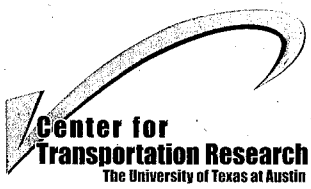

RESEARCH REPORT 1884-1

TRANSIT SCHEDULING DATA INTEGRATION: PARATRANSIT OPERATIONS REVIEW AND ANALYSIS

Dr. Leon S. Lasdon, Dr. Hani S. Mahmassani, and Sourav Dutt

CENTER FOR TRANSPORTATION RESEARCH
BUREAU OF ENGINEERING RESEARCH
THE UNIVERSITY OF TEXAS AT AUSTIN

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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 is the key issuer here. In these systems, data management is complicated by the fact that clients of several external agencies contribute to system demand. These include the Texas Department of Health (TDH), workforce boards, and others. For example, regional TDH offices perform client eligibility screening for Medicare recipients, and authorize trips for medical purposes. TDH generally provides these trip schedules by phone or fax to the transit system the day before the required service. Using manual scheduling processes, these Medicare trips may be allocated inefficiently to the available fleet, limiting the systems ability to respond to other demands for service.

The primary goal of this study is 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 paratranist systems and (2) process improvements for the transit agencies and their external partners which will enable them to realize the full benefits of the new system.

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DISCLAIMERS

The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Federal Highway Administration (FHWA) and the Texas Department of Transportation (TxDOT). This report does not constitute a standard, specification, or regulation.

There was no invention or discovery conceived or first actually reduced to practice in the course of or under this contract, including any art, method, process, machine, manufacture, design or composition of matter, or any new and useful improvement thereof, or any variety of plant, which is or may be patentable under the patent laws of the United States of America or any foreign country.

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BIDDING, OR PERMIT PURPOSES

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Research Supervisor

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EXECUTIVE SUMMARY

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 is the key issue here. In these systems, data management is complicated by the fact that clients of several external agencies contribute to system demand.

The primary goal of this study is 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 which will enable them to realize the full benefits of the new system.

This report documents the progress accomplished in the first phase of the project. It provides a review of available software products and their key features. A field investigation has been investigated to document first-hand actual operating procedures of selected paratransit agencies in Texas, and experience to date with available software.

The assessments have shed important insights into the operational requirements that must be satisfied by scheduling software, as well as into ways that current procedures and performance could be improved through judicious use of appropriate information technology. Available software products appear to fall short of agency expectations and needs. There appears to be room for significant improvement in the software products if the developers had deeper understanding of the agencies operating realities.

CHAPTER 1: INTRODUCTION

Paratransit services are demand-responsive public transportation services for people who meet special eligibility requirements, such as the disabled and elderly. The primary objective of this project was to observe the operations of Paratransit operations in the state of Texas, especially those situated in small urban and rural communities, and 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.

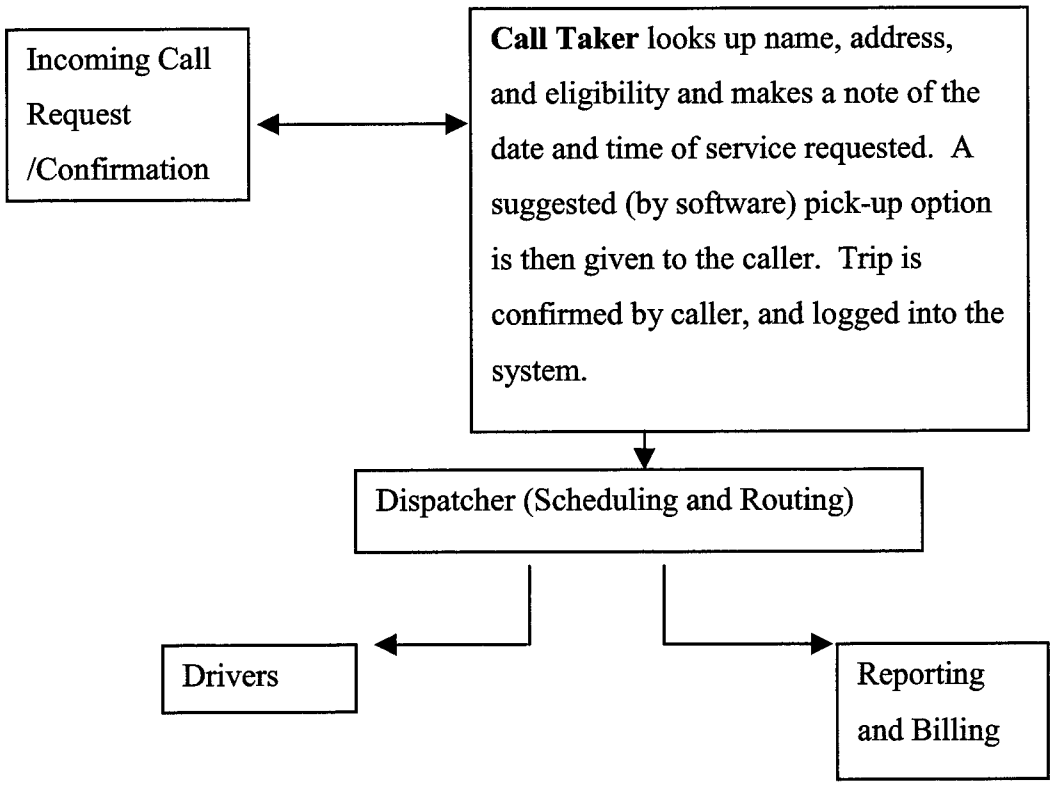
The project team investigated the technical and operational problems faced by some small Paratransit providers in Texas with the primary objective of identifying and recommending improvements. To that end, the team studied and assessed software used for planning and scheduling daily operations. The most widely used Paratransit software in Texas is the Trapeze system, and the most current version available is TRAPEZE PASS 4.0. Some operators have purchased new hardware such as Mobile Data Terminals to make communication easier.

This report is organized as follows. Chapter 1 assesses transit operations in forty-one Texas counties. The salient features examined are the area served, hours of operation, number of employees, fleet characteristics, total one-way trips, total budget, and 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, and researchers visited several of these agencies in order to examine their operational problems and software use more closely. The status of these providers is presented in tabular form.

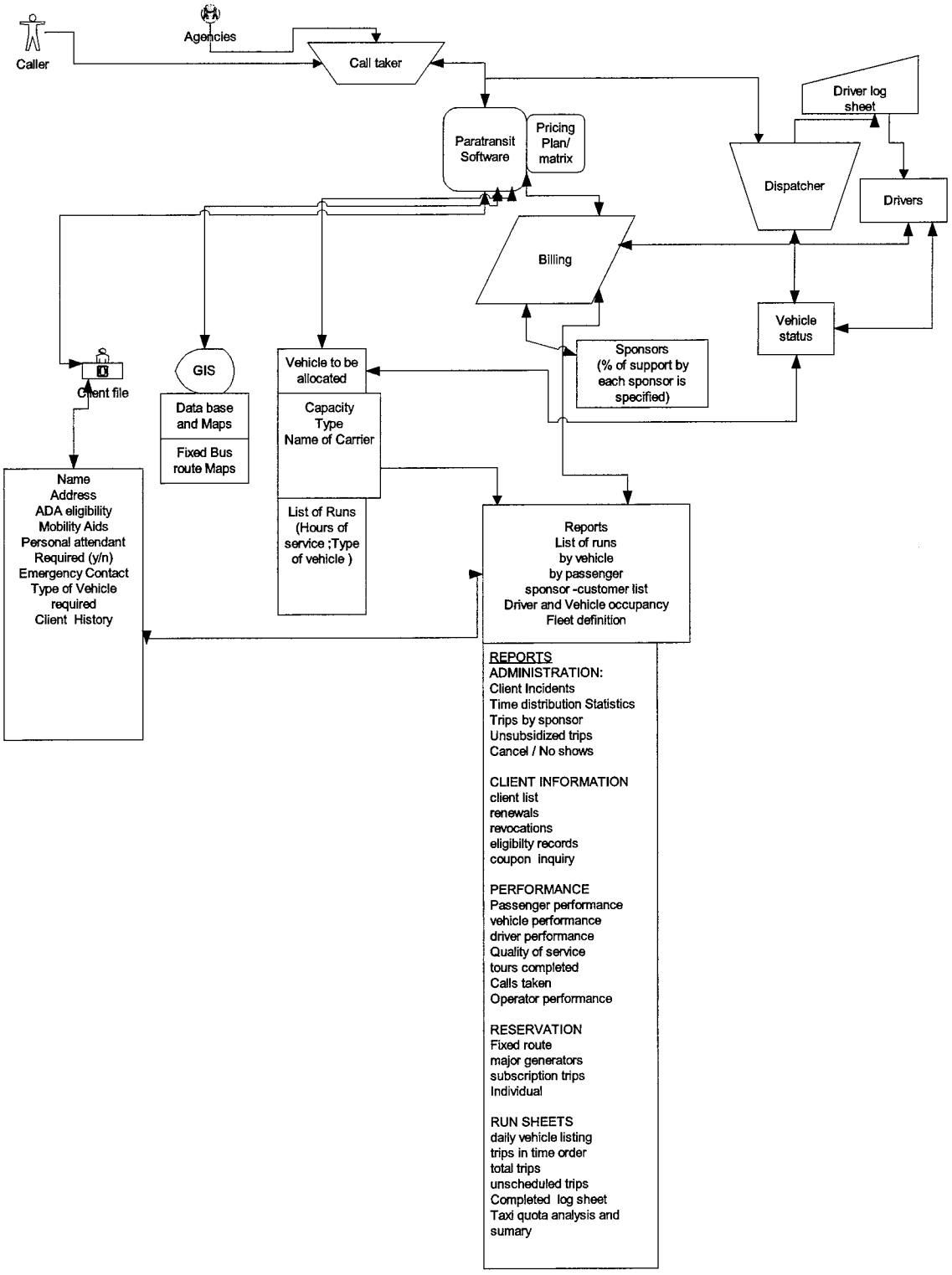
Chapter 2 outlines some important characteristics of a demand-responsive Paratransit system and provides a comprehensive checklist of important Paratransit software. Chapter 3 describes the operations of the systems observed and recommends new features that would improve the software. Chapter 4 compares Paratransit software currently available on the market. Comparisons are based on initial configuration and data requirements, system maps, billing, scheduling methods, and dispatching. Chapter 5 makes recommendations to transit providers regarding their operations and use of software.

DESCRIPTION OF A 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 fourteen 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 passenger is picked up and dropped off. The following flow chart is based on the information obtained by the project team from the Paratransit agencies surveyed. The chart below outlines the basic workings of a Paratransit system.



The following flow chart presents the data flow in a Paratransit system.



SURVEY OF TEXAS PARATRANSIT SYSTEMS

The Paratransit systems of forty-one Texas counties were surveyed and compared using the same criteria. In consultation with Paul Hamilton (TxDOT project advisor), the UT team selected eleven Paratransit systems to be studied further. Three systems were visited so the researchers could investigate their operational problems.

Paratransit operations in forty-one Texas counties were analyzed on the basis of

- Area of service in terms of square miles
- Hours of operation
- Number of employees
- Fleet characteristics
- Total one-way trips
- Total budget (excluding capital)

The comparison of the Paratransit operations in forty-one Texas counties determined the following:

- It identified those counties presently using any sort of Paratransit software for their scheduling and billing purposes.
- It estimated the productivity of each county 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.

It is evident that the transit providers using some Paratransit software have improved efficiency more than those doing manual scheduling.

The table below is based on information available in Ref 6.

TABLE 1.1 COMPARISON OF PARATRANSIT IN FORTY-ONE TEXAS COUNTIES

Name	System Characteristics	Employees	Fleet Characteristics	Total Budget (Excluding cap) '97	Comments
Panhandle Community Services – Panhandle	Service Area – 25,825 Square Miles Service Area - 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 13 centers located throughout the service area. • Contract services Department of Health; several local school districts; Department of Mental Health and Mental Retardation, and the Commission for the Blind. • Coordination of services is very complex due to the enormous size of the service area. • Panhandle Transit often picks up as many as 22 clients, as far as 150 miles away, with one bus.
South Plains Community Action Association, Inc., - SPARTAN	Service Area - 8,807 Square Miles Service Area - 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	• More than 50 fixed and scheduled routes. • Demand-response service is available. • Revenue vehicle capacity ranges from 7 to 22 passengers, with and without wheelchair lifts. • Vehicles; transportation centers equipped with two-way radios.
Cap rock Community Action Association - CAP-TRANS	Service Area - 5,702 Square Miles Service Area - 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 7 to 22 passengers capacity.
Aspermont Small Business Development Center, Inc.	Service Area - 5,421 Square Miles Service Area - 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 6 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 with many farms and ranches and 27 small towns, many without a municipal organizational structure. • Elderly and disabled and low-income households with young children benefit most.
Rolling Plains Management Corporation	Service Area - 6,605 Square Miles Service Area - 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 are employment, education, shopping, recreation, and healthcare locations. 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.

TABLE 1.1 COMPARISON OF PARATRANSIT IN FORTY-ONE TEXAS COUNTIES(Continued)

Name	System Characteristics	Employees	Fleet Characteristics	Total Budget (Excluding cap) '97	Comments
Texoma Area Paratransit System - TAPS Public Transit	Service Area - 5,634 Square Miles Service Area - 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 6 county areas is provided weekdays from 8:00 am to 5:00 pm. 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.
Services Programs for Aging Needs – SPAN	Service Area - 889 Square Miles Service Area - 1997 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.
Collin County Committee on Aging	Service Area - 848 Square Miles Service Area - 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 are able 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 Service Area - 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.

TABLE 1.1 COMPARISON OF PARATRANSIT IN FORTY-ONE TEXAS COUNTIES(Continued)

Name	System Characteristics	Employees	Fleet Characteristics	Total Budget (Excluding cap) '97	Comments
ARK-Tex Council of Governments	Service Area - 5,704 Square Miles Service Area - 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.
West Texas Opportunities, Inc.	Service Area - 21,659 Square Miles Service Area - 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 its 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 Service Area - 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 communities and governments who wish to expand or convert their transportation services. More than 25 programs are offered, serving 8,000 persons per month.
Central Texas Rural Transit District	Service Area - 7,840 Square Miles Service Area - 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	• CTO began receiving funding directly from TxDOT to operate a rural public transportation program.
Palo Pinto County Transportation Council, Inc.	Service Area - 1,817 Square Miles Service Area - 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 Miles Service Area - 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 serve their passengers better after-hours and on weekends. A member is on call at all times to give information and to handle problems as they arise.

TABLE 1.1 COMPARISON OF PARATRANSIT IN FORTY-ONE TEXAS COUNTIES(Continued)

Name	System Characteristics	Employees	Fleet Characteristics	Total Budget (Excluding cap) '97	Comments
The Transit System, Inc.	Service Area - 609 Square Miles Service Area - 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, shuttle, airport, and agency contract service, and flexible routes. Local demand-response service does not require advance notice.
Community Services, Inc., - Community Transit Service	Service Area - 2,011 Square Miles Service Area - 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 Service Area - 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 several hours in advance to schedule their rides for the day. They are given a pick-up time span of 30 minutes.
Kaufman County Senior Citizens Services, Inc. –Kaufman Area Rural Transportation (KART)	Service Area - 786 Square Miles Service Area - 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 are collected by the driver with a wand and hand-held scanner and are later downloaded into the dispatcher's computer for analysis. Information such as passenger names, destinations, and mileage are 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, AIM is being developed as though it were a custom computer program for the agency.
East Texas Council of Governments	Service Area - 9,722 Square Miles Service Area - 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	

TABLE 1.1 COMPARISON OF PARATRANSIT IN FORTY-ONE TEXAS COUNTIES(Continued)

Name	System Characteristics	Employees	Fleet Characteristics	Total Budget (Excluding cap) '97	Comments
Concho Valley Council of Governments	Service Area - 15,293 Square Miles Service Area - 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 Service Area - 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	
City of Del Rio	Service Area - 15 ½ Square Miles Service Area - 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	Service Area - 5,556 Square Miles Service Area - 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	

As previously mentioned, eleven transit providers were short-listed on the basis of service area, budget, fleet size, and level of automation. The team visited three of these short-listed agencies for a closer review of their operational problems and software requirements.

TABLE 1.2 THE ELEVEN IDENTIFIED PARATRANSIT SYSTEMS

Name and address	Characteristics	Budget (In US Dollars)	Comments
Aspermont Small Business Development Center, Inc. 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	• Would be a good option. • It seems that the dispatch facility is, to a major extent, being operated 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: 972.563.5878 Fax: 972.563.1491 E-mail: KARTTRANSP@AOL.COM **TxDOT District: Dallas**	• Funded to an extent by TxDOT. • KART has no subcontractors. • Advanced Information Management (AIM) is the computer software purchased to track operating data. Data are collected by the driver with a wand and hand-held scanner and are later downloaded into the dispatcher's computer for analysis. • Information regarding passengers 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 use to compare results and take useful inputs from the software being tested.
Concho Valley Council of Governments 5002 Knickerbockers Road, San Angelo TX 76904 PO Box 60050, San Angelo TX 76904 Phone: 915.944.9666 Fax: 915.944.9925 E-mail: trans1@airmail.net **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	• This comes under the heading of medium-budget operators. The dispatch facility uses a centralized number whose benefits would be interesting to observe.

TABLE 1.2 THE ELEVEN IDENTIFIED PARATRANSIT SYSTEMS (continued)

Name and address	Characteristics	Budget (In US Dollars)	Comments
Texoma Area Paratransit System - TAPS 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 two-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 would be good for a comparative study.
Services Programs for Aging Needs – SPAN 1800 Malone Street, Denton TX 76262 Phone: 940.382.2224 Fax: 940.383.8433 e-mail: span@iglobal.net **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. 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 **TxDOT District: Lubbock**	• More than 50 fixed and scheduled routes as well as demand-response service. • Vehicles and transportation centers are equipped with two-way radios.	$1,260,731	• This county 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)

Name and address	Characteristics	Budget (In US Dollars)	Comments
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: CARTSHQ@aol.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. It 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 1817A North State Highway 6 Bryan, TX 77803 Phone: 409.778.4494 Fax: 409.778.3606 E-mail: transit@myriad.net **TxDOT District: Bryan**	• Budget and number of vehicles are 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 89 vehicles.
Hill Country Community Action Association, Inc. – Hill Country Transit District 2905 West Wallace, San Saba TX 76877 PO Box 846, San Saba TX 76877 Phone: 915.372.5167 Fax: 915.372.6110 Contact: Carole Warlick, Transit Manager **TxDOT District: Brownwood**	• Until recently, Hill Country 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 its Mobile Data Terminals. • This would give the team an opportunity to solve its operational problems.
Collin County Committee on Aging	• 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 optimize routing.

CHAPTER 2: DEVELOPING FUNCTIONAL SPECIFICATIONS FOR SOFTWARE AND ITS INTERFACES

Several characteristics of demand-responsive transit systems were identified for use in their analysis. These characteristics are described below:

1. Size measures:
   - Number of vehicles dedicated to Paratransit operations.

     After speaking to Paratransit software vendors and reading suggestions made in Ref. 5, we found that agencies are classified as follows:

     Small (ten to fifteen vehicles)

     Medium (fifteen to fifty vehicles)

     Large (more than fifty vehicles)
   - Amount of funding from an external agency for Paratransit operations.
   - Total vehicle miles per day.
   - Average rider time.
   - Variability of promised pick-up and arrival time.
2. Number of riders (as a measure of demand):
   - Total number of customers per day.
   - Trips per day or per year.
3. Demand density (number of trips per square mile per hour).
4. Measure of scheduling effort (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 following are determined to be desirable features of Paratransit software:

1. Retrieval of passenger data from database and automatic insertion in reservation form.
2. Recent ride history.

3. Multi-user reservation processing.
4. Rider eligibility check.
5. Software completion of information when one enters only partial information (such as name/address).
6. Geo-Coded Addresses (physical address associated with some special map codes).
7. Keyword and common characteristics search and sort capability.
8. Frequent destination list (speeds up the reservation 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 the need for training).
13. Performance data collection and calculation (to evaluate the Paratransit systems).
14. Online pick-up time estimate, with or without vehicle assignment.
15. Online address verification (to provide better guidance for pick-up drivers).
16. ADA (Americans with Disabilities Act) eligibility check.
17. Duplicate reservation 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 online help.
26. Billing codes (for easy summary of cost and trip frequencies).
27. Problem-passenger warning (allows reservation agent to warn driver to make specific seating arrangement).
28. Pop-up activities menu.
29. Automatic vehicle selection (determined by specific passenger needs).

30. Immediate real-time reservation and scheduling.
31. Elimination of inactive customers over a period of time.
32. Detailed computerized vehicle route selection.
33. Capability to import/export data to 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 for receipt of 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 trips that transfer 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

The team has analyzed the following Paratransit agencies at this time:

1. Capital Metro – Austin
2. CARTS – Austin

The key points on which the analysis is based are

a) Resources — Fleet size, drivers, reservation agents.
b) Scheduling agent, types of vehicles.
c) Number of calls attended, capacity of the system, training practices.
d) Major operating costs.
e) Frequency of service.
f) Operational problems.
g) Dispatching and scheduling method.
h) Steps toward improvement.

CAPITAL METRO – AUSTIN

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

The Fleet Size and Other Resources of the Special Transit Service

Capital Metro's Special Transit Service is a mid-sized provider, somewhat large in relation to the city size.

- Special Transit Service has 103 vehicles.
- 52 sedans (Ford Crown Victoria; seating capacity for 4 passengers +1 driver).
- 51 vans (14 seated passengers +3 wheelchairs).
- 132 drivers.
- There are 6 full-time and 1 part-time dispatchers.
- Special Transit Service operates on 2 radio frequencies, one for the sedans and one for the vans.

- The system handles 750 calls per day.
- Special Transit Service has 15 call-takers.
- It takes about 3 to 4 minutes to process each call.
- Special Transit Service uses the TRAPEZE PASS DOS software for its scheduling, dispatching, and billing.
- Special Transit Service has an annual budget of $7 million.
- Since the number of calls handled is so large, a good scheduling and dispatching software, one that can handle standby and immediate requests, is essential.

Special Transit Service Riders

5 - 7 % of riders are dialysis patients who have fixed trips of 3 days per week. The scheduling of subscription trips is thus a primary need.

Current System Capacity

In the fiscal year 1999, disabled passengers on Capital Metro's fixed-route system took a total of 2 million passenger-trips. The Special Transit Service made half a million passenger-trips. The entire fleet of buses is accessible to wheelchair passengers.

Driver Training

Van drivers receive 6 weeks of training and sedan drivers receive 5 weeks of training.

Missed Calls

5 - 7 % of the total number of incoming calls are missed. The application of Mobile Data Terminals and more advanced dispatching software is a potential solution to this problem. In addition, the improvement of radio communication between dispatcher and driver will increase the number of immediate requests that can be handled.

Major Operating Costs of the System

- Maintenance of vehicles.
- Fuel.
- 60% of the operating budget goes to driver salaries and benefits.

Operational Problems Facing Special Transit

- No-shows and cancellations consume valuable resources of the Special Transit Service 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:*

    - The dispatcher completes cancellation forms for the drivers to read at the Special Transit Service station. This process is valid for future trip cancellations.
    - Voice transmission of cancellation through radios.

In this process there is a time lag of ten minutes while the driver is called 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 Mobile Data Terminals (MDTs), where information regarding pickup and drop-off and cancellations is exchanged instantly while the driver is in transit.

Steps That Are Being Taken to Improve the System

To reduce the need for voice transmission, MDTs will be installed in each of the cars and vans by the end of this fiscal year. 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 are:

1. Same-day service will be possible.
2. Reduction of load on dispatchers.

Performance of Paratransit Routing / Scheduling Software

Installed in 1994, Trapeze has only failed (i.e., crashed) 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 performed to finalize routes and optimal usage of vehicles.

Advantages of This Kind of Manual Review

1. Pickups are often scheduled in the same area and within the same time frames.
2. Last-minute road condition changes may be incorporated.
3. Additional trips may be added.

Performance Criteria Used to Evaluate the Special Transit Service System

1. Productivity (passengers/vehicle hour).
2. Time performance.
3. Customer complaints.
4. Cancellations.
5. No-shows.
6. Denials.

Suggestions Made During the Meeting

1. The Special Transit Service application form, a questionnaire assessing eligibility of candidates for Special Transit Service, can be made available via the Internet.
2. The re-certification process, revised and updated every two years, can also be made available via the Internet.
3. Advance reservations and cancellations can be done through the Internet.

Subsequent follow-up meetings with the Capital Metro Special Transit Service staff generated the following information:

Meeting With the Reservation Agent

Capital Metro Special Transit Service reservation agents receive an estimated 280 calls per day, or about 20 calls per hour. 9 reservation agents work from 7:00 a.m. to 9:00 p.m.

The principal tasks of the reservation agents are:

1. Reservations.
2. Cancellations.
3. Voucher allocation.
4. Confirmation of standby client requests.
5. Denial of requests.

Problems Arising from the Partial Utilization of the Trapeze Software

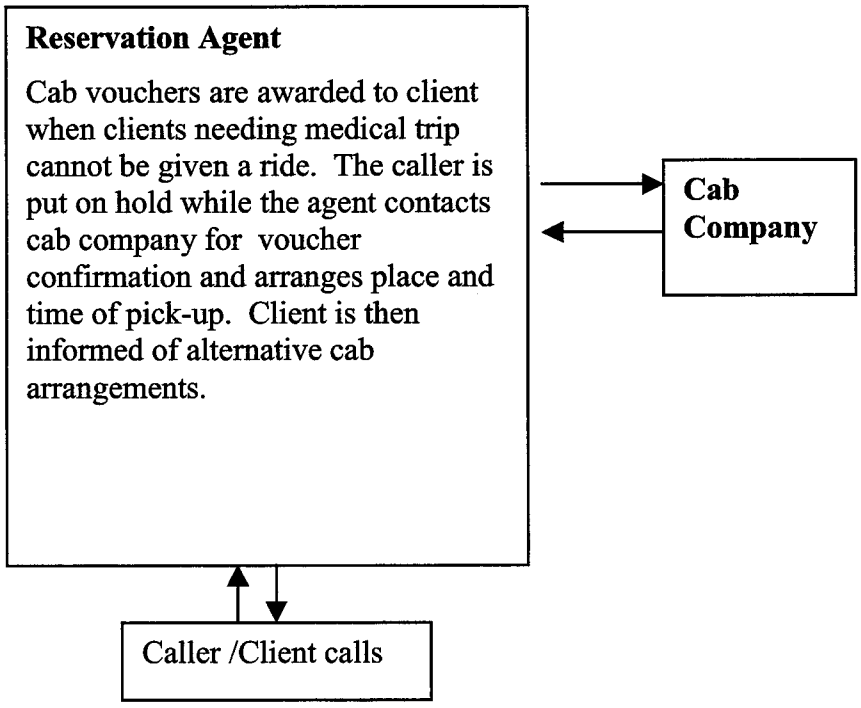
It is important to note that the Capital Metro Special Transit Service is not realizing the full potential of the Trapeze software. The fixed-route division and Special Transit Division are using different components of the same software, resulting in the duplication, or partial utilization, of certain services because the scheduler does not have access to complete information when planning a trip. In fact, Capital Metro's Special Transit Service is only using the Pass module which is 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.

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 accessible, fixed-route vehicle can transport him to Destination X, the lack of information regarding fixed-route vehicles prevents this. Instead, an independent trip, ignoring the existing fixed-route trip, is booked for Client A.

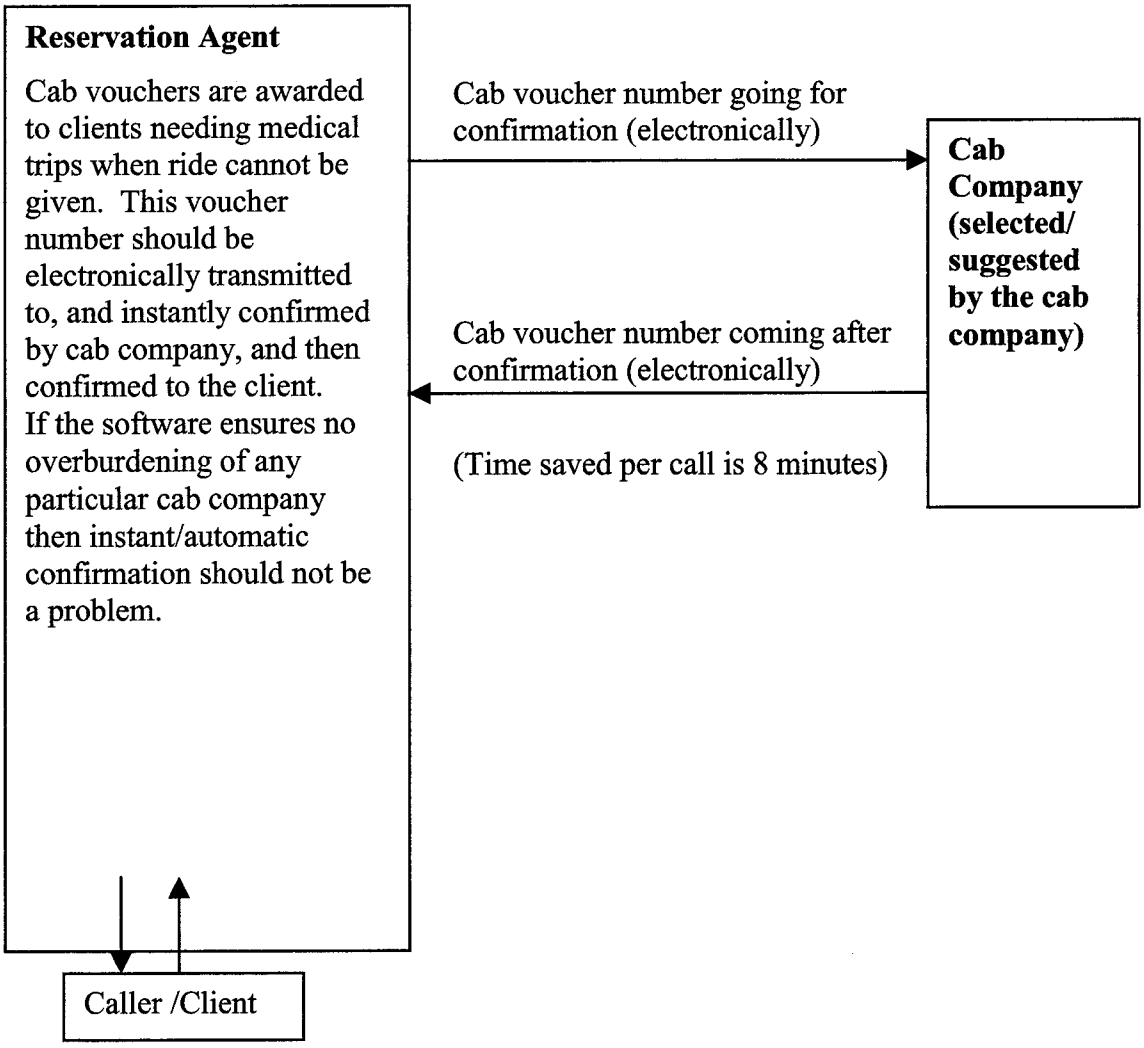
Observed Software Problems Reducing Reservation Agent Efficiency:

- The time required for entering a client's data after the call is received is about half a minute. The processing time after the data has been entered is about one minute. If this processing time can be reduced, the number of abandoned calls can be significantly reduced.
- Entering a wrong date of travel causes the software to go into an inactive phase, thereby causing a major loss of useful time.
- The address/destination options (addresses frequently visited by the client) provided by this software should preferably be ten. Currently there are only five address options provided by the software.
- There is no provision in the software for preventing the overloading of a particular cab company in the city.
- The process of incorporating a new address for a client is not a user-friendly one.

Operational Problems Arising from Cab Voucher Allocations:



The way this voucher problem could be solved is shown below:



- An added feature of the software, and one that could increase customer satisfaction, is its ability to avoid overburdening 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.

- Another way to expedite reservation entry is to use the client's birthdate as the entry ID number. Most users do not remember their original ID number, a number assigned them when they were originally added to the system.

Meeting With the Dispatching Team

The principal work of the dispatching team involves the following:

- Creating daily time sheets / log sheets for drivers for their daily operations.
- Scheduling open-routing and pickups (from medical appointments and airports.)
- Calling in trips.
- Subscription trips.
- Accommodating standby trips.
- Informing drivers via radio of new pickups (generally while drivers are on their way), as well as the time allotted for pickup.

The following are some suggestions for improving the efficiency of the Paratransit operations:

- The Cap Metro Special Transit Service allows reservations to be made only 8 days in advance. A screen displaying all the days with dates would rectify any errors resulting from entering the wrong date.
- Online confirmation of cab vouchers awarded to clients by reservation agents would save time.

Notes:

- There is no performance evaluation data available on the Special Transit Service workforce.
- Reservation agents request supplemental information not already in the client file, i.e., door or curb pickup, need for an attendant, and other special comments.

CARTS: AUSTIN, TEXAS

Capital Area Rural Transportation System (CARTS) is located at 2010 E. 6th Street, Austin. It is a community-based transportation provider serving the counties of Bastrop, Blanco, Burnet, Caldwell, Fayette, Hays, and Lee, and the non-urbanized areas of Travis and Williamson.

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)
- V. Jackson

CARTS services are supported by 32 local governments, federal and state transit assistance from USA, TxDOT, customer fares, service contracts, fund-raisers, private donations, advertising revenues, inter-city bus terminal agency fees, inter-local agreements with Capital Metropolitan Transit Authority and the city of San Marcos, and other ancillary revenues.

CARTS Routes

CARTS operates primarily on the following 3 routes:

I) The Blue Route service - Bastrop, Fayette, Lee.

II) The Green Route service - Caldwell, Hays, Travis.

III) The Red Route service - Blanco, Burnet.

Fleet Size and Other CARTS Resources

- CARTS has a fleet of 80 vehicles.
- The system is staffed by 5 reservation agents and 2 dispatching agents.
- It has an annual budget of $3 million/year.
- Service is provided to 133 communities.
- CARTS serves a 7,500 square mile region surrounding Austin.

CARTS Riders

CARTS does not follow ADA regulations in their entirety. 60-70 % of trips are demand-responsive. CARTS service is open to the general public. It is noteworthy that CARTS is using TRAPEZE - PASS software for fixed-route and demand-responsive trips.

Major Operating Cost

About 65 % of the operating costs are for the drivers.

Operation Details

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

Dispatchers currently create log sheets for the drivers to carry with them. Drivers report, via radio, the miles traveled between each trip, and communicate pickups as a (+) and drop-offs as a (–). While it facilitates communication between the driver and dispatcher, the Lower Colorado River Authority radio service used needs further improvement.

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 reservation agent outside CARTS handles reservations on behalf of CARTS. CARTS would prefer Medicaid customers to book rides on their own.

Steps Being Taken to Improve the System

- CARTS is planning to incorporate MDTs in order to improve communication between driver and dispatcher. This should 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 the system for the new version of Pass.
- The necessary data were migrated to a new system using SQL 7.0.
- Trapeze itself is being encouraged to make a Web-based module. This would allow interactive booking between the customer and the service provider over the Internet.
- Incorporation of automatic vehicle-location packages is also being planned, as this would improve the dynamic of scheduling to great extent.

Future Goals

An important goal of CARTS is to offer services over the Internet. CARTS plans to begin by listing the services offered on the Web. CARTS is also considering booking rides via the Internet.

Subsequent follow-up meetings with CARTS for Trapeze Windows Pass 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 were the following:
  - The mapping system was upgraded. CARTS incorporated the latest maps of its area of service by using the 911 MAP repositories. These maps were then formatted and fed into the new TRAPEZE PASS to be used by CARTS.
  - All the client data files subscription trips had to be fed 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 fed into the trip wizard.
- Although many addresses were geo-coded automatically from the DOS version, many pick-up, drop-off, and client addresses had to be geo-coded before complete installation and usage were possible.
- The knowledgeable Trapeze staff provided very thorough training to the CARTS reservation and dispatching agents. The training spanned four days in order to make the DOS users proficient in using the new Windows application.

The project team decided 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 help the reservation agent locate the caller with greater ease.
- Different colors for drop-off and pick-up points on the map would greatly help 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 determine the progress and status of trips at a glance.
- Trip ID number assignment was a very useful feature of the DOS version. Although the Client ID booking number is available in the Windows version, the Trip ID number is thought to be more useful.

HILL COUNTRY TRANSIT AGENCY - TEMPLE

Hill Country Transit District is a private, nonprofit company that manages Paratransit (PT) (and perhaps other transit) operations in several Central Texas regions,

under contract to city or county transit agencies. The company manages PT operations for the city of Temple (population about 55,000). Until October 1999, it was located at the Scott and White Clinic and the transit service was being run under a contract with Scott and White. It is now located in a small building in downtown Temple, about a block from City Hall, at 15 N. 2nd Street. The company has a contract with the city of Temple to manage PT services; the contract pays $7.50 per ride, thus giving the transit district the incentive to increase the number of riders and trips. Glenda Moseley, with whom we did not meet, is the operations manager. Jake Salazar, with whom we met on April 14, 2000, is the assistant transit manager and handles day-to-day operations.

Resources

Temple has five vehicles dedicated to PT operations. Two of the vehicles are station wagons with no wheelchair capability. Three are minivans that can hold up to three wheelchairs. There are two reservation and dispatching agents for the Temple company which operates from 7:00 a.m. to 7:00 p.m. Monday through Wednesday and from 7:00 a.m. to 10:00 p.m. Thursday and Friday. It is closed on Sunday. Each agent answers calls for service, talks to drivers, and enters and views information on a computer screen. They all use the Trapeze software, and vehicles are equipped with MDTs that have two-way communication with the Trapeze software. Temple began using the Windows version of Trapeze in November 1999. Prior to this time, trips had been scheduled manually. On the other side of the room are two reservation agents handling the Hill Country operations for neighboring areas. They still do their scheduling and other related operations manually.

The team briefly discussed the possibility of using a Paratransit Web site to communicate with clients. The transit manager explained that many did not have computer or Web access. Temple Transit has discussed the possibility of using an automated telephone system for reserving trips.

Ridership

The approximately 1600 riders are all elderly or handicapped, and the numbers include some students. When the company used manual scheduling it handled 64 to 80

clients per day. With the aid of the Trapeze software it now handles about 150 clients per day and travels about 800 miles per day, averaging 4 clients per hour per vehicle. Clients are encouraged to call seven days in advance, but same-day callers are served if a vehicle is available. Mr. Salazar said that 90 percent of same-day calls are currently not served. The transit group rarely calls clients to reschedule. There are many regularly scheduled clients, such as those undergoing dialysis.

Ride on a Vehicle to Observe the Operation Using an MDT

The team and Mr. Salazar took a 1-hour ride in a large PT van, equipped for wheelchairs and about 8 people, which had an MDT. The MDT is a small device located near the driver with a small screen displaying the names of people to be picked up on this route, their addresses, their times of pick-up, and their destinations. It has several touch keys for scrolling, entering numbers and letters, and sending, plus a device to read a card. Each authorized rider has a card that is swiped upon entry. We made three stops. The first was for a wheelchair-using client and an accompanying family member. It took about 10 minutes to load and secure the chair in the van, and unloading took about the same time. After loading the passenger, the driver enters the card number by using the keypad or by swiping the card and enters the odometer reading (this is used to check the mileage for this trip), which is computed by Trapeze. The necessity of this step is in question. The city asked that it be done because MDTs were failing and this info was not being recorded. However, it is not clear that this step helps, because MDTs send this information and cannot do so if they are failing. 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 his or her destination, the driver again enters the odometer reading and sends a message indicating delivery of the client. We were told that most pickups are followed immediately by delivery of the client picked up, before another passenger is picked up.

The next stop was for pickup of an elderly couple. The driver honked, waited a few minutes, and then went to ring the doorbell. Evidently no one was home, so this was recorded as a no-show.

The final stop was for an elderly woman waiting in her driveway. The driver helped her in and took her a short distance to the beauty parlor. We then returned to the dispatching center.

Problems

- Mr. Salazar indicated that the software sometimes gives 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. This appears to be improving. A back-up voice communication system had to be installed, even though the MDTs include voice communication.
- The MDTs can be distracting to the drivers because they signal arrival of a message while the vehicle is moving on the road.
- It is observed that after batch scheduling, clients' pick-up times are sometimes pushed back by the software by 4 to 5 hours. This time lag from the promised pick-up time of the client until the actual pick-up remains a big problem.
- A subscription ride or trip is often booked seven 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 cancelled.
- Hill Country Transit sometimes does not have clients' phone numbers.
- It appears that real-time contact with clients is minimal, and improvements here could make service more effective and efficient.
- An instance was noticed wherein a trip was scheduled by the software at a starting time prior to the driver's starting time.
- We suspect that Trapeze cannot adjust the estimated arrival and delivery times on a route when unexpected delays occur. Also, clients are not informed that their pickup will be delayed.
- The MDT system allows voice communication, but this fails when the MDT system goes down.

- On some occasions, trips that have already been carried out reappear on the small MDT screen. This is confusing to the driver and clutters the screen.

Meeting with Temple Transit Manager

- After we left the PT van, we walked to Temple City Hall and Mr. Salazar introduced us to the Temple Transit Manager, Edward Kaboble (ekaboble@ci.temple.tx.us). We had a brief and cordial conversation, and he encouraged us to contact him if we had further questions.

Summary

Mr. Salazar indicated that Hill Country is much more efficient using Trapeze than using the older manual system. It can now handle many more riders with the same set of vehicles, drivers, and reservation agents. The company would not consider returning to manual scheduling, despite the initial problems with Trapeze. The Hill Country staff believe that these problems can be overcome and will not consider switching to another PT management software system. The Killeen dispatching operation, which occupies part of the same room Hill Country does, is considering acquiring some PT software.

CHAPTER 4: SURVEY OF SOFTWARE VENDORS

A basic description of the features of each software is presented below: [Ref. 7]

MOBILITY MASTER FROM INTELITRAN

- A 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, which can vastly increase customer service productivity.
- Its support of on-board vehicle computers provides real-time, two-way mobile data communications, which allow instantaneous data collection; dispatch; vehicle rerouting and rescheduling while in transit; and communication with multiple service providers without the use of multiple radio systems.

Client Management Database

- User-configurable client master files.
- Online 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 geographic information system 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

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

SMV WI FROM KERNEL SOFTWARE

- KSI is primarily a Paratransit software for specialized medical transportation providers.
- It is an Access-based software, which means 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.

RIGHT CAD FROM PIN POINT TECHNOLOGIES

Feature Index:

- Right CAD is a Windows application.
- Easy and flexible call-taking.
- Standing orders made easy.
- Dispatch information at your fingertips.
- Fully geo-based 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).

Right CAD has features like mapping, telephony, and advanced user configuration. Right CAD also supports a suite of products such as MDTs, Global Positioning Satellites (GPS), and SSM.

New Features of the Upgraded Version:

- 100 percent 32-bit technology
- Multiple copies of Right CAD 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 commands at the click of a mouse make it a very user-friendly program.
- OLE (Object Linking and Embedding) - OLE is a technology that allows applications to interface with data elements from other Windows programs. This feature also allows Right CAD to share data and functionality with other future applications.
- ODBC - This application enables other 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. Right CAD takes advantage of TAPI services such as integrated faxing and automatic dialing of numbers in the system. Results of calls are recorded in the trip history.

Some Special Features of Right CAD

- On-screen calendar.
- Flexible standing orders: These standing orders are configurable by day of week, end dates, alternating weeks, first week of the month, and more.
- The TAPI allows the computer to dial out for the agent.
- Candidate rankings: Each time you highlight a trip in dispatch, Right CAD automatically ranks candidate vehicles, letting the dispatcher know which is the closest appropriate vehicle. Right CAD also ensures that only appropriate vehicle types are selected for each cell.
- Multi-loading: Right CAD allows vehicles to be multi-loaded, based on user-defined vehicle capabilities, and will warn a dispatcher of an attempt to overload a vehicle.
- Overdue checking: Right CAD allows the user to set up time limitations based on call type and priority that check to see if a vehicle is operating within pre-set time limits. This feature ensures the best response times and warns the dispatcher if a vehicle is outside the limits.
- Pre-assignment: 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 graphic format.
- Filtering: Right CAD allows dispatchers 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/Automatic Vehicle Location 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 transferal of information into other computer programs for analysis easy.
- Integrated internal e-mail.
- Training and configuration via telephone and computer linkup.
- Customizable and fully supported twenty-four 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 lets you create scheduled stops and then schedule 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 the 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 unschedule) 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 addition, and reservation 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 SOFTWARES

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

- Registering passengers.
- Creating bookings.
- Scheduling passengers to vehicles.
- Dispatching vehicles and drivers.
- Recording trip events.
- Geocoding locations.

One can choose to schedule passengers and dispatch vehicles manually, 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 functionality 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 such as ADA 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 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.

- Mobile Data Terminals (MDTs).
- Connect dispatchers and drivers for live communication.
- Update route progress enables dispatchers to take corrective action where needed.
- AVL.
- View vehicles on the system map in real time using GPS technology.
- Reassign vehicles based on vehicle locations and schedule adherence.
- Computerized voice.
- Support trip confirmations, cancellations, bookings, and passenger call-outs without human intervention at the reservation center.

TABLE 4.2 FEATURE COMPARISON

Software Vendor Name	Software Name	Operating System	Hardware Requirement	Base Price S = single M = multi user	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.	NA
Intelitran	Mobility Master`	Windows	PC	For up to 200 trips/day the license fee is $19,500 For 201 – 500 it is $26,000 For 501- 1,000 it is $37,000 For 1,001 – 1,500 it is $48,000	NA
Kernel Software	SMV WI	Windows 95	Pentium Class II or II PC (200 – 400 MHz)	Price per vehicle over base number 1 – 10: $300 11 – 20: $250 + base price of $3,000	Training/technical support is available at a rate of $55/hour.
Pin Point Technologies	Right CAD	Windows NT server 4.0	PC Pentium II 350 MHz or better	NA	NA
Multisystem	MIDAS PT	Windows 3.1 or higher (Windows for Workgroups, 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 $50K – 55 K for a single user and includes installation, training, one year of warranty, etc. Multiple users can be added for $2,500/user.	NA
Trapeze Software	PASS	32-bit software application built for Windows 98 NT	Penitum Class PC	Software cost is around $100K. License fee is $3,000	NA

TABLE 4.2.1 INITIAL CONFIGURATION AND DATA REQUIREMENTS

MIDAS PT	TRANWARE	SMV WI	Trapeze 4 PASS
This is a Windows-based software. The system administrator at the 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. **Client details should include:** • Name • Address and zip code • ADA eligibility • Mobility aids required • Whether 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.	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 • Zone codes • City codes • Landmarks • Account numbers and groups for billing • Trip service types • Zone pricing • Standing orders • Shift types • Mode of payments to drivers	The software divides the access rights into 3: • Accountant • Scheduler • Supervisor The lead times used for each trip need to be pre-defined. 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 very 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; passengers 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 assignments is to geo code each address of each client's starting and frequent destination addresses in the map.

TABLE 4.2.2 SYSTEM MAPS

MIDAS PT	TRANWARE	SMV WI	Trapeze 4 PASS
Allows setting up of the service area maps, dispatch zones and travel times, client file, and standing orders file. Individual address location is possible. Driver map book and street database are needed for initial setup of the map. The maps to be fed can be 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 is: • List of zip codes for service area • Common addresses such as municipal buildings, hospitals, malls, and supermarkets identified by type and with geo-codable addresses. • This can also be done if the transit provider furnishes an ASCII file of a similar format as mentioned above. The software provides: • System-wide bus route map for optional ¾ 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.	City codes can be added by going to the administration menu; going to table maintenance; selecting city codes options; and entering the information using insert, pagedown, and other hot keys.		The street wizard allows the user to geo code and find specific streets, cross streets, and street ranges, and pinpoint pick-up and drop-off points on the map. The software provides a system-wide bus route map for optional ¾ mile test.

TABLE 4.2.3 BILLING

MIDAS PT	TRANWARE	SMV WI	Trapeze 4 PASS
• 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 percentage of sponsorship.	• Each service type is first entered according to their pricing structures 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 price trips properly based on the company's current pricing tables. The data are entered using the hot keys. • The Zone Pricing matrix is used after a pickup and drop-off zone is entered and the appropriate Trip Service Type is used. It allows the operator to enter a pickup and drop-off zone at the time the order is taken and the software automatically to price 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 categories such as lease, salary, and hourly drivers.	• 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 4.2.4 SCHEDULING METHOD

MIDAS PT	TRANWARE	SMV WI	Trapeze 4 PASS
Four types of methods: 1) Trip by trip 2) Batch load taxi trips 3) Batch load holding trips 4) Best feasible option Using the best feasible option forces the software to choose the best feasible option based on factors like cost of run, percentage of time the vehicle is empty, productivity of run measured in passengers per vehicle hour, and number of trips that violate the window constraints placed on them when initially scheduled. One can choose to schedule escorts along with the clients while scheduling trips.	Sufficient information on the algorithm was not available.	At the time of installation, characteristics like maximum unloaded time, maximum loaded miles, and maximum wait time, are added. If any calculated values exceed their respective values the entry is disallowed. Note: Once the trip schedules have been distributed we cannot reset the daily trip. This implies that trip requests coming in while the driver is en 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 geo codes; and rescheduling bookings already scheduled. The scheduling solution parameters are: • Expanding early/late requested time • Scheduling batch size. • 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 geo codes 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 4.2.5 SCHEDULING TEMPLATES / RUN TEMPLATES

MIDAS PT	TRANWARE	SMV WI	Trapeze 4 PASS
• Subscription/ standby schedule • Working Schedules • Daily dated schedules Eliminates double/conflicting bookings. If 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.			Master template runs specifically for a certain group of days and operates continuously throughout the year unless overridden by the daily run file. Master templates are always inserted in the system at the beginning. Single insert of casual booking for multiple days is possible.
• 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 the dispatch monitor screen for ASAP assignments. • The software allows for morning and 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 -Expressways or other divided highways. The software also allows for morning and evening peak factors to adjust the average speed of the road and aid in scheduling	• 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. • The status of each driver/vehicle on that day is displayed with different colors and blinkers. • Some of the common statuses are run in loaded, completed, no-show, cancel and priority trips. • The software does not have an interface with MDT. Thus each trip is completed after receiving the completed driver log sheet. • Drivers can be paged by the dispatcher through an alphanumeric paging module using Tranware.		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 locations through MDT • Allows display of urgent trips (only in terms of display) • Allows voice transfer of messages In this software, as well, average speeds on roads are adjusted based on time of day and day of week, if possible, for: -Residential streets -Major intersections -Expressways or other divided highways -Actual time after a pickup or drop 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: CONCLUSIONS AND RECOMMENDATIONS

While studying Cap Metro's STS service, we noted that 5 to 7 percent of the total incoming calls are missed. The primary reason for missed calls is the inability of the dispatchers to notify the drivers about incoming standing requests. The team, in agreement with the transit manager, agreed that application of MDTs 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. In fact, it was observed that 60 percent of the total operating budget goes toward driver salaries.

The team thinks that paying the driver per trip would be a wiser method of payment. It is also advised that this mode of payment would act like an incentive for the drivers to make more pickups and drops and thus increase the overall performance of the system. A similar mode of payment is already being used by the City of Temple transit agency. While observing the STS operations we noticed that no-shows and cancellations consume a lot of the resources of the STS system. Communicating these cancellations is at present a long procedure.

Again, the use of MDTs is suggested, as this should reduce the volume of unclear voice transmission through the radios drastically. Separate utilization of Trapeze software for dispatching fixed-route buses and Paratransit buses does not allow the maximum utilization of the fleet resources of Cap Metro. The software in use lacks the feature that prevents overloading of a particular cab company in the city when the voucher rides are awarded. Such a provision would make the STS customers more satisfied with the cab voucher service.

The other suggestion made by the team was to make extensive use of the Internet. We suggested that the STS application form and re-certification 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 and cancellations could also be done through the Internet.

CARTS – AUSTIN

The problem of communicating messages to the drivers by the dispatchers appears to be a pronounced problem for CARTS. CARTS should consider purchasing MDTs to improve communication between driver and dispatcher. The team suggests that CARTS put its service and schedule on the Internet and eventually even take reservations over the Internet. The team encourages CARTS to introduce the concept of interactive booking between the customer and the service provider over the Internet.

Incorporation of Automatic Vehicle Location 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 and MDTs.

TEMPLE TRANSIT – TEMPLE

The biggest problem that Temple Transit faces is frequent failure of the MDTs. Thus, despite its use of the advanced TRAPEZE PASS version 4.0 with MDTs, the company still has to record and maintain driver log sheets. Temple Transit also uses swipe cards for registering its pickups and drop-offs. But swipe cards often fail, too. The team plans to investigate these problems for possible solutions. The MDT system allows voice communication as well, but failure of MDTs results in failure of both communication modes. Therefore, the drivers and dispatchers have to maintain separate radio communications as well.

REFERENCES

1. J. R. Stone, A. M. Navelonko, and G. Gilbert. "Computer Dispatch and Scheduling for Paratransit: An Application of Advance Public Transportation Systems," *Transportation Quarterly* Vol. 48, No. 1, March 1994.
2. J. R. Stone, A. M. Navelonko, and J. Tsai. "Assessment of Software for Computerized Paratransit Operations," *Transportation Research Record* No. 1378, National Academy Press, Washington, D.C., 1993.
3. J. R. Stone. "Paratransit Scheduling and Dispatching Systems: Overview and Selection Guidelines" Proceedings, 3rd Annual Meeting of IVHS America, Washington, D.C., April 1993.
4. J. R. Stone, A. M. Navelonko, and G. Gilbert. "Software Assessment for Computerized Paratransit Operations," Proceedings, 13th National Conference on Accessible Transportation and Mobility, Transportation Research Board, Tampa, Florida, October 1992.
5. R. E. Lave, R. Teal, and P. Piras. "A Handbook for Acquiring Demand-responsive Transit Software," Transportation Research Board, National Academy Press, Washington, D.C., 1996.
6. Website: www.state.tx.us/txdot.html.
7. Product overviews and user manuals of the software mentioned.