the entire fleet or a single vehicle on easy-to-view zoom maps; provides location of the nearest vehicle to an address, landmark or nearest cross-street; and stores location information when a vehicle is outside the wireless coverage area. In addition, it allows vehicles to be easily routed and re-routed, records and stores out-of-area vehicle movements, and allows simultaneous access by users at multiple locations.

Reporting Features

Reports can be generated about the fleet, a segment of the fleet, or a single vehicle. In addition, reports on location, speed, and direction of travel, stops, real-time, end-of-day, and activity reports are also possible.

Messaging Features

MRM software allows two-way text messaging, which enables the dispatcher to send route changes or other instructions to any vehicle quickly and accurately, and to receive a text message in reply. The system can leave messages for later viewing when the driver is not in the vehicle.

Web Convenience

Each customer of the @ROAD package is provided with a home page accessible as a World Wide Web page. The Web page provides the following details about the client's fleet:

- Vehicle status
- Up-to-the-minute summary of all the vehicles
- Vehicle tracking

- On-line street map with zoom features
- View present position, vehicle path, stops by duration

Hardware Requirements

- GPS antenna*
- Cellular antenna
- Power cord

* Note: The GPS antenna requires a clear view of the sky. It does not work in tunnels, underground or inside buildings. To learn about this package, the reader is advised to visit www.atroad.com.

This chapter discussed some of the technologies that can be used to evolve toward an integrated paratransit system. The flowchart in Figure 5.1 displays the proposed design.

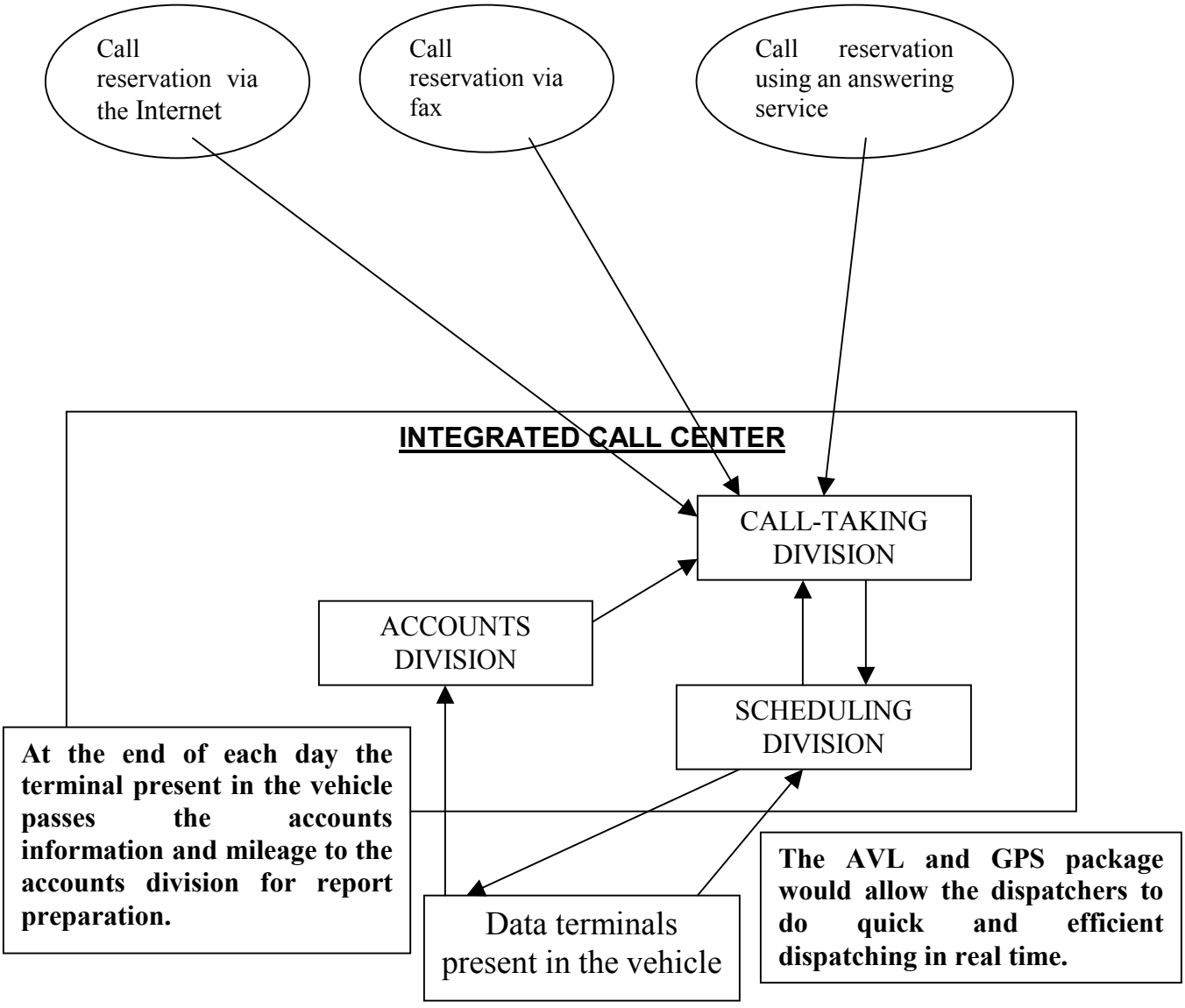


Figure 5.1 Conceptual Design Data Integration

The research team concluded that data integration of paratransit agencies is certainly a possibility. Although expenses would be involved in the initial setup, these costs would translate into future cost savings and improved service levels to customers.

Chapter 6. Conclusions and Recommendations

This report has documented the findings of the research team regarding integrated scheduling of paratransit operations. While software and data processing automation are an integral element of any approach to achieve such integration, important changes in the agencies' operational procedures could greatly contribute to this objective. The research team's review of available software options revealed several critical limitations of off-the-shelf software targeted at the paratransit market. Most available software tends to be direct descendants of software from an earlier era of hardware platforms and software models. As a result, off-the shelf targeted software lacks many desirable features for this type of operation, and more importantly seems to lack the desired flexibility and ease of use in this context. Furthermore, vendors tend to be very "possessive" of their software and reluctant to reveal much about its intervals, forcing the users to accept a defacto "black box" product for an application that requires the utmost transparency. For these reasons, the research team does not recommend nor endorse any of the currently available packages identified and reviewed in this report. In particular, user experience with deployed packages in Texas was not positive, suggesting that a different approach should be sought. The research team believes that a more flexible, Web-enabled, less expensive software solution could be customized for paratransit applications, and offering the users greater ease of use and flexibility.

In addition to the above general conclusion and recommendatios, several potential procedural improvements were identified in the course of the team's in-depth interaction with selected agencies. These are summarized, hereafter, as an indication of the types of changes that could improve paratransit operations.

Capital Metro's Special Transit Service (STS)

While studying Capital Metro's Special Transit Service (STS), the team noted that 5 to 7% of the total number of incoming calls are missed. The primary reason for missed calls is due to the inability of the dispatchers to notify the drivers about incoming standing requests. The team agreed with the transit manager that application of Mobile Data Terminals (MTDs) and more advanced dispatching software are potential solutions to the problem. Also, if the radio communication between dispatcher and driver is improved the number of immediate requests

that can be handled will increase. The major operating costs of the system are maintenance of vehicles, fuel, and driver salaries and benefits. About 60% of the total operating budget goes toward driver salaries.

While observing the STS operations the team noticed that the no-shows and cancellations consume a lot of the financial and labor resources of the STS system. Communicating these cancellations is, at present, a time-consuming procedure.

The use of MDTs is suggested, as this should reduce the volume of unclear voice transmission through the radios drastically. Utilization of Trapeze software separately, for dispatching fixed-route buses and paratransit buses, does not allow the maximum utilization of the fleet resources of Capital Metro. The software in use lacks the feature which would prevent overloading of a particular cab company in the city when the voucher rides are awarded. Such a provision would increase the satisfaction of STS customers with the cab voucher service.

The other suggestions made by the team were to make more extensive use of the Internet. The team suggested that the STS application form, recertification form (a questionnaire to assess or reassess the eligibility of candidates for STS), be made available via the Internet. This would save a lot of data entry operations for the STS staff. In the future**,** advance reservations/bookings and cancellations could also be done through the Internet.

Capital Area Rural Transportation Systems (CARTS) — Austin

The problem of communicating messages to the drivers by the dispatchers appears to be a rather acute one for Capital Area Rural Transportation System (CARTS). When CARTS purchases MDTs it will improve communication between driver and dispatcher. The team suggests that CARTS place their service and schedule on the Internet and eventually enable reservations over the Internet. The team encourages CARTS to further introduce, over the Internet, the concept of interactive booking between the customer and the service provider.

Incorporation of Automatic Vehicle Location (AVL) packages should also be considered, as this would greatly improve dynamic scheduling. CARTS recently began using the Windows version of Trapeze PASS. In order to reap all the benefits of this new software, CARTS should eventually acquire AVL packages.

A final general observation is that acquisition and installation of software is not sufficient to achieve the kind of operational improvement that is potentially possible in the delivery of

paratransit services in small and medium-sized communities. Software is only one piece of the overall operational scheme. An essential ingredient is the careful restructuring of existing operations, in order to better enable the effective and productive use of the software investment. As indicated previously, existing software does not meet the functional requirements for simple, transparent and flexible operation and integration of the services. An approach to achieve such improvement would require: (1) careful observation and re-engineering of the processes involved in the delivery of these services, and (2) development of software conceived for operation and interaction over the internet on modern operating systems and inexpensive platforms.

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