Strategic Plan: Computer Assisted Scheduling and Dispatching System

Illinois Department of Transportation
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Executive Summary

In times of increasingly selective federal and state funding possibilities, rural public transportation providers will need to consider whatever efficiencies can be gained through operational improvements and coordination with other providers. Both these objectives can be facilitated through implementation of computer-assisted scheduling and dispatching (CASD) systems. The deployment of such systems has shown measurable efficiency, effectiveness and quality of service gains and confirmed expectations that CASD systems provide improvements in dispatching, scheduling, on-time performance, and increased passenger satisfaction. The level of realized positive impacts, however, depends on the specifics of each implementation plan and overall deployment strategy.

CASD technology is relatively new and, therefore, lacks the standardization benefits of a mature technology. With growing numbers of local CASD system implementations, state departments of transportation have begun to realize the need for statewide strategies for future deployments of such systems. By commissioning a study of this nature, the Illinois Department of Transportation (IDOT) becomes a nationwide leader in acknowledging this need and undertaking the initiative to develop a statewide strategy for CASD systems.

This report provides recommendations for such a strategy and develops a roadmap for future CASD system implementations. The recommended strategy results from a research effort that synthesized information gathered through a literature review, personal interviews with industry leaders, federal and state contacts, and site visits with the State's 5311 operators.

Chapter 2 examines legislation that led to the growth and expansion of rural paratransit services and reviews the available literature on how CASD technology is applied to rural paratransit systems, with a focus on paratransit issues. While limited in scope, the research literature regarding CASD implementations provides encouragement and warnings for the current study.

As rural populations age, the need for rural public transportation services is increasing. Federal funding for such services has increased as well, but with increased funding has come expectations that states will spend those transportation grants efficiently and effectively. Accordingly, transportation providers will need to consider whatever efficiencies can be gained by implementing CASD and improving coordination with other providers.

While most of the implementation studies reviewed showed some gains in system efficiency, few have indicated significant cost savings resulting from CASD. However, various researchers have indicated that even a modest efficiency increase can be a compelling argument for CASD.

The combination of service coordination with CASD implementation offers the possibility of even greater efficiencies and service improvements than could be achieved by implementing them separately. Although only a few states have coordinated their rural public transportation systems, the limited experience of statewide coordination

efforts in paratransit suggests that a possibility exists for considerable costs savings. The possibility of realizing benefits for users, operators and IDOT suggests the importance of planning for coordination when implementing a CASD system.

The benefits of coordination are typically realized, however, only after meeting and overcoming a series of well-documented barriers. If the possibility exists for eventual coordination, either at the statewide or regional level, selecting a CASD system that can coordinate with other providers could prevent having to re-implement a new system later on.

Chapter 3 provides a survey of state and Federal strategies for applying CASD technologies to paratransit systems. This survey indicates that no industry-wide standards exist for CASD technologies and no well-used prototypes show how these technologies are applied to paratransit systems. However, the experiences of state administrators who were interviewed can help IDOT with its own CASD implementation program. While it is easy to concentrate primarily on the benefits of such a program, there are problems that need to be dealt with in order to successfully implement it.

Although many states are interested in pursuing CASD implementation, many legislators and paratransit providers are skeptical about the benefits of CASD implementation. Paratransit providers have many concerns with implementing new software, and it may prove hard to win their support. As a result, incentives or further legislation may be needed to gain their confidence. A thorough examination must be done of the agencies in order to obtain a better understanding of their operations. This will make it easier to match them with the appropriate software. Overall, most of the emphasis should be placed on supporting and training employees who must operate such a program. This stage of implementation could mean the difference between failure and success.

Chapter 4 discusses attributes of available CASD systems and uses a vendor survey to document their similarities and differences. A wide range of software exists to satisfy all needs. Scheduling and dispatching software is complex and feature-by-feature testing is needed to determine the most suitable software. Generally, vendors will agree to provide a copy of their software for testing purposes.

A good match between operator needs and software sophistication is needed. Transit agencies with simpler operations need simpler software, whereas those with more complex operations need more complex software. Although peripheral technologies such as Mobile Data Terminals (MDT) and Automatic Vehicle Locators (AVL) are unnecessary for smaller operators that rely heavily on subscription and advance registration trips, communication technology advancements may offer inexpensive alternatives that could be deployed early on in the CASD hardware and software implementation cycle.

The State preferably should plan for and carry out procurement, installation, and maintenance at the statewide level to benefit from economies of scale. It is critical that a

knowledgeable entity, which can provide guidance and ensure that established milestones are accomplished (e.g. IDOT or a third party consultant), supervises the deployment process.

Chapter 5 discusses interviews that were conducted with Illinois paratransit operators to assess their degree of interest in CASD systems and their readiness to implement such a system. Experience indicates that computer skills and support are geared toward tasks at hand. All but one of these agencies has staff that uses a computer for some aspect of its operations. Most of their staff tend to use word processing and spreadsheets, with little daily use of more complicated systems. For most agencies, implementing CASD would require teaching existing personnel new computer skills and use of the new CASD program.

Transportation plays a small part in many of these agencies' everyday operations. They are typically not-for-profit human service agencies that provide transportation services as part of their overall community service mission. While this ensures that some level of public transportation is available in much of the state, it suggests that the transportation component may not be the greatest concern of the agencies' leadership.

Although most agencies understand the need for reporting and accept it as a requirement for using public funds, they tend to see reporting requirements as complicated, arbitrary, and inconsistent among grantors. Standardizing IDOT and IDHS' reporting requirements would significantly ease operator frustration. Developing ways to accept electronic data submission could be a way to help facilitate acceptance of CASD systems.

These CASD applications should be integrated with accounting applications. Most agencies have in-house accounting systems that are based on legacy software and would be difficult to migrate. CASD implementation should be carried out with this in mind, allowing ways for CASD systems and legacy accounting systems to share data.

Also critical is the acknowledgement that computer upgrades must precede CASD system installations. The technology assessment revealed that not all agencies possess computers suitable for CASD applications. Therefore, prior to proceeding with system installation, computer configurations must be evaluated more closely and upgraded, if they do not meet the vendor's specified requirements.

Chapter 6 presents alternative statewide CASD deployment strategies and synthesizes information obtained from a focus group regarding these strategies. Three high-level deployment strategies, a centralized, decentralized and regional approach, were conceptualized and presented to a group of operators for their feedback. They concluded that a hybrid approach, which combines the strengths of the decentralized and regional approaches, should be pursued.

This study therefore concludes the following:

1. **CASD is worthwhile for operators who provide 100 or more trips per day.** The research literature suggests that the benefits of CASD are proportionate to the size of a transit operator. The larger operators surveyed as part of this study concurred that CASD implementation benefited their operations.

2. **CASD can realize some benefits, such as streamlined reporting and record-keeping, for operators who provide less than 100 trips per day.** The benefits yielded from a low-level CASD system are likely to be limited, however, and could come at a considerable cost.

3. **CASD Facilitates Coordination and Brokerage.** Combining service coordination with CASD implementation will offer the possibility of even greater efficiency and service improvements. Moreover, implementing a regional or statewide transit brokerage plan can greatly increase Illinois' transit services.

   However, the benefits of coordination and brokerage are typically realized only after meeting and overcoming a number of well-documented barriers. If the possibility exists for eventual coordination and brokerage either at the statewide level or among regional systems, planning the state's CASD systems around that possibility can help streamline its eventual transition.

4. **Peripheral technologies may not be cost-effective for operators who provide less than 100 trips per day.** Although peripheral technologies such as Mobile Data Terminals and Automatic Vehicle Locators are not a necessity for smaller operators that rely heavily on subscription and advance registration trips, advancements in communications technologies may offer inexpensive alternatives that could be deployed early on in the CASD hardware and software implementation cycle.

5. **Few states have implemented a CASD program.** Although many states are interested in implementing a CASD, many legislators and paratransit providers are skeptical about its benefits. The experiences of those states that were interviewed can help Illinois with its CASD implementation.

6. **Most 5311 operators have only rudimentary knowledge of computers.** Since computer skills and support are generally geared toward tasks at hand, most 5311 operators use computers for word processing and spreadsheets. Implementing CASD systems would require teaching new and existing personnel new computer skills.

7. **Transportation is a small part of most agencies' everyday operations.** The majority of their attention is focused on providing human services such as counseling and rehabilitation for the elderly and handicapped.

8. **Reporting is the bane of paratransit agencies.** Standardizing IDOT and IDHS' reporting requirements and developing electronic data submission would significantly ease operator frustration.

9. **CASD applications must integrate with accounting applications**. Most agencies have in-house accounting systems that are based on legacy software. CASD implementations must allow for CASD and accounting software to share data.

10. **Computer upgrades must precede CASD system installations**. Many agencies have outdated hardware that cannot support a complex CASD system.

11. **A wide range of software exists to satisfy all needs**. Scheduling and dispatching software is so complex that feature-by-feature testing is needed to determine the most suitable software. Generally, vendors will agree to provide a copy of the software for testing purposes.

12. **Some of Illinois' paratransit operators have already installed CASD systems**. In some instances, software implementation failed at the first attempt, but experiences gained from these failures helped lead to successful software implementation. IDOT should capitalize on these experiences in order to avoid common mistakes.

13. **Most of the software is built to function in client-server architecture**. With the advancement of Internet technologies, software is moving towards a multi-tiered approach where the Internet is the information transportation medium.

14. **Most operators are skeptical but also hopeful, especially in the longer run.** Although focus group participants voiced many fears and few hopes for CASD implementation, only a few of them were completely unwilling to consider it.

15. **Most operators prefer decentralized or regional CASD implementation.** Focus group participants favored a decentralized scenario, which keeps local system control and operations, but allows for eventual cooperation and coordination with neighboring and regional agencies. However, they also wanted some of the standardization and bulk-purchasing aspects found in the regional and centralized approaches.

Given all the above factors, the best strategy for implementing a computer assisted scheduling and dispatching program in the State of Illinois is the following:

1. **IDOT should try to implement a hybrid CASD program in the State of Illinois.** This program would combine the decentralized system with the regional system that was discussed in Chapter 6. IDOT should provide some agencies with stand-alone computer systems, while persuading others to use regional systems in areas where a regional transit district already operates and is willing to host such a regional system.

2. **For stand-alone systems the following guide should be used to decide which type of equipment is appropriate**: The table below depicts which type of software (described in Chapter 4, section 4.4.1) should be deployed for each operator category.

Recommended Software Implementation by Operator Size

Operator Size	CASD Software Type
Large (>300 trips/day)	Fully-automated
Medium (100 – 300 trips/day)	Semi-automated
Small (<100 trips/day)	Customized database

3. **For regional systems, IDOT should supply host agencies with fully automated CASD systems and contract with them to operate it.** In the regional approach, some of the large agencies will become Application Service Providers (ASP) or host agencies. They will maintain the system and provide training and online access to the CASD software for other agencies in their network. Considering that agencies in a regional system will vary in size, the host agency will provide different types of CASD software (i.e. semi-automated and customized databases) to meet its members' needs. The final architecture will be developed from proposals, which participating vendors submitted.

4. **IDOT should assign peripheral equipment to agencies based on their size**. It should use the following schedule to make its assignments:

Automatic Vehicle Locators: The value of real-time information on vehicle locations is relatively low, given the character of most of the state's paratransit operations (i.e., low productivity, long dwell times due to passenger characteristics, and mostly pre-scheduled operations). Automatic vehicle locators, moreover, are still a new technology that is challenging to implement and prone to complications, despite becoming less expensive (<$500 per vehicle). Simply stated, if an agency does not make most of its scheduling and dispatching decisions in real time, the economic rationale for investing in automatic vehicle locator technology is limited.

Mobile Data Terminals: Although the cost of acquiring mobile data terminals has been declining, it is still relatively expensive. In-vehicle mobile data terminals probably cost more than $1,000 per unit and include radio frequency (RF) modems, automatic odometers, transmission transducers, and installation. In-vehicle computers probably cost a few hundred dollars more. Paratransit operators will also need to acquire communication servers and communication software to handle digital data communication between central control systems and mobile units. This could cost from under $5,000 to over $30,000 more, plus

the cost of computer hardware to host the communications system. For a 50-vehicle operation, the mobile data terminals could cost less than $70,000 to more than $150,000. This exceeds the cost of a CASD system that provides the basic value of the combined system. The mobile data terminal's added value is uncertain unless a paratransit operator is experiencing serious radio capacity problems (i.e., in the taxi industry). Since many operators rely predominantly on subscription trips and advance reservations, the need for real-time trip insertions and schedule modifications is ostensibly minimized.

Smart Cards: Off-the-shelf card-based data/fare collection systems have technological and economic uncertainty for paratransit operators, which can create a potential mismatch between operator capabilities and system requirements. The value of smart cards may not be commensurate with the costs of the required technology, particularly in view of the low productivity of paratransit systems.

Personal Digital Assistant: The personal digital assistant is a constantly evolving technology that can offer a low cost solution for many operators. For example, a combination ID card reader and personal digital assistant has been developed. The design of this device allows the personal digital assistant to be inserted into the card reader containing the interface connector. When the card is swiped through the reader, data is stored directly into the personal digital assistant. Application software is available.

A pass through the connector allows insertion into the cradle of the personal digital assistant for downloading or charging without the need to remove the personal digital assistant's card reader. This particular design claims that no batteries are required and that power drain to the personal digital assistant is minimal since the inactivated card reader is in sleep mode. A second technology can be coupled with the first one to provide an inexpensive automatic vehicle locator alternative. The design is a GPS receiver with a flash-card interface that can communicate with a personal digital assistant.

Given the above, the deployment of such peripheral technologies, except for personal digital assistants is probably not warranted, except for regional operators and the most technologically advanced paratransit operators. The brokerage capability would potentially add to that need.

5. **Implementation of these recommendations should follow a five-year schedule.** At the end of five years, all 5311 operators will have some type of CASD system in operation, with most operators participating in a regional system.

6. **IDOT should utilize a single vendor for all CASD and custom database systems.** It may be necessary for two vendors to form a joint venture, with one providing the CASD systems and the other providing the custom database

software. Compatibility should exist between these systems in order to ease the upgrade process as an operator's needs increase.

7. **The following functionalities should be included in each type of system**: As part of this study, the research team has summarized the capabilities of various CASD software packages. Because successful implementation is dependent on human factors as well as on technological ones, the research team has not attempted to evaluate the relative performance of the various packages. However, the research team suggests that when selecting a software vendor for statewide CASD implementation, the vendor should be able to provide software with the characteristics listed below.

   Scalability
   The software should be scalable to a variety of operator sizes. The research team suggests a minimum of three levels of software capability.

   At its simplest, the software should have an easy-to-use data entry interface that will allow operators who don't use or need CASD to log services provided and produce reports using data collected for IDOT and IDHS.

   The middle level should provide for simplified computerized scheduling, without requiring use of a geographic database or mapping package. At this level, an operator of five or more vehicles should be able to schedule trips with the computer to ensure that drivers and vehicles are not overscheduled.

   The highest level of software should be capable of providing a full assortment of CASD features. Scheduling should include a geographic component. Route optimization capability should be available and easily implemented.

   Peripheral Hardware Support
   The systems should be capable of supporting a variety of hardware peripherals such as automatic vehicle locator and personal digital assistant systems, yet also be capable of operating without this hardware until such time that the operator can benefit from the hardware.

   Brokerage Capability
   CASD systems provide a technological platform for implementing service brokerage. The systems deployed should be capable of allowing individual paratransit operators to participate in brokerage systems if the state or local operators should decide to implement such a system at a later date.

   Coordination capability
   While most paratransit operators in rural Illinois now operate independently of each other, many currently provide a degree of informal coordination with neighboring carriers. The CASD system selected for implementation should support and encourage this type of informal coordination, as well as provide for

the eventual adaptation of whatever degree of formal coordination is planned for in Illinois.

Support Capability

The selected system should include on-site support prior to and including the first days of operation, as needed. The vendor should provide training in Illinois for the rural transit agencies' managers and software users as well as telephone support during the transit agencies' operating hours. These services can be provided using either vendor or subcontracted support personnel that are capable of ensuring that the system performs satisfactorily.

Appendix X displays a more detailed list of functions with their descriptions. It also shows the functions that each of the three different types of agencies (large, medium, and small) would need. These functions are grouped into the following subcategories:

- Client Registration,
- Trip Booking,
- Scheduling,
- Dispatching,
- Billing,
- Reporting, and
- Other Capabilities.

Although this list is not complete, it can be used as a starting point or as a framework for grouping existing or additional functions.

One advantage of using CASD software is the ease of generating reports. Vendors typically ship their products with many built-in reports and can create additional ones tailored to the agencies' needs. Therefore, it is important to identify all the reporting needs, especially the common reports (i.e. reports that all or most participating agencies use), and ensure that they are included during the initial software installation. Although additional reporting tools are included in CASD software packages to allow generation of new reports, building the most used reports into the system will substantially reduce the report generation time, thereby streamlining this function.

8. **IDOT should fund the entire cost of computer hardware, software, maintenance, and data conversion for each agency that has agreed to convert to a CASD system.** Operators have indicated their disinclination to participate in the absence of a funding commitment from the State.

9. **Training and support are integral parts of successful computer software implementation. IDOT should provide adequate funds for both.** The legacy of failed implementations demonstrates the problems of attempting CASD implementations without sufficient training of management and users alike. The

research team, therefore, recommends a training program that trains both initial users and administrators.

In many smaller operations, with just two or three non-driving employees, administrators are the backup schedulers. For these systems, it will be essential for administrators to fully understand the CASD system and be able to use it capably in the absence of the usual operator. Because the scaled-down system will not be particularly complicated, training for both administrator and the main user will require only a minimum of time.

In larger operations, the research team recommends a more specialized training program, with different approaches for management and scheduling personnel.

Management
Where software system implementation projects succeed, they do so with the support of management personnel that are fully committed to the project. This will only be achieved by showing management the full spectrum of potential benefits of CASD implementation. The research team, therefore, recommends that management training be included and mandatory for participation in the state CASD program.

The training for administrators and managers need not emphasize the day-to-day operations of the software. They will, however, need to be familiar with the reporting functions and be able to obtain reports from the software and verify their accuracy.

For smaller systems, the research team expects that management personnel will serve as backup schedulers. To the extent that they do, they will need training in the day-to-day operation of the scheduling system.

Key Users
The "key users" of the CASD system are the personnel who currently perform scheduling duties. Because they know what needs to be done to successfully deliver service, they will know early on if the CASD system is performing as expected. As their comfort with the system increases, the research team anticipates that they will be able to provide in-house training to their back-up personnel.

Automation often raises the fear among employees of their jobs becoming redundant. Accordingly, training of key users should emphasize their importance to the organization, ensuring that they will accept the challenges of their new responsibilities.

10. **While CASD systems need not be coordinated, most forms of coordination require some elements of CASD**. Given the investment required for CASD implementation, it is important that the State consider in advance of

implementation the degree to which the various CASD systems should be coordinated with each other.

11. **The statewide implementation plan should emphasize medium and large operators.** Illinois' rural transit operators vary greatly in fleet size and number of trips delivered. Since this research shows that CASD benefits increase with an increase in the number of vehicles and trips, the research team recommends that the statewide implementation plan emphasize medium and large operators (operators that provide 100 or more trips per day).

   At the same time, the research team emphasizes that while smaller operators do not derive the same benefits from CASD as the larger ones, they still benefit from having access to a standard database system that eases the burden of reporting needs. Increased coordination among rural transit operators will also eventually mean that having smaller operators linked to a regional CASD system will provide greater efficiency for operators and more service for passengers.

   Lastly, the enthusiasm of some operators to participate in CASD implementation should be capitalized on. The simplicity of implementing CASD on a small scale can generate success stories that will help promote further operator interest in CASD. Also, including small and medium-sized urban areas in a statewide implementation plan will ensure that operators of all sizes can benefit from the experience of a comparably sized operator's CASD implementation. Yet the desirability of involving all of the state's transit operators must be weighed against cost considerations. The research team thus recommends a prioritization that emphasizes implementing CASD first in systems that meet the largest number of these criteria:

   - Operating a Large Number of Vehicles: The experience of many CASD implementations shows that benefits are greatest when the number of vehicles is the largest.

   - Serving a Large Number of Clients: Where resources are scarce, the priority should go to the operators that can pass along the benefits derived from CASD implementation to the greatest number of riders.

   - Providing a High Percentage of Non-Subscription Trips: The unpredictability of demand-response service suggests the greatest benefits are likely to come from using CASD to more efficiently manage this service.

   - Showing a Commitment to Using CASD and Its Features to Improve and Increase Service: The success of a CASD implementation depends greatly on the willingness of an organization to make it happen. The small scale of benefits from a smaller organization can be offset by a strong commitment to CASD.

- Having a High Degree of Technological Readiness: The research team has developed a technological readiness measure for each of the 5311 operators in the sample. This measure could be used or questions could be asked in the application process to ascertain this information.

12. **The following steps should be taken to Implement CASD at participating operators:**

   a. **Pre-implementation preparation.** The CASD systems should be prepared well in advance of the anticipated go-live date. Much of this work involves transferring data from legacy data systems (whether computerized or not) into the CASD system and can be done off-site, preferably through the main contractor or by third-party vendors. For the larger systems equipped with geographic databases, it will be important to have the users verify the accuracy of geographic information that off-site consultants may not be completely familiar with.

   b. **Going "live".** Experience shows that the first days are critical for implementing a new software system. At this stage, consultants should be on-site, at the operator, to directly address any problems, and most importantly, to ensure that the system is not allowed to fail. The importance of having support available at this key stage cannot be overemphasized. After the first few implementations, both the State and its contracting consultants will have a better idea of what can be expected in the first few days of the new system's service.

   c. **Plan for problems, especially with early implementation.** Implementing CASD means changing the way an organization performs its functions and the ways employees and managers do their jobs. Much can be done to smooth this transition, yet some unforeseen complications are inevitable. Both the State and the vendor should plan for ways to solve problems as they arise, rather than letting them put a site's implementation at risk.

   d. **Evaluate the results**. Evaluating the implementation's results will give IDOT and the transit operators an opportunity to verify any efficiency improvements and cost savings. Knowing that CASD has helped a transit operator will be an important part of that operator's satisfaction with the system. It will also enable IDOT to identify which operators have benefited the most from CASD and in what ways.

   Two types of evaluations are recommended. In the first stage, to be completed when the CASD system is running, a post-implementation evaluation should be conducted to let the State and implementation consultants know which aspects of implementation are working and

which should be modified or reconsidered in subsequent sites. The second should be conducted when the system has had enough time to impact the transit operation. This evaluation will show whether the CASD implementation has had a favorable impact on operating costs and employee time spent on tasks such as scheduling and reporting. As some of the benefits of CASD are thought to be long-term in nature, not all operators are likely to post immediate efficiency improvements, but most should show that time spent on functions such as reporting has decreased. The results of the final evaluation will also allow IDOT and operators to plan any changes to the system, and to determine if further improvements are appropriate.

Implementation Strategy

CASD systems should be phased in over a five-year time frame. An implementation strategy over five years is shown below. The timing can be adjusted depending on budget availability.

Year One

1. **Write specifications for vendor bids.** Specifications for bidding on CASD systems should be written out in detail. These should include functionalities to be included, training, assistance with pre-implementation preparation and on-site presence on go live dates. The research team cannot emphasize enough the importance of writing detailed specifications for each system category and for each group of operators. Often technical specifications can be developed in an earlier stage before procurement and actual deployment by an outside vendor. If IDOT opts to outsource this process, the assistance of an independent expert organization could help obtain the best possible bids from interested vendors.

2. **Evaluate vendor bids.** The evaluation should include both a quality and cost evaluation. Previous clients should be contacted, and a hands-on evaluation should be done. The hands-on evaluation should be done with data supplied by one of the transit operators in Illinois. The evaluation could be conducted by IDOT or independently by an expert third party. Selecting and later monitoring the most qualified vendor is critical for the success of the overall deployment effort.

3. **Award bid to a single vendor for the entire state.**

4. **Develop a process to select participating operators.** Operators submitting applications for CASD software and equipment should include their information on number of vehicles, number of clients, number of non-subscription trips, and a statement of management commitment to use the new technology. Additionally, operators should submit whatever information is

needed to evaluate their readiness to implement new technology, such as the level of computer expertise of the employees and managers who will use the system.

5.   **Develop a first year budget for software, hardware, etc.** The research team estimated that the following costs would result, for typical decentralized and regional systems.

Decentralized System

	Large	Medium	Small	Total
Trips/Day	600	200	90	
Hardware Price	3,000	2,500	1,500	7,000
Software Price	75,000	25,000	10,000	110,000
Data Conversion	7,680	3,840	1,920	13,440
Support (On Site)	65,280	11,520	0	76,800
Maintenance	1,500	500	200	2,200
Training/Windows	0	0	300	300
Training/CASD	10,500			10,500
Total Cost of Ownership				**220,240**

Regional System

	Large	Medium	Small	Total
Trips/Day	600	200	90	
Hardware Price	3,000	3,000	1,500	7,500
Software Price	75,000	0	0	75,000
Data Conversion	7,680	7,680	1,920	17,280
Support (On Site)	65,280	0	0	65,280
Maintenance	1,500	0	0	1,500
Training/Windows	0	0	300	300
Training/CASD	10,500			10,500
Total Cost of Ownership				**177,360**

For the decentralized system, costs were computed with the assumption that participants would include one large, one medium, and one small-sized agency. For the regional approach, it was assumed that one large operator, two medium-sized and one smaller operator would participate. These cost estimates are extremely tentative and do not take into account single vendor discounts, cost savings from learning how to best train and support such software, etc. Actual costs will be determined in the bidding process.

6.   **Announce and Promote CASD Program.** Details of the program should be communicated to providers through a variety of approaches including a presentation at the RTAC meeting.

7. **Fund first year recipients.** Applicants should be prioritized based on the results of their applications. If the budget does not allow funding of all qualified applicants, place the remaining applicants on top of next year's applicant list (the application process should be repeated in case operational characteristics have changed). Peripherals should not be funded in the first year. Rather, there should be at least one year of experience with CASD software in place before peripherals are included in the program.

8. **Plan for non-applicants.** Allocate a portion of the budget to bring non-applicants up-to-date with regard to computer use. Training for both managers and schedulers should include basic Windows and MS Office (mostly Excel, Word, and Access) training.

9. **Establish a user group for managers.** A user group can be very helpful in providing valuable information to users on applications, implementation strategies, new technology, uses for the CASD system, etc. It provides an opportunity for users to share ideas, successes and failures, and strategies for improving the performance of their system. A user group should be established and it should meet twice a year. A user group meeting could be held in conjunction with the RTAC meeting, or in another venue.

By the end of year one:

- A number of large operators have purchased (with funds from IDOT) and begun implementing a CASD system
- A number of small operators have purchased (with funds from IDOT) and begun implementing a custom database.
- Non-applicants have advanced their computer readiness.

Year Two

1. **Evaluate costs of deployment and success or failures of first year's implementations.**

2. **Develop second year budget.** Typical budgets would include all costs presented in the tables above (same as Tables 7.2 or 7.3 in the report). However, the budget for the second year could be considerably lower than in the first year, provided that most system implementations have been completed in the first year. Since the costs for any new system implementations would be the same as in the first year, the focus should be on the recurring costs such as maintenance, on site support and training costs. Therefore, the second year's budget can be inferred from the figures in Tables 7.2 or 7.3, for new system installations. For systems implemented in previous years, second year costs can be estimated from the recurring costs, described in the tables shown below. Budgeting for the second year should also account

for price changes over time, both in equipment and software costs as well as employee costs.

Recurring Costs (Decentralized System)

	Large	Medium	Small	Total
Trips/Day	600	200	90	
Support (On Site)	65,280	11,520	0	76,800
Maintenance	1,500	500	200	2,200
Training/Windows	0	0	300	300
Training/CASD	10,500			10,500
Total Cost of Ownership				**89,800**

Recurring Costs (Regional System)

	Large	Medium	Small	Total
Trips/Day	600	200	90	
Support (On Site)	65,280	0	0	65,280
Maintenance	1,500	0	0	1,500
Training/Windows	0	0	300	300
Training/CASD	10,500			10,500
Total Cost of Ownership				**77,580**

3. **Announce and Promote CASD Program.** Include in the announcement that peripheral equipment will also be funded, if available.

4. **Fund second year recipients.**

5. **Evaluate program and make changes as appropriate.**

6. **Conduct two user group meetings and expand the number of managers in the group.**

By the end of Year Two:

- The operators that acquired a system in the first year have gone "live".
- The second wave of operators that are in line to acquire a system have done so and started implementing it.
- A few of first year non-applicants have become computer ready, acquired a system and begun implementation.
- Second year non-applicants and remaining operators continue to advance their computer readiness.

Year Three

1. **Evaluate costs of deployment and success or failures of the second year's implementations.**

2. **Develop third year budget.** Compute similarly to the second year budget.

3. **Announce and Promote CASD Program.** Include in the announcement that peripheral equipment will also be funded (for operators with at least one year of "live" CASD operation).

4. **Fund third year recipients**

5. **Evaluate program and make changes as appropriate**

6. **Conduct two user group meetings and expand the number of managers in the group.**

By the end of Year Three:

- The first and second waves of operators have gone "live" with their system.
- A third wave of operators have acquired a system and begun implementation.
- One or more qualified regional operators have begun implementing the regional strategy.

Year Four

1. **Evaluate costs of deployment and success or failures of third year's implementations.**

2. **Develop fourth year budget.** Compute similarly to the second year budget.

3. **Announce and Promote CASD Program.** Include in the announcement that peripheral equipment will also be funded (for operators with at least one year of "live" CASD operation).

4. **Fund fourth year recipients**

5. **Evaluate program and make changes as appropriate**

6. **Conduct two user group meetings and expand the number of managers in the group.**

By the end of Year Four:

- All operators have acquired, implemented and routinely use a system in day-to-day operations.
- All regional operators have begun implementing the regional strategy.

Year Five

1. **Evaluate costs of deployment and success or failures of the fourth year's implementations.**

2. **Develop fifth year budget.** Compute similarly to the second year budget.

3. **Announce and Promote CASD Program.** Include in the announcement that peripheral equipment will also be funded (for operators with at least one year of "live" CASD operation).

4. **Fund fifth year recipients**

5. **Evaluate program and make changes as appropriate**

6. **Conduct two user group meetings and expand the number of managers in the group.**

By the end of Year Five:

- The regional strategy has been implemented in full
- Evaluation has identified program successes and appropriate changes.

Chapter 1 – Introduction

In times of increasingly selective federal and state funding possibilities, rural public transportation providers will need to consider whatever efficiencies can be gained through operational improvements and coordination with other providers. Both these objectives can be facilitated through the implementation of computer-assisted scheduling and dispatching (CASD) systems. The deployment of such systems has shown small but measurable efficiency, effectiveness and quality of service gains and confirmed expectations that CASD systems provide improvements in dispatching, scheduling, on-time performance and increased passenger satisfaction.   However, the level of realized positive impacts depends on the specifics of each implementation plan and overall deployment strategy.

CASD technology is relatively new and, therefore, lacks the standardization benefits of a mature technology. Moreover, with increasing numbers of local CASD system implementations, state departments of transportation have only recently realized the need for statewide strategies regarding future deployments of such systems. By commissioning a study of this nature, the Illinois Department of Transportation (IDOT) becomes a leader nationwide in acknowledging this need and undertaking the initiative to develop a statewide strategy for CASD systems.

This report provides our recommendations for such a strategy and develops a roadmap for future CASD system implementations. The recommended strategy is the result of a research effort that synthesized information gathered through the literature, personal interviews with the industry, and federal and state contacts and site visits with the state 5311 operators.

The report is organized into seven chapters. Following the introductory chapter, Chapter 2 examines the legislation that led to the growth and expansion of rural paratransit services and reviews the available literature on the application of CASD technology to rural paratransit systems, with a focus on coordination issues. Chapter 3 documents a survey of states with information on a statewide strategy for the application of CASD technology in paratransit systems. Chapter 4 discusses attributes of available CASD systems and documents similarities and differences based on a survey of vendors. Chapter 5 discusses the interviews with Illinois paratransit operators to assess the degree of operator interest in CASD systems and their readiness to implement such a system. Chapter 6 presents alternative statewide CASD deployment strategies and synthesizes information obtained from a focus group in relation to these strategies. Finally, Chapter 7 presents our conclusions from the previous research effort and recommends a strategy for a statewide implementation.

Chapter 2 - Legislative Background and Literature Review

2.1   Introduction

Applications of computer assisted scheduling and dispatching (CASD) technology to paratransit have been the subject of numerous studies. Much of this recent research activity is due to the passage of legislation such as the Americans with Disabilities Act, the Welfare Reform Act, the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991, and the Transportation Equity Act for the 21st Century (TEA-21).

The combined effect of these laws has greatly increased demand for paratransit services. Funding for such services has also increased, as has the pressure on providers to deliver services more efficiently. High costs of CASD limited their applications to larger urban areas until recently. However, as the technology has become more affordable, smaller transportation providers in rural areas have begun to consider CASD, and states have begun to experiment with statewide applications.

This chapter will examine legislation that led to the growth and expansion of paratransit services throughout the U.S., and particularly in rural areas. Summaries of past research regarding the application of CASD technology in paratransit systems will follow, along with a summary of the issues involved in coordinating paratransit and other public transportation systems. Finally, conclusions will be drawn regarding the research literature's implications on the current study.

2.2   Legislative Background

The growth of paratransit in both urban and rural areas is directly linked to federal legislation mandating and funding these services. Since 1990, four major pieces of legislation have affected paratransit services.

2.2.1   Americans With Disabilities Act (1990)

The Americans With Disabilities Act (ADA) signed by President George Bush in 1990, mandated equal access to public facilities, including public transportation services. For paratransit operators, this meant that all services now had to be accessible; previously, only federally funded services were so required (Weiner, 1992).

The ADA also affected the scope of paratransit services operated by public transit agencies. Paratransit services were now required by law to be "comparable to the level of service provided to individuals without disabilities who use the fixed route system." Specifically, hours of operation, fares, and extent of service were all required to be substantially similar to fixed-route publicly accessible service. Immediate compliance was not mandated; waiver provisions were made for operators who could demonstrate that providing full service would be too costly (Weiner, 1992).

2.2.2   Personal Responsibility and Work Opportunity Reconciliation Act of 1996

The Personal Responsibility and Work Opportunity Reconciliation ("Welfare Reform") Act led to increased demand for many providers of public transportation services, including rural paratransit operators.

2.2.3   Intermodal Surface Transportation Efficiency Act of 1991

As the first transportation-funding bill to follow the ADA, the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) provided new support for transit systems that were now obligated to provide complimentary paratransit services.

2.2.4   Transportation Equity Act for the 21st Century 1996

The Transportation Equity Act for the 21st Century (TEA-21) continued the funding of paratransit services begun under ISTEA. Under TEA-21, transportation providers are expected to use funds from the traditional elderly and disabled paratransit programs as well as rural transportation programs to best provide services.

2.3   Federal Programs and Requirements

Illinois' rural paratransit programs are typically funded through two federal programs. One, the Elderly and Persons With Disabilities program (Section 5310 of TEA-21), funds services just for those groups. The other, the Rural Transit Assistance Program (RTAP) funds transportation services available to the general public, regardless of age or disability. This program is funded through Section 5311 of TEA-21. Many of Illinois' programs are funded through both programs, although a few of the larger rural paratransit operations provide only services for the elderly and disabled.

The FTA uses a Bureau of the Census definition of urbanized and non-urbanized areas. Urbanized areas, according to the Census Bureau, include "a core area and the surrounding densely populated area with a total population of 50,000 or more, with boundaries fixed by the Bureau of the Census or extended by state and local officials." (Section 5311 Circular). This report will use "rural areas" to include all areas not considered as urban according to the FTA definition.

2.4   CASD Implementations

Academic interest in CASD applications has followed the increase in demand for paratransit services and the need to deliver services more efficiently. Relatively few

research projects have directly addressed CASD implementations in small urban and rural areas. The one study identified to date of a statewide system is in Delaware, which may not provide many useful parallels for Illinois.

Of the implementations reported in larger urban areas, most report that CASD implementation has helped cut costs and increased productivity and efficiency. The literature has also provided examples of lessons learned that may prove useful in future implementations, and gave many specific recommendations to help streamline implementations in other jurisdictions.

2.4.1   Chira-Chavala, Venter and Gosling's Santa Clara Implementation Studies (1997, 2000)

In 1997, Chira-Chavala et al. surveyed the implementation of CASD by the Santa Clara Valley Transportation Authority's OUTREACH paratransit service, which serves a populous urban county. The initial study (1997) focused on the cost and effects of implementation on productivity, while the follow-up article (2000) presented a more general evaluation.

According to the authors, implementation of the CASD system brought about substantial savings in operating costs and efficiency. Unit transportation operating costs were found to have dropped by 13% following implementation, a cost reduction accompanied by a "a significant increase in the percentage of shared rides." (Chira-Chavala et al., 1997).

The authors further reported that the benefits "were achieved without affecting passengers' travel time or ride comfort" (Chira-Chavala et al., 1997). Specifically, the follow-up telephone survey found that clients were less likely to be put on hold following implementation of the CASD system (62.7% before, 40.9% after). Clients also reported an improvement in pickup time accuracy following its implementation. The number of clients reporting a pickup within five minutes of the scheduled time increased from 50 to 53 percent, and the number reporting pickup within 15 minutes increased from 81 to 84 percent. The authors found the service improvements even more notable in light of the corresponding increase in the number of clients served.

However, the cost savings and service improvements were not achieved without obstacles. The authors caution that future implementations require "changes in personnel skills," both in the operations staff and in management. "In particular, staff members with a unique combination of expertise in the system's hardware, and software, computer system integration, and paratransit operations should be available from the outset of the planning phase…." (Chira-Chavala et al., 1997).

The authors conclude that Santa Clara County's CASD implementation was instrumental in reducing costs and improving service. It would have been "very difficult" for the agency to serve the increased demand without the efficiency increase made

possible through CASD implementation. The authors also called for the development of more user-friendly systems that combine scheduling and accounting. (Chira-Chavala et al., 2000).

2.4.2   Kikuchi's Evaluation of Delaware's System (1988)

Kikuchi's 1988 study of the Delaware paratransit system remains unique in its evaluation of a statewide implementation. Predating both ADA and ISTEA, the study's recommendations nevertheless have been corroborated by subsequent studies of later CASD implementations.

Kikuchi identified five stages of a CASD project (Table 2.1.) The implementation of the system, Phase Four, was further divided into four stages (Table 2.2.) The gradual implementation of the system was cited by the author as an important factor in the success of this early project.

Table 2.1: Kikuchi's (1988) CASD Project Phases

Phase	Description
1	Examination of existing dispatching method
2	Development of a vehicle scheduling model
3	Development of a computer program package
4	Implementation of the computerized scheduling system
5	Evaluation of operational performance

Following the implementation, Kikuchi found that the number of trips required in order to provide a comparable level of service had decreased, as did the number of empty vehicle miles. The ability to provide the same service with fewer trips enabled the agency to use fewer contract vehicles (taxis) and part-time drivers, making better use of the full-time drivers.

Table 2.2: Lessons Learned (Kikuchi, 1988)

1. Must define objectives and purposes first
2. Rules and guidelines must be defined clearly
3. Package must reduce cost and improve efficiency
4. Accurate data is essential, esp. travel time data
5. Take precautions against breakdowns
6. Direct management involvement is essential--not just contractors
7. Dispatchers and management must know how model works, including shortcomings
8. Consider management data needs as well; hardware compatibility, etc.
9. Cut costs other ways too (split shifts, taxi contracts, etc.)

From the early Delaware experience, Kikuchi cited a number of "Lessons Learned" from the implementation. The lessons are listed in Table 2.3 and described below.

- *Define objectives and purposes first*

Establishing the goals of implementation is essential, in order to ensure that the implemented system can provide needed improvements.

- **Rules and guidelines must be defined clearly**

Because implementation of the CADS system will change the way work is done in the agency, operational rules such as vacation policies, shift schedules, break time limits, vender contracts, etc. should be clarified in advance of implementation.

- *Package must reduce cost and improve efficiency*

For the initial implementation to be cost-effective, cost reductions and efficiency improvements should be the primary consideration. Implementation of features that do not achieve these goals should be deferred or avoided.

- *Accurate data is essential, especially travel time data*

Significantly, the ability to update the travel-time database based on actual driver experience should be included.

- *Take precautions against breakdowns*

Strict system backup and hard-copy printing procedures should be followed to ensure that service can continue and that automation benefits can accrue during any unplanned system downtime.

- *Direct management involvement is essential*

Successful implementation requires direct management involvement and knowledge of the system. Management should be able to identify and isolate any problems and be able to describe them to contract personnel, rather than having contract personnel run the system.

- *Dispatchers and management must know how model works, including shortcomings*

Similarly, those using the system (and those who supervise them) should be familiar with the system's logic, including any shortcomings in the model. This will allow users to anticipate problems, such as those that might arise from the system overscheduling rides on a particularly high-demand day.

- *Consider management data needs as well, hardware compatibility, etc.*

Billing, payroll, and client qualification needs, among others, should be considered at the time of implementation, so that these important needs can be designed in from the start.

- *Continue the hunt for cost-saving measures*

CASD implementation may facilitate indirect ways to cut costs, such as changing vendor contracts, splitting shifts, etc. Implementing such cost-cutting initiatives can help continue successes resulting from CASD implementation.

In his conclusions, Kikuchi cites the success in the state's CASD project, emphasizing the need for cooperation and communication between all parties involved: management, dispatchers, drivers, system developers, and contracting vendors. Communication should emphasize the benefits derived from a successful implementation, while being mindful of any inherent limitations and shortcomings of the system (Kikuchi, 1988.)

2.4.3   Bennett's Multi-Trip Evaluation (1994)

Bennett (1994) evaluated an implementation of the Multi-Trip software package and its acceptance by employees and users.

In his findings, Bennett found that in this implementation, support of the human decision-making process was more successful than replacement of that process with computerized decision-making. The software's Vehicle Diary feature was popular, while the Pick-up Scheduling feature was seldom used.   The software's inability to show vehicle shifts "at a glance" was considered to be a major flaw by users.

2.4.4   Alfa's Algorithm for Elderly Paratransit Scheduling (1986)

Alfa (1986) described the implementation of an early application of a computerized algorithm for paratransit scheduling in the Canadian city of Winnipeg. The algorithm divided the workday into scheduling "windows," and the limits of the service area into 139 sectors, and then attempted to optimize. Although primitive, the system as evaluated bears some similarities to current low-end CASD systems.

The results showed that even in relatively undemanding scheduling and dispatch applications, CASD systems could have advantages, if only in reducing "the tedium of manual scheduling." Because the system assumed equal travel times between equidistant points, some manual rerouting was needed.

2.4.5   Spring, Collura, and Black's Study of Automatic Vehicle Location Systems (1997)

Spring, et al. (1997) looked at the specific case of automatic vehicle location (AVL) systems in three of 17 vehicles in a Winston-Salem, North Carolina paratransit operation. A CASD system was used in conjunction with the AVL system. Per vehicle costs were about $3000 at the time of the implementation in 1994.

The paratransit system's efficiency improved slightly with AVL. However, demand variables did not change significantly relative to non-AVL equipped vehicles.

Reasons for the outcome are examined. "Findings indicate that the AVL devices have led to an improvement in the efficiency performance measure (time deviation). None of the effectiveness or user acceptance measures showed any statistically significant improvement over the non -AVL equipped vehicles."

2.4.6   Stone, Nalevanko and Gilbert's Report on CASD Implementations (1994)

Stone, Nalevanko, and Gilbert (1994) surveyed the operators of taxis and paratransit vehicles who had implemented CASD systems. The paratransit systems were selected from throughout the U.S.

The authors found that implementing CASD enabled paratransit systems to typically perform scheduling and dispatching tasks with one fewer employee than was required before the implementation. They further found that having the CASD system in place made it possible to handle growth in demand of up to 50% using the same number of personnel for scheduling and dispatching: "As personnel requirements decrease with computerization, productivity increases" (Stone et. al, 1994, p. 181).

Based on the experiences of the surveyed operators, the authors recommended computerizing first such non-scheduling aspects as certification, records and billing; and cautioned that in many cases, owing to the difficulty of matching long-term and short term demands for transportation, scheduling "is not easily fully automated" (Stone et. al, 1994, p. 179)

2.5   Paratransit Coordination

Facilitation or improvement of coordination between transportation providers serving the same area or adjoining areas is one of the most attractive benefits of CASD implementation. Several states have implemented paratransit coordination programs, mindful of the many potential benefits to consumers, providers, and the states. Yet because of a variety of barriers, paratransit coordination remains elusive in many areas.

2.5.1   Definitions

The Coordinating Council on Access and Mobility, a joint effort of the U.S. Departments of Transportation and Health and Human Services, defined paratransit coordination as the "process through which representatives of different agencies and client groups work together to achieve any one or all of the following goals: more cost effective service delivery, increased capacity to serve unmet needs, improved quality of service, and, services which are more easily understood and accessed by riders." (Coordinating Council on Access and Mobility, 2000.)

The Council further identifies three levels of coordination: cooperation, coordination, and consolidation. At the cooperation level, the state may seek to achieve cooperation among the agencies and paratransit providers, as a prerequisite to any coordination. At the coordination level, arrangements are made to share resources such as vehicles, staff time, staff knowledge, training, marketing, and/or facilities. Finally, at the consolidation level, transportation providers formally merge into a single system.

Although coordination does not necessarily mean that transportation provider efforts have been consolidated or centralized, it does require the centralization of at least one critical function. A list of the critical functions is shown in Table 2.4.

Table 2.4: Functional Areas for Potential Coordination

• Planning	• Dispatching
• Public Information	• General Service Monitoring
• Call-Intake	• Daily Service Monitoring
• Certification	• Trip Reconciliation
• Eligibility Records	• Billing
• Reservations	• Reporting
• Trip Allocation	• Cost Sharing
• Scheduling	• Information Sharing
• Transport	

2.5.2   Hallock's Iowa Statewide Coordination Report (1991)

Hallock (1991) reported that Iowa had mandated coordination among agencies receiving state transportation funds since 1984. Agencies that received funds but did not coordinate with other agencies could be penalized in future grants.

The author reported that channeling all public transportation grants through locally designated transit systems facilitated and advanced coordination. The number of agencies providing transportation shrank, but many of these former independents worked with local transit operators to provide coordinated service.

2.5.3   Sen and Radhakrishnan's Study of Coordination in Harris County, Texas (1993)

Sen and Radhakrishnan (1993) evaluated the level of coordination among various paratransit systems in Harris County, Texas. "Results show that little coordination is taking place; primary interaction occurs between the main funding agency and individual transportation or service providers."

"It would be appropriate to conclude that there is limited interagency cooperation and no interagency coordination in Harris County."   "It appears that the transportation agencies are not interested in interacting with the aging network and do not depend on this network for their business."

"The overwhelming feeling of the authors was that agencies were unable to keep track of information, needs, or actual use of services by their clients beyond the minimum required to comply with contractual obligations."

2.6   Conclusions

While limited in scope, the research literature regarding CASD implementations provides both encouragement and cautions for the current study.

2.6.1   Legislative and Demographic Trends

As rural populations age, the need for rural public transportation services is increasing. Federal funding for such services has increased as well, but with increased funding has come hand in hand with expectations that states will spend those transportation grants efficiently and effectively. Accordingly, transportation providers will need to consider whatever efficiencies can be gained through implementing CASD and improving coordination with other providers.

2.6.2   Realistic Expectations

While most of the implementation studies reviewed showed some gains in system efficiency, few have indicated significant cost savings resulting from CASD. However, various researchers have indicated that even a modest efficiency increase can be a compelling argument for CASD. The increased efficiency can help paratransit operators provide more service with the same resources. Furthermore, as the provider's proficiency and comfort with the CASD system increases, the possibility of even greater efficiency increases in the long-term becomes apparent.

2.6.3   Consider Possibility of Coordination

The combination of service coordination with CASD implementation offers the possibility of even greater efficiency and service improvements than could be achieved by implementing the two separately. Although only a few states have coordinated their rural transportation system, the limited experience of statewide coordination efforts in paratransit suggests the possibility exists of considerable costs savings. The possibility of realizing real benefits for users, operators and IDOT suggests the importance of planning for coordination in the implementation of a CASD system.

However, the benefits of coordination are typically realized only after meeting and overcoming a series of well-documented barriers. If the possibility exists for eventual coordination, either at the statewide level or among regional systems, selecting a CASD system that can, in the long-term, allow coordination with other providers could save having to re-implement a new system a few years down the road.

Chapter 3 – Survey of State and Federal Strategies

3.1   Introduction

DOTs from other states were contacted and solicited for information concerning attempts at a statewide strategy for implementing CASD systems. Specifically, this part of the project was concerned with states that implemented a strategy for state funded, computer aided, scheduling and dispatching systems (CASD). Specific states were identified and a telephone survey was administered to knowledgeable personnel. Through these surveys is was possible to inquire about the strategies used, benefits obtained, problems encountered, and other information that would be helpful in understanding these strategies. An exploration of FTA requirements and guidelines was also conducted to give a more accurate picture of federal guidance, and what might prove to be additional barriers to implementation. Besides the telephone survey, information was gathered through DOT websites, FTA websites, and contacts with a number of FTA officials familiar with operations software for paratransit. A directory of state contacts was obtained from: "Advanced Public Transportation Systems: The State of the Art" (Casey, et al. 2000).

3.2   Methodology

Selection Process

A total of 36 states were identified as potentially having a program for CASD implementation in place. These states were identified through personal contacts, the CASD literature and discussions with software vendors. A complete breakdown of the states examined is shown in Table 3.1. Out of the original 36 contacted, only seven states had a program and were eligible for in depth examination. A few, such as Minnesota, Maryland and Indiana, were in the beginning stages of implementation and could only provide their findings after their system was functional. The remaining 26 states had limited to no implementation effort existing at the time, but several expressed interest in such a system. Figure 3.1 provides a visual perspective of the stages of implementation among the fifty states. All were enthusiastic to see how other states' efforts would develop.

Table 3.1: States Contacted

Have Program	In Progress	No Program			No Information	
Florida	Indiana	Alaska	Ohio	Washington	California	Massachusetts
Kentucky	Maryland	Arizona	Oklahoma	Wisconsin	Connecticut	Maine
New Jersey	Minnesota	Montana	Pennsylvania	W. Virginia	Delaware	Michigan
North Carolina		New Hampshire	Tennessee		Georgia	Missouri
Oregan		New York	Virginia		Hawaii	Nevada
Rhode Island					Iowa	South Dakota
South Carolina					Kansas	

Figure 3.1: Stages of Implementation
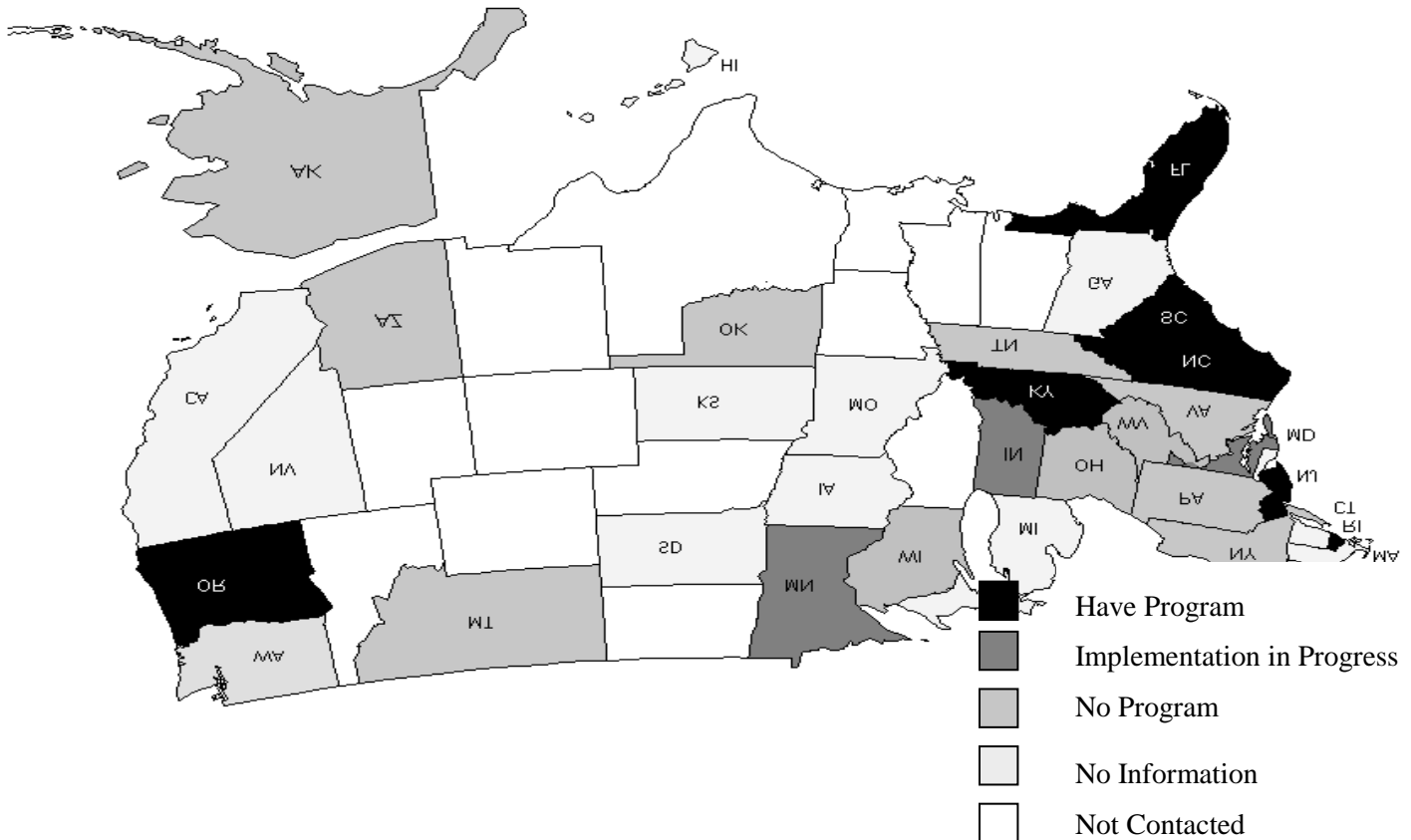
Survey Instrument

In the early stages of the project, vendor contacts, FTA, DOT websites, and individuals in the field were utilized to provide a list of state DOTs that may have a statewide CASD implementation program in effect. The coordination specialist was contacted in some states and the computer technology specialist in others. Initially, states were contacted via a preliminary phone call to the DOT's computer system coordinator/analyst. A person in this position would be familiar with the technological aspect of such a strategy and would also be acquainted with updated information pertaining to their state's paratransit community.

A survey instrument was devised to extract information about the strategies including problems and suggestions for implementing computer aided scheduling and dispatching systems. The survey contained questions pertaining to problems encountered in the planning stage, post-implementation stage, and software problems. For a complete listing of the questions, refer to Appendix I.

3.3   Results

Interviews with the states that had a CASD strategy in place produced a wealth of information that could be used in Illinois to successfully achieve a CASD strategy. Tables 3.2 to 3.5 discuss the strategies implemented and major areas of concern that will be discussed in the following sections. Only North Carolina, Florida, Oregon, New Jersey, South Carolina, Kentucky, and Rhode Island are included in these tables, since only these states had some sort of implementation in place.

3.2.1   State Approaches

Strategy

A variety of approaches were used by these states in implementing a CASD program. They include having a statewide-centralized brokerage, a decentralized brokerage strategy, and a map based approach (regional call centers). The most popular choice for a coordination strategy was the use of several decentralized brokerages.

The most complex is a statewide-centralized strategy that focuses on the use of a single "agency" as the sole provider of support and data control. This strategy involves a single agency coordinating trips, scheduling, dispatching, reporting, etc. Participating agencies are connected to the central database via the Internet, where possible clients are posted. If the agency is able to accommodate their needs, the client is then placed on that vehicles route for pick-up. Control by the centralized agency becomes an essential characteristic of this strategy.

When using a decentralized brokerage system, lead agencies in each area act as a coordinator for their surrounding region. This strategy allows for sharing of resources such as technology, vehicles, and clients in order to coordinate trips and improve efficiency. The brokerage acts as the call center and trip scheduler. If one provider is unable to serve a particular client, the brokerage would then schedule them with a provider that can.

The simplest strategy that was implemented is call centers. Call centers act solely as the initial contact to schedule a trip. Through this system, there is no sharing of resources or information. When implementing a CASD system, starting with the call center approach allows for a smoother transition into the brokerage system.

North Carolina exhibited the most intricate system that has been implemented thus far. This system was not used as a statewide approach for coordination. Rather, it

was used for consolidation. The North Carolina DOT suggested the most beneficial system and its components for each individual agency.   In order to select the appropriate system, this state devised a breakdown, which categorized paratransit providers by size and location (urban or rural). By following a detailed matrix, which is attached as Appendix III, North Carolina DOT was able to identify which type of service would be appropriate for each provider. In order to gain support for this project, they took a "top-down" approach, which meant they gained support from state legislators first. This trickle down effect was useful in obtaining the support from the individual paratransit providers, because these providers felt like they had someone in place that was addressing their needs. Since NC DOT took the initiative over the project, many agencies were fearful of the DOT becoming absorbed in their own objectives and losing sight of their concerns.

Although Kentucky and Florida had similar approaches, their strategy is focused on establishing a decentralized brokerage system. They had a list of vendors, from which the individual providers could choose. Although theoretically a list of chosen vendors sounded easiest, Kentucky expressed their concern for the delay in finding the correct software vendor and components that were suitable for each agency's needs. Kentucky stated that if they were to do it all over again, they would have chosen a standard vendor.

Florida's agencies were examined in two phases: 1. Necessity of upgrades, and 2. "Test-run" phase.   In phase one, many facets of both administrative and operational functions were examined to see if any system changes were necessary for the introduction of a CASD system. In addition, the assessment was used to determine the extent of their transportation-related technological development, what miscellaneous software and hardware upgrades would be necessary, and what level of ITS mobility management software would be necessary to enable them to prepare for possible use of AVLs, MDTs and other complex applications. In the second phase, two community transportation coordinators (CTC) were chosen to participate in the primary installation of a CASD system. They were chosen based on their service size and their meeting at least one criterion for establishing a Metropolitan Planning Organization. Unfortunately, the parameters of these criteria were not supplied to the research team. However, by implementing a minimal number of CASD systems, specifically two, Florida was able to easily assess any problems that might be addressed before implementing such a system at a statewide level.

Oregon, on the other hand, has a unique strategy. They have several scheduling and dispatching software purchase grants, but they have not implemented a statewide approach for a CASD system. Instead, they have used the regional call center strategy. In the long-term, a project called "Trip Planner", which is an expansion of the state's "Trip Check" website, will be implemented in hopes to create seamless trip planning, scheduling and ticketing. This will require that agencies talk to each other in order to coordinate service in their area. Oregon is eager to first study the outcome of their existing software deployment project as well as that of other states participating in like projects. Further information on all of the seven states interviewed can be found in Table 3.2 and will also be explained in the following sections.

Table 3.2 Aspects of Strategies Implemented by States

	Kentucky	New Jersey	North Carolina	South Carolina	Rhode Island	Oregon	Florida
Aspects:							
Strategy Implemented	Regional brokerage system (15 total)	Brokerage system, each region has central system	Six categories for software implementation, determined by size of agency	Standardized, centralized system	Statewide brokerage system	Not statewide, decentralized, regional call centers	Six regional call centers
Used for Coordination?	Yes, for all paratransit providers	Yes, six regions run software independently	No, used for consolidation	Yes, for paratransit	Yes	Yes, goal is to centralize info. And trip requests	Inter-county coordination
Who Qualifies?	5311 providers	ADA paratransit, non-profit agencies	5311, non-profit, and public agencies	5311 providers	5311 providers (only elderly and disabled)	Paratransit providers (5311 & 5307)	Human services
How many qualify?	15 counties	21 agencies	103 agencies	18, only 13 are paratransit	12 to 15	N/A	6 (1/region)
Vendor(s) Chosen	Providers chosen based on suitability	Trapeze	RouteLogic	Providers chosen based on suitability	Trapeze	Each grantee and call center chosen based on suitability	RouteLogic
How were vendors dealt with?	Vendors need to be approved, providers given a list of standards	Proposals were received, chosen based on needs of agencies	RFP sent out	RFP sent out, let individual RTAs accept own bids based on suitability	Sent RFP, KPMG proposed Trapeze, state has certified vendors for hardware	There is a list of pre-selected vendors or providers, make independent purchases	RFP sent out
Components installed, used?	Not many AVLs installed, Implementing CardSwipe	Web Interface (Trapeze), IVR, MTC, and AVL	Based on hierarchy (See Appendix III)	Vary greatly	ARCtecture to work with AVL and "Reservation"	AVL & MDT (minimal use), online trip-planner	Varied, had field people do demos to choose appropriate components
Funding	80% Federal, 10% State, and 10% from agency	75% funded by "Share of State" gas tax, agencies had funds available	100% state funded	$4.5 million for complete project	Board authorized full funding for 5 yrs	50% from Title XIX, and match from ODOT source-funds	FTA= $400,000, (Comm. for Trans. Disadv.)= $50,000
Training/ Support	Training was given for up to a year	In house staff w/ 1st line of support, then KPMG as prime contractor, finally individual vendors	State level guru	Comprehensive training program began after on-site evaluation	N/A	N/A	N/A

Coordination

Using these CASD systems for the purpose of coordination was another aspect of several state strategies. Five out the seven states interviewed use their system for the purpose of coordinating their paratransit providers statewide. Coordination was important, because the goal of the entire implementation project was to centralize information and trip requests. Florida uses their system for coordination, but for inter-county coordination only.

Who Qualifies

The issue of enough funds is always a concern, so it was important to identify who was chosen to participate in the implementation of a CASD system. All seven states include their 5311 providers on their list of qualified participants. In addition to 5311 providers, New Jersey and North Carolina include non-profit and public agencies in the list of qualified agencies. Florida stated that they include all human service providers. On average, there were about 15 agencies per state, depending on the implementation strategy, who participated in the installation of some sort of CASD system at their facility. For example, Kentucky used a brokerage system as their strategy for implementation. Since they have 15 counties, they have 15 providers who qualified to be a broker and received funding for this project. Similarly, New Jersey has a brokerage system in place. They have 21 regions that use a central system installed; therefore, they have 21 agencies that qualify to be a regional call center/brokerage. The agencies (private and public), depending on state stipulations, that did not qualify for brokerage status were given minimal funding in order to have the capability of using an on-line application to access the information that was necessary for coordination.

North Carolina was the exception, because they did not use their system for coordination. Altogether, they had 103 agencies that qualified for funding. This larger number is a reflection of not having a central system at regional call centers. Each agency received funding for their own system.

Vendor Selection

Vendor selection differed among the states. Kentucky, South Carolina and Oregon allowed the individual agencies to use vendors that were suitable for their needs. The remaining four states, New Jersey, North Carolina, Rhode Island and Florida chose a standard vendor which all of the agencies used to purchase their software. In the states that chose a standard vendor, RFPs were sent out to various companies, which were then selected and approved by the state, based upon the necessary level of sophistication needed by their state's operators. NCDOT had $500,000 available to fund rural technology applications. Individual agencies sent out their own RFP. In contrast, Kentucky supplied a list of approved standards that the vendor must meet. Operators were given the list of standards and it was the responsibility of the operator to seek a qualified vendor. That vendor must then be approved by the state. Rhode Island was

similar in that RFPs were sent out, but the state also had a list of certified vendors from which agencies could purchase hardware.

Overall, three out of the seven states allowed for their transit providers to independently choose the software that best suited their needs. This strategy proved to have many problems associated with it, such as compatibility issues and software lags. The states that chose a vendor or several standard vendors experienced fewer problems. Table 3.3 shows the states and their corresponding vendors.

Table 3.3 States and Their Corresponding Vendors

State	CASD Vendor
Kentucky	Various – Trapeze, etc. (agencies able to choose) Moving to single vendor
North Carolina	Route Match
New Jersey	Had Inteletran – In the process of installing Trapeze
South Carolina	Various – Vendors chosen based on suitability (Specific vendor names not provided)
Oregon	Various (StrateGen, Trapeze, Route Match, Tabs Plus)
Rhode Island	Trapeze
Florida	RouteLogic

Software Components Installed

Paratransit operators from all of the states listed above installed common features regardless of the software that was purchased. North Carolina had the most elaborate and comprehensive system outlined, which can be seen in Appendix III. They based the purchase of specific features on the hierarchy of agency size. This hierarchy begins with foundational or baseline technologies and works its way up to advanced technologies. Examples of the baseline technologies are templates, Voice Mail/Email, and computer upgrades. The advanced technologies include client ID/bar codes, electronic manifest software, and scheduling software. Similar to North Carolina's approach, the other states implemented features such as web interface, IVR (Interactive Voice Response), MTC, AVL, and MDTs. Kentucky did not use many AVLs, but they did implement use of the "Cardswipe" system. This allows for the rider to automatically board the vehicle without having to provide their information each time. The card holds all of their client information, which can be easily transferred into the agency's database. In addition to AVLs and MTCs, New Jersey used a web interface (Trapeze) in order share necessary information. Rhode Island used a program called ARCtecture to coordinate AVLs and scheduled trips.

In an attempt to decrease costs, Florida had their field people do software demonstrations instead of representatives from vendors. Not only did it save them money, but they also gained a unique perspective as to the specific features that the software must encompass. Since the field people have to work with this software, they knew exactly what would be essential and beneficial to their operators.

Funding

For the most part, agencies would always like more funding, but in this case funding did not seem be a major concern for those who participated in the implementation of a CASD program. The majority of the state DOTs did not accept responsibility for the complete funding of such a project. For example Kentucky's DOT accepted only 10% of the total funding responsibility and Florida received most of it's funding from the FTA. Most agencies received their monies elsewhere. Only a few such as Rhode Island accepted full responsibility for complete funding. This state locked in an estimated cost up front. The board authorized complete project funding for five years. In addition to state funds, the agencies themselves had funds available due to the monies received through, for example, the "Share of State" gas tax, which was given to transportation providers that supplied service for seniors and ADA clients. South Carolina set aside $4.5 million dollars for their CASD project. Table 3.4 is provided to show a complete breakdown of the fund allocation for the seven states.

Table 3.4 Fund Origination

State:	Funding Type:
Kentucky	80% Federally funded, 10% State funded, 10% from individual agencies
North Carolina	Completely state funded
South Carolina	Set aside $4.5 Million to do it all, received funds from various sources (Ex. Federal, State, etc.)
New Jersey	75% funded by "Share of State" gas tax, 25% state
Oregon	50% from Title XIX, and match from ODOT source-funds
Florida	FTA provided funding in the amount of $400,000, and CTD (Commission for the Transportation Disadvantaged) added $50,000 to the project
Rhode Island	State funds were locked in up front. Board authorized full project for 5 years. Additional: agencies had funds available (majority of services paid by ADA clients. Also in '94, funds were allocated from "Share of State" gas tax.

For many of these states, the original funds set aside for the duration of the project were greatly underestimated. Many issues contributed to the increased expenditures incurred by the implementation of a system. Problems became evident when many

agencies were not fitted with the correct software. Software costs were greatly underestimated, due to the need to uninstall incorrect software and reinstall correct software. In addition, the time needed to install such software greatly increased, which contributed to an increase in costs due to overtime. Maintenance, operation and update costs were overlooked in some states, such as Oregon. The addition costs were typically paid for by the individual agencies, which financially hurt any of the small operators. These obstacles could be prevented by accurately assessing the sophistication and needs of each individual operator.

Training/Support

        Collectively, all the states that were interviewed stressed that the most important contribution to successful implementation of the system was the extent of systemic training that was provided. Most of the employees that were expected to operate these systems had very little computer expertise, and it was important to update their knowledge, along with management's knowledge, in order to maintain the system's effectiveness.

        Training can be the principal element that leads to successful implementation of these systems. However, after analyzing the various states interviewed, it was found that there was a varying degree of training that was provided to employees of the paratransit agencies. Depending on the CASD system that was purchased, training was provided by the either the vendor or by the transportation provider. In Kentucky, each agency was able to choose a system that would be most beneficial to the size of their company. Regardless of the system chosen, the state provided training for up to one year after the computer system was installed. After this period, any additional training was the responsibility of the provider. In contrast to this approach, New Jersey, South Carolina and North Carolina provided pre-implementation training. These states also provided some additional training during the post-implementation stage was needed. New Jersey used an independent contractor, KPMG, as their second line of support that provided extra training if it were needed. North Carolina provided a CD-ROM that assisted management with further training. As a baseline of support, North Carolina was equipped with a state level guru. This "guru" was positioned at NCDOT, and was able to answer any questions concerning the use of the new CASD system. The South Carolina DOT sponsored a comprehensive training program, which included training in Office Suites and the Internet.

        The most important component of training is the increased knowledge that management must possess of the system. This was a commonality felt by all the states interviewed. Management should be the underlying force of an organization's support for its employees. If they do not have the answers, then the system is sure to fail.

3.2.2   Problems and Benefits

Prior to implementing a CASD program, there are benefits of the project that should be understood. The benefits are outlined in the following sections. There are also some serious problems that need to be understood and solved in order to make such a program successful.

Problems arose in each stage of implementation, from the planning stage to the implementation of software. The following sections identify and analyze these problems. The areas where problems arose include problem/benefit awareness, planning for implementation, post-implementation issues, administrative obstacles, software issues, and operator concerns. States have also provided insight as to how they would have done the implementation process differently. The subsequent sections are summarized in Table 3.5.

Table 3.5 Specific Problems and Benefits

	Kentucky	North Carolina	New Jersey	South Carolina	Oregon	Rhode Island	Florida
Aspects:							
Benefits	Saves money due to efficiency, increased safety, easier to monitor	Pure network agencies learning from each other	Increase productivity by 16-18%	Standardized system	Increased service level available to Medicaid population, increased revenue	Lower agency costs, increased service	Efficiency, increased revenue. and ridership, small counties lowered operation costs
Planning Stage Problems	Tremendous amounts of legislation, opposition to legislation	Conducted on-site assessments of all transit agencies (time consuming)	Minimal; had intensive planning, consultants,	Unsure where to begin planning	Insufficient planning for software	Turf problems, control problems, confidentiality	Selection of correct vendor
Post-Implement-ation Problems	Finding correct program for reporting, lack of funding, delayed payments	Many of the software functions can't be fully utilized because of skill level needed	Keeping up with documenting procedures, fast system growth	Unknown, implement-ation in progress	Implementation in progress	Schedule compliance, cab companies excluded	Unforeseen costs (fuel prices, shortage of drivers)
Administrative Obstacles	Designated additional department, went smoothly	Development & agreement to a pre-defined list of billing terms (lack of common definitions)	None, admin. is responsibility of prime contractors	Skill level not at level of software	Should increase state oversight of call centers' software	Reporting, more cooperation, difficulty est. trip costs, explanation of sharing billing costs	None
Software Issues	Minimal GIS coding, providers not equipped for software	Product development (vendor delays), integration issues	None	None, has IT person at each agency with on-site support for five years & can contact DOT	Software costs underestimated, different software packages, software too complex for skill levels	Batch scheduling: schedule 25% demand response manually	Extensive *bugs* in software, hardware crashes, software vendor did not deliver specific reporting formats
Operator Issues	Don't like being monitored, decreased number of riders/trips, lack of funding	High turnover in staff	None	N/A	N/A	Scheduling; afraid of lost service, too tight of a schedule	Inability to accomplish goals, overtime expenditures, decreased ridership for small operators
What would be done differently?	Increase efforts on all fronts, standardize system, increase funds	More in-depth on-site pre-evaluation of agencies	Spend more time at on-site inspections	N/A	Align purchases with goals	Spend more time explaining system to agencies and consumer groups	Standardize list of vendor requirements

Benefits

The states interviewed experienced a variety of benefits from implementation of their strategy. These benefits include increased efficiency, increased monetary savings, increased ability to monitor more closely, the sharing of resources, increased ability to learn from each other, increased productivity, and ultimately coordination of services.

All of the states that were examined experienced the above benefits to some degree. For example, after initial implementation of its CASD system, Oregon, which is still adding and subtracting modules from its software, was able to dramatically increase its service levels, to better serve its Medicaid population. As a result, some providers in this state were actually able to increase their revenues by increasing ridership volume. Rhode Island experienced similar advantages by implementing a centralized brokerage. The coordination of trips lowered per agency costs. The agencies were able to provide a lot more service without increasing their overall costs. Florida experienced analogous results. Route efficiencies increased revenues and ridership for their larger counties. Although smaller counties experienced lower ridership, they were left with lower operating costs.

Problems

The problems can be divided into two different categories, which represent individual stages of implementation. These categories include the planning stage and the post-implementation stage. It is crucial to study both in order to obtain an accurate description of all the factors that contribute to implementation of a CASD program. The complete picture also includes an examination of software, administrative, and operator problems that might be encountered in either stage.

Planning Stage Problems

In order for the implementation process to operate smoothly, a detailed and precise planning stage should be outlined. This will eliminate any preliminary obstacles that would hinder the progress of implementation. States that are interested in implementing a CASD program should be aware of some specific problems that previous states have encountered at this stage. These problems included Kentucky's difficulty with legislation, North Carolina and New Jersey's lack of on-site assessment and intensive planning efforts, Rhode Island's issues with turf and control problems, and Florida's problem with vendor selection. Oregon also reported having difficulty implementing appropriate software for the individual agencies.

In some states, legislation needed to be written before such a system could be funded and implemented. This legislation tends to be met by a lot of opposition from the agencies, and was counteracted by having a backer for the legislation (a legislator). Legislation becomes important when turf problems become an issue between agencies. Agencies become aware of problems over control of client ridership and client information. Who will retain control over confidentiality? In order overcome the

problem of control, this question needs to be answered prior to the implementation of a strategy that utilizes brokerages. Kentucky found a solution to its legislation problem by gaining the support of its state legislators. By gaining their support, these pivotal backers were able to push for the implementation of a CASD system. This tactic was also used to subdue the fears of turf and control problems, which were expressed by the operators. For the next few months, Oregon's call center/brokerage project will be assessing which software would best fit their needs. In addition, their TripPlanner project is being planned at this time. This system will allow the transit agencies to run more efficiently by coordinating their subscription service with their demand responsive service. This system is used individually, not as a central system for all agencies to share information with each other. Their approach is very systematic and will result in standardized specifications as to what is needed at the local level to connect to their TripCheck system. This system is used by the client/rider to better assist them. They are able to determine when a vehicle is available, where it is going, etc.

Post-Implementation Stage Problems

After the planning and implementation stages, a post-implementation analysis should be conducted, because many problems can arise during this time. If they are not dealt with, the entire project could fall into a downward spiral. During this stage, many states, such as Kentucky and New Jersey, found it difficult to match the needs of the particular provider with the correct software. They found themselves concentrating most of their efforts on installing software, and then training the staff to use it. Combined with the inability to find the correct software, New Jersey reported difficulty with the speed that its system grew, because it was difficult to maintain quality assurance of the data. These issues consumed most of the resources set aside for this project, and also put them off schedule. Another major concern with other states was the lack of computer skills possessed by agency employees. North Carolina reported that many of the software's functions could not be fully utilized because of the skill level, of its employees and management.

This leads to the next problem; unforeseen costs. Providers in Florida were not prepared to spend extra time and money on additional training of their employees. Coupled with increased fuel prices and a shortage of drivers, many agencies were forced to acquire further funding from the state or abandon the software temporarily.

Administrative Obstacles

When implementing such a complicated system, one should expect to run into administrative complications. As mentioned above, the most critical obstacle to overcome is the development of managements' computer skills and knowledge of the software. This seems to have been clear to most states before they undertook their project. Kentucky designated one department of its DOT for administration over the paratransit providers. They reported that this strategy went smoothly. Creatively, New Jersey's DOT hired prime contractors who shouldered the administrative burden. Under

the prime contractors, there were six subcontractors. They reported that this procedure alleviated the responsibility from the agencies' shoulders and placed it on the contractor's shoulders. This allowed the paratransit providers to directly focus on implementation of the software.

Complaints were at a minimum for administrative barriers, but there were two interesting recommendations that were voiced by a few of the states. Oregon stated that it would have been beneficial to have had increased state oversight for call centers' software purchases. A standardized list of criteria or vendor list would have been useful. In addition to standardization, they felt that more time should have been spent on software related issues. Both Rhode Island and North Carolina mentioned the issue of standardized reporting. For the most part, reporting agencies should be cognizant of what reports they need ahead of time. Placing more emphasis on explaining shared billing costs to the financial personnel in each agency should have taken place. It became too difficult at first to estimate the cost of trips for reporting purposes. Developing and agreeing to a pre-defined list of billing terms would have eliminated some of the confusion and inefficiency.

Software Issues

During the post-implementation stage, most agencies hit a speed bump when it came to software issues. One major issue was that of GIS coding for the state of Kentucky. Not all counties were properly coded, therefore making it impossible to identify their locations. Many providers were not equipped for the new software, due to lack of sophisticated hardware. Consequently, this led to product development and integration issues. This added to the difficulty of vendors moving their product from the testing phase to the live implementation phase, which created large delays. This also hindered the advancement of Florida, North Carolina, and Oregon's projects. In Florida's case, the brokering agencies continue to experience extensive amounts of bugs in the software and often experience hardware crashes. In addition, the mobility management software vendor did not follow through with the delivery of specific reporting formats. Due to these unforeseen time delays, software costs were greatly underestimated.

Two states came up with their own solutions to their software complications. South Carolina installed an IT person at each agency, which included on-site tech support for five years. As a final resort, the agency can contact a person at the NCDOT. New Jersey implemented a second solution. Batch scheduling was not as successful as they would have liked, so NJDOT manually track 25% of their demand responsive business. This is easier than finding the correct software that would fit their needs.

Operator Issues

Prior to implementation of a new CASD program, operators expressed various concerns they had with the project. Kentucky's operators had an extreme distaste for

having every movement that the agency made monitored and scrutinized. Kentucky, Florida and Rhode Island operators were also concerned that the efficiency of a CASD program would decrease the number of trips/ridership for their agency. Eventually, this would mean less funding for their organization from the DOT. Additionally, Florida's operators were afraid of their inability to accomplish the goals that were outlined by the DOT for the agency in order to implement the system on time and effectively. Achieving these goals would require large overtime expenditures and a lessening of employee morale. High turnover became a great concern to the participating agencies in North Carolina. Training costs were significantly increased due to the constant training of new employees.

<u>What could have been done differently?</u>

After all of the previous data had been gathered, a final question was asked: "If your state could redo the implementation of its CASD system, what would be done differently?" All seven states agreed on two areas: 1. In-depth provider evaluation, and 2. Standardized vendor list. They firmly stated that on-site evaluation is the most crucial aspect of implementation, and that the greatest effort should be focused at this stage. This stage enables the state to determine the extent of the provider's capabilities and to identify the degree of training and support needed after implementation. Secondly, those states that did not use a standardized list of vendors, nor use a single vendor, said that this made implementation extremely difficult. Matching providers with the correct system consumed too much time, due to the fact that it was trial and error. Also, the coordination of information was not easily done because compatible software among the providers did not always exist.

3.4   FTA Requirements and Guidelines

In addition to obtaining information from states, which have some type of strategy in place, the FTA was contacted in order to ascertain whether a federal strategy for CASD system deployment is in the process of being implemented. According to an Advanced Public Transportation Systems publication, at this time there are no industry-wide standards in place for architecture, nor are there any expectations regarding the features and functions that such a system should have, or the degree to which it should interface with other software or hardware (Casey, et al., 2000). Federal officials were contacted to confirm this. Their understanding of such information was compatible with the findings in the reference listed above. For a list of these official contacts, refer to Appendix II. Nevertheless, FTA has commissioned a project for the compilation of a "Best Practices" guide for Rural ITS applications, and project managers/participants. According to the Rural Florida ITS Project, this publication was due to be finished some time in the year 2001, but is still in the process of being written.

3.5   Conclusions: Implications for Illinois

As of now there are no industry-wide standards for CASD programs, nor is there any specific strategy that should be used when initiating this program. It can be seen that the implementation of a CASD program is a relatively new concept. Although many states are interested in pursuing this concept, it is met with skepticism by paratransit providers and many legislators. Those states that were interviewed can be used as guidance for Illinois when implementing its own CASD program. It is easy to concentrate primarily on the benefits of such a system, but there are problems that need to be dealt with in order to implement a successful program. Paratransit providers have many concerns with implementing new software, and it may prove hard to win their support. As a result, incentives or further legislation may be needed to gain their confidence. A thorough examination must be done of the agencies in order to obtain a better understanding of their operations. This will make it easier to match them with the appropriate software. Overall, most of the emphasis should be placed in the support and training of the employees that must operate such a program. This stage of implementation could mean the difference between failure and success.

Chapter 4 – CASD Software Characteristics

4.1   Introduction

This chapter will focus on the existing software for CASD systems. Section 4.2 describes Advanced Public Transit Systems (APTS), the technologies they are based on, and their impact on paratransit operations. Section 4.3 introduces the various paratransit software vendors, the survey instrument that was used to acquire the information and some common conclusions that were drawn. Section 4.4 describes the paratransit software from the perspective of their operational functionalities, coordination and brokerage capabilities. A comparison of the software packages was done in order to better understand the similarities and differences. Section 4.5 discusses the hardware aspects of APTS, reviewing existing technologies and how they integrate into CASD systems. Finally, Section 4.6 presents our conclusions.

4.2   APTS Technology – Impacts

APTS are a set of technologies used in transportation with the primary role of increasing productivity, mainly by automating functions, such as call taking, scheduling, dispatching, and communication. APTS are comprised of both hardware and software. Both components play an important role in such an automated system. The hardware provides the underlying physical infrastructure while the software makes it work and it is often called "the brain of an APTS system for demand responsive transit" (Stone et al., 1992).

There are many possible combinations of different hardware and software or software modules. APTS systems can be built with different functionalities, incorporating only those that are relevant for transit operations. This is possible because most software is designed to be modular. In the modular approach once the core application (computer instructions, or a set of related instructions written in a programming language) (Lai, 1999) is installed, installing any additional module is a trivial operation. Suppose a transit agency installs the core of a scheduling/dispatching software and it experiences tremendous growth, leading to the necessity of having an AVL /MDT system. This upgrade will be trivial in the sense that the existing software will be augmented with the new module, which supports the AVL / MDT hardware and integrates it into the entire system. Having modular software is important, especially when regional or statewide level implementations are concerned, because in multi-transit agency implementations not all agencies will need all or the same set of functionalities. This way, all sites will benefit from customization, the possibility of later upgrades, and the overall cost of the APTS will reflect the true needs.

The motivation behind implementing APTS systems is to increase the effectiveness and efficiency of transit system operations, which will translate into cutbacks in *deadhead-miles*, better resource utilization, both human and physical, and in lower operating costs.
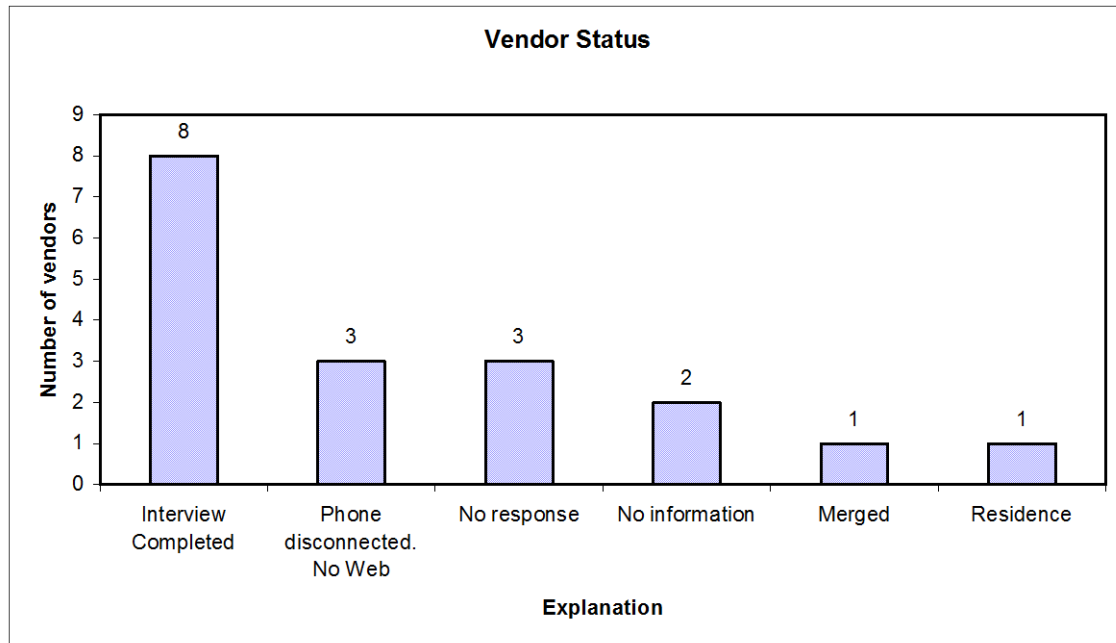
4.3   Vendor Survey

4.3.1 Overview of Vendors

The purpose of the vendor survey was not to identify all existing vendors on the market, nor to identify all existing scheduling and dispatching software; rather, to identify a set of vendors along with their scheduling and dispatching software that would be representative of the paratransit industry. In other words, the research team turned to vendors that are the major players in this area and software that is at the forefront of the industry. Apart from the well-established vendors, which tend to have complex software, the research team also assessed less sophisticated software that might be useful at some smaller agencies. As with the "blue chips" in transit software, the research team did not try to contact all smaller vendors out there, rather the research team looked at vendors that would give us an understanding of the level of sophistication of scheduling and dispatching software.

The research team contacted 18 vendors (see appendix V) and completed interviews with eight. The starting point in selecting the vendors were two previous projects that were conducted in this area: "List of Software Vendors" (Stone, 1999), and "Computer-Aided Scheduling and Dispatching Systems: Impacts on Operations and Coordination" (Pagano et al., 1998). The low ratio in completing the survey is due to the high turnover in the software industry. Vendors change their names, are being acquired by others, or just simply disappear (previous phones and addresses are not valid anymore).

Fig. 4.1 provides information about the vendors and their status:
Fig 4.1 Vendor Status

- Interview completed – vendors that were found and had favorably responded to our inquires, resulting in a completed survey
- Phone disconnected. No web – vendors could not be traced
- No response – vendors were left messages but never got back to us
- No information – vendors were contacted but did not share any information
- Merged – vendors that have merged with others
- Residence – the place was a residence (with the same name as the company's name)

As the research team can see from the figure above, not all vendors that were included in past projects could be contacted, for a variety of reasons. Below is the list of vendors in which an interview was completed along with their software products pertaining to paratransit:

Trapeze Software Inc. Scottsdale, Arizona
  PASS – Fully automated scheduling and dispatching system with client registration features for demand response operations.
  PASS-Lite – Computer-assisted scheduling, dispatching and client management tools for smaller demand response services.
  FLEX – Adaptable scheduling, dispatching and routing solutions for multi-modal services.
  OPS – Efficient tools to manage bidding, driver dispatching and timekeeping.
  INFO – Timetable look-up and trip planning tools for telephone and web-based passenger information services.
  PLAN – Advanced tools for ridership analysis, forecasts and reports.
  FLEET – The easy way to manage vehicles, maintenance, inventories and costs.

Multisystems Inc. Cambridge, Massachusetts
  Midas PT – Client eligibility and reservations, vehicle scheduling and dispatching, billing and administration
  Midas-VOS – Fixed route transit vehicle scheduling and runcutting, integrated GIS access, AVL/APTS data support
  Midas-CIS – Transit customer information/trip planning
  Midas-BD – Bid processing, timekeeping, complaint management, dispatching control, accident tracking
  Midas-MDT – Mobile data transfer software, display AVL mapping, run dispatching, sending messages, posting mobile data

Teleride Inc. Toronto, Canada
  TransView – Client registration, call taking, booking, scheduling and dispatching, MDT facility, GIS mapping
  TeleSched – Automated transit scheduling, runcutting, rostering and reporting
  TeleFleet – Scheduling preventative maintenance (PM), tracking repair costs
  TeleDrive –Driver/employee bidding, work assignment, timekeeping, and performance management

TeleAVL – Works with scheduling systems, driver management systems and geographic information systems (GIS) to accurately calculate the schedule adherence of transit vehicles from position data (differential global positioning system (DGPS) reading and odometer) supplied by an automatic vehicle location (AVL) system

RouteMatch Software Inc, Atlanta, Georgia

RouteMatch TS – Provides fully automated, GIS-based scheduling and routing and handles all facets of transportation management including vehicle management, advanced billing and reporting, invoicing, ADA eligibility and trip verification.

RouteMatch PM – Advanced software solution for demand-response scheduling and dispatching. Manages operational resources, customers, geocoding, trip requests and standing orders, driver manifests and directions, multiple funding sources, billing and invoicing.

StrataGen Systems, Woodinville, Washington

Adept 2.2 – A fast, fully-automated, all-in-one, and easy-to-use solution for paratransit scheduling, dispatching and passenger management. It combines: client reservations, trip reservations, automated scheduling, standard ad hoc reports, database management, and GIS.

RouteLogic, Pembroke, Florida

ParaRoute – Full-featured routing and scheduling software with complete ADA and fixed route functionality. It has both real-time and batch scheduling capabilities, giving you either or both methods for order taking, scheduling, and dispatching.

ParaLogic – Easy-to-learn and easy-to-use real-time and batch paratransit software.

ClientMap – A first step to GIS technology for those not ready for or needing a complete paratransit routing and scheduling software system.

Shah Software, Midland, Texas

Transportation Manager – Integrated software providing scheduling and dispatching, trip booking, trip reports, vehicle utilization reports, vehicle trip tracking, vehicle miles tracking, passenger miles tracking, revenue and non-revenue miles tracking, vehicle maintenance and expenses, maintenance scheduling, reminders, vehicle downtime, drivers training, and billing.

4.3.2   The Survey Instrument

The survey instrument consisted of 28 questions, see appendix VI. The questions were formulated to cover the following areas:

- Vendor Information

- Software description
- Hardware requirements and compatibilities
- Operational functionalities (number of vehicles and trips, AVL/MDT compatibilities, support for GIS, etc.)
- Setup and training information
- Software and maintenance cost
- Licensing agreement

The questions were intended to be open-ended, leaving room for any issues that might have been important, yet not addressed by any of the questions.

4.3.3   Results

The eight completed interviews revealed that there is common ground among all vendors along with their software. These similarities are described below:

- Products have a Windows-based operating system
- Products are customizable
- Products export to common formats, such as ASCII, Dbase, Lotus/Excel
- Reported to support unlimited number of trips per day and vehicles
- Large number of reports that can be produced
- Most products can be interfaced with AVL, MDT

Beginning in the mid 90's, Windows has become the preferred Operating System (OS) in small and medium organizations since it is easy to understand and uses Graphical User Interface (GUI). As a result, most of the applications are created for Windows based platforms.

All software that is available on the market can (and will) be modified if the client requires it. This will result in highly customized software that can offer the most out of its original framework. Of course, there is a price that has to be paid for customized software, but with adequate expertise (the capability of clearly formulating the requirements and of requesting only those modifications that have a significantly positive impact on the operations) such investments can be cost effective.

The number of trips per day or the number of vehicles that the software can handle is, according to the vendors, unlimited. All vendors reported that their software does not impose limitations, as far as these two variables are concerned. However, database theory can provide some insight into the limitations of the software's underlying database. It studies the impact of the different database designs on the software's performance. When designing databases, an important factor is their size. A rough measure of database size is the number of rows (i.e. entries in a table) that is being stored. For paratransit, the best approximation of database size is given by attributes such as: number of trips per day, number of vehicles, and number of customers. Since different databases are designed for different sizes, when choosing paratransit software, one has to make sure that the underlying database is adequate for the size of operations. This is

especially important in the case of brokerage centers, which usually have a centralized database that stores information from all transit agencies. Considering these arguments, the best approximation of software reliability (from the database point of view) would be the maximum number of trips per day and the number of vehicles that the software is currently handling.

The number of reports that can be generated is overwhelming (tens and even hundreds). All systems come with a set of predefined reports, which in most instances are more that what is needed. These reports were built by software development teams based on requirements gathered from the transit agencies. They include general, operational and other kinds of reports. Besides the predefined set of reports, ad-hoc reports can also be generated using reporting tools. Crystal Reports is one of the most widely used reporting tools.

Another important area in transit operations is the capability of APTS systems to establish real-time communications with the dispatched vehicles. This is especially important for demand responsive trips. Hardware and software advancements have made getting real-time feedback possible. This is accomplished through the use of MDTs and AVLs (see section 4.5). Almost all software can interact with MDT and AVL using plug-and-play (that seamlessly integrate with existing system) modules. It is customary to have software modules that add such functionality to the core system, where each module adds a well-defined functionality. The best approach is to deploy the minimal (but core) system and add additional modules later (as the business grows).

Software development has radically changed, resulting in more sophisticated, easy-to-implement, and upgradeable software. There are many software applications available on the market for transit systems that would provide the needed functionality. The question remains, which is the best one?

4.4   Software

4.4.1   Definitions and Taxonomy

Software is the core component in APTS technology. It is the engine of such systems. There are many kinds of software that help organize and make operations more efficient. Starting with simple things, such as having a customer table or keeping a vehicle inventory to complex systems that perform route optimization and provide real-time automated communication with the dispatched vehicle, software is as different as these systems. These differences led to the need to categorize the software.
In this project, the research team will follow Stone's four categories (Small Urban and Rural Advanced Public Transportation Systems, 1999), described below:

- Off-the-shelf software
- Custom database application
- Semi-automated CASD software

- Fully automated CASD software

Off-the-shelf software is the simplest software offering the least functionality. It is comprised of bundled software that usually comes with the hardware purchase, usually some kind of spreadsheet. MS Excel is definitely the most widely used for this purpose. In-house personnel develop all applications. The complexity of such a system is dependent on the programming expertise of in-house personnel. Most transit agencies have implemented some kind of off-the-shelf software. This category is viewed more like an aid that would help ease daily work (especially paperwork).

Custom database applications can be characterized as tailored applications that were built by professional programmers using the same bundled tools. Common applications are based on Microsoft's ACCESS database, which is sold with the Office software suite. Such an application incorporates all functionalities offered by off-the-shelf software plus rudimentary functions to help the scheduling and dispatching process. This form of software is not very common among transit agencies. Examples of this kind of software are: *Transit Manager*, by Shah Software, and *SMV WI*, by Kernel Software.

Semi-automated CASD software is the next in rank. These applications are built on top of a database that offers even more functionalities than custom database applications. This category would include simplified versions of fully automated software (to be presented), such as Pass-Lite, which is a simplified version of Pass. Some of these systems can be interfaced with MDT/AVL technologies after adding one or more additional module(s) to the core application. They usually incorporate a simplified scheduling engine, which is a set of algorithms that maximizes vehicle usage (revenue-miles).

Fully automated CASD software is the most complex type used by transit agencies. Being the core component of the APTS, they are built on scalable databases (back-end) destined for large applications, such as SQL Server, Oracle, DB2, etc. Users interact with the software through screens (referred to as front-end). Most importantly, they provide a complete and sophisticated scheduling engine. These applications can be interfaced with MDT, AVL, Computerized Voice (IVR), and SmartCard technologies based upon the insertion of the corresponding module.

4.4.2   Functionalities of CASD Software

The software analysis was conducted assessing various functionalities, which could be grouped in two main areas:

1. Operational functionalities, and
2. Coordination and brokerage capabilities.

The first area incorporates most of the quantifiable functionalities. The second area addresses the software's capability to operate as a central application where all scheduling and dispatching operations are done by one system, placed in the brokerage center.

Typically, fully automated software would support both types of functionalities. However, semi-automated and custom database applications would not support all of these functionalities, especially the brokerage ones.

4.4.2.1. Operational Functionalities

Operational functionalities are one of the most important facets of the CASD software. They replace the tedious work conducted by call-takers, schedulers, dispatchers, and sometimes drivers and mechanics.

Client registration – Provides operators (i.e. call takers and schedulers) an easy way to handle the client registration process. Data is entered *live* while the customer is on the phone, which is saved in the database and therefore accessible. Most of the interfaces allow operators to gather all necessary information about the client, including types of disabilities, need for attendants, eligibility codes (e.g. Americans with Disabilities Act), as well as non-standard comments or notes about the customer (such as his or her wheelchair does not fit through the front door).

Trip booking – This operation facilitates the booking of both demand responsive and subscription trips. CASD software substantially simplifies this process by automatically displaying all information necessary to book trips for customers (e.g. common addresses, funding sources, whether an attendant is required, etc.).

Scheduling – Semi-automated and fully-automated paratransit automatically assign passengers to vehicles optimizing vehicle usage. Subscription trips are scheduled in a batch mode, where all trip requests are assigned to vehicles. Demand response trips are inserted into the existing trip schedule. In both cases, complex methods are used to compute the optimal way to assign trips to vehicles. Without software, this process requires the attention of many experienced scheduling personnel (depending on the size of the operation).

Dispatching – Depending on the sophistication of the CASD system, the dispatching functionality can vary from handing printed schedules to drivers (driver's manifest), to having the software automatically send to the driver the schedules along with instructions, and fully monitoring all the dispatched vehicles and trip status. Some of these functionalities require vehicles equipped with MDT/AVL.

Billing – This functionality generates the bills for trips according to a set of predefined rules. The rules can specify single or multiple sources of funding, a flat rate, or a combination of these. Also, agencies can set up geographical boundaries with different flat rates, in which case the software will apply the corresponding fare in computing the bill. Whatever rules apply, the software will automatically generate all necessary bills based on trip and customer information stored in the database.

Reporting – A myriad of reports can be generated by the software, such as client, operational, and administrative reports. Besides the predefined reports, ad-hoc reporting is also available, in which case reports containing any information in the database can be generated. This functionality makes it easy to monitor performance factors and gives management accurate and summarized information facilitating better decision-making.

Other non-critical functionalities are also available, such as Incident reporting, vehicle maintenance, or even functionalities that allow clients to view and cancel their schedules over the Internet or by using the Interactive Voice Response feature. For an additional cost other custom features can be built into the system, based on client requirements.

4.4.2.2. Coordination and Brokerage

The state of the art system might involve one call/data center (that might evolve into a full fledged brokerage center) per region, or one per state, in which all transit agencies would perform their scheduling and dispatching operations. This system cannot exist without powerful software and hardware to handle these operations. Since there will be more agencies participating in the brokerage system, the software would have to be able to generate separate batch schedules for separate covered areas, for separate agencies. To implement this, each agency would have its own database located on a file server that is part of the central system. In the same manner, there will only be one software application, most probably located on an application server, in the same location. To carry out their daily operations, agencies will access the system over the Internet or Virtual Private Networks (VPN).

For a better understanding, one can regard the system as a circle with databases pertaining to agencies as slices from that circle. Even though agencies will access the same system, it will "look and feel" as if they have their own system, installed on their terminals. The most important advantages of having such a system are:

- Easier software installation
- More cost-effective training
- Maintenance and Service costs are lower
- Fewer IT personnel are needed.

In other words, the total cost of ownership is smaller if the system is installed in one central location (call/data center) rather than installing it at all sites. Besides these immediate advantages, intangible benefits can be identified as well (e.g. the ease of implementing a standard reporting system), that will add value to a call/data center.

4.4.3   Comparison and Differentiation

Considering the functional similarities among the software packages, the research team needs to identify other attributes to efficiently screen the products offered by the vendors.

The research team has identified attributes such as:
- Software cost
- Training (both initial and extra)
- Maintenance fees and services included
- Customer support
- Licensing agreements
- Pricing flexibility

Most of these attributes are quantifiable, but there are also attributes that cannot be quantified. Customer support is reportedly good for all companies. However, the only way to find out the quality of customer support is to get a feedback from operators that have implemented the software. Also, all vendors employed a flexible pricing scheme, if the deployment would be statewide.

4.4.3.1 Software Pricing

The introduction of a CASD system will result in a wide range of costs. Some of these are intangible costs and therefore harder to quantify. The *Total Cost of Ownership* sums up all the expenses related to IT infrastructure. This metric gives a dollar value to variables such as hardware/software costs, operations, administration, reflecting the costs involved in having an IT system in place. Computing the *Total Cost of Ownership* is beyond the scope of this project, but it is an analysis that MUST be done prior to purchasing and setting up an IT system.

The two major expenses with software are the initial **price** and recurring **maintenance fees**. The following table compares the software prices reported by the vendors
.

Table. 4.1 Software Pricing

	Software Price	
Vendor - Software	**Minimum**	**Maximum**
RouteMatch - XP, PM, TS	10,000	100,000
Trapeze - Pass	40,000	50,000
Trapeze - Pass Lite	10,000	20,000
RouteLogic - ParaLogic	34,000	34,000
Teleride - Transview	30,000	50,000
Multisystems - Midas PT	40,000	50,000
Shah Software - Transportation Manager	10,000	10,000

StrataGen - Adept	50,000	250,000

The listed prices in the table are rough figures, used only for estimation. Real prices vary from implementation to implementation. Typically, the final cost of the software is determined after the customer needs are assessed so that the vendor will precisely know his or her software configuration. In some instances the core module will be supplemented with additional modules, resulting in a higher final price. Consequently, Table 4.1 contains a wide range of prices.
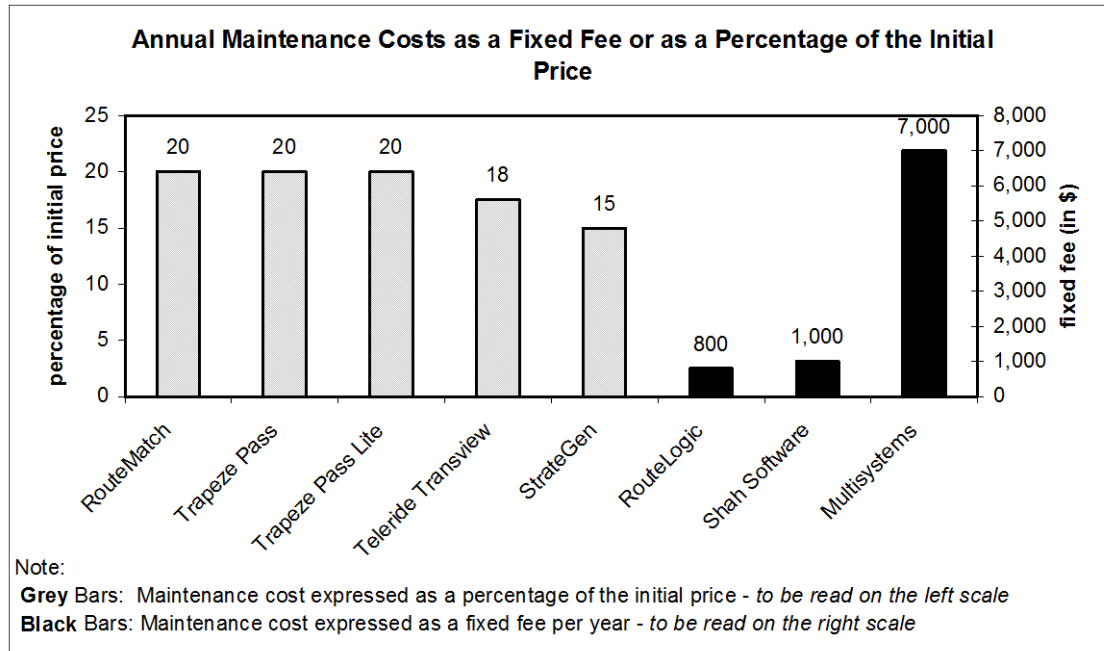
4.4.3.2   Maintenance

Software maintenance is the means by which technical support is provided, system upgrades are done or bugs are fixed. Technical support is usually provided through 1-800 numbers, email or web support. On-site assistance, for major breakdowns or problems that cannot be resolved using other means, is also available for an additional fee. Dialing into the system can also be done using software like *PC Anywhere*. This methodology offers direct and full remote access to any computers connected to the Internet. By using this technology, virtually all problems can be solved, since the vendor has a mirror of the computer in trouble, therefore being able to "see and feel" all the potential problems.

Software upgrades are usually categorized into minor and major upgrades. Usually major upgrades are released on a yearly basis and contain major enhancements, bug fixes, security upgrades, or even new functionalities. Minor upgrades differ from major ones only in scope. Both of these can be deployed by using the conventional methods (e.g. floppy, CD, or ZIP) or by using the Internet as a medium for file transfer.

Maintenance is computed either as a percentage of the initial price or as a fixed price per year. Figure 4.2 shows the maintenance pricing practices of the surveyed vendors. In the figure, gray bars are read on the left scale and black bars on the right scale.

Fig 4.2 Maintenance Costs (computed as a fixed annual price and as a percentage of the initial price)

Annual Maintenance Costs as a Fixed Fee or as a Percentage of the Initial Price

Note:
Grey Bars: Maintenance cost expressed as a percentage of the initial price - *to be read on the left scale*
Black Bars: Maintenance cost expressed as a fixed fee per year - *to be read on the right scale*
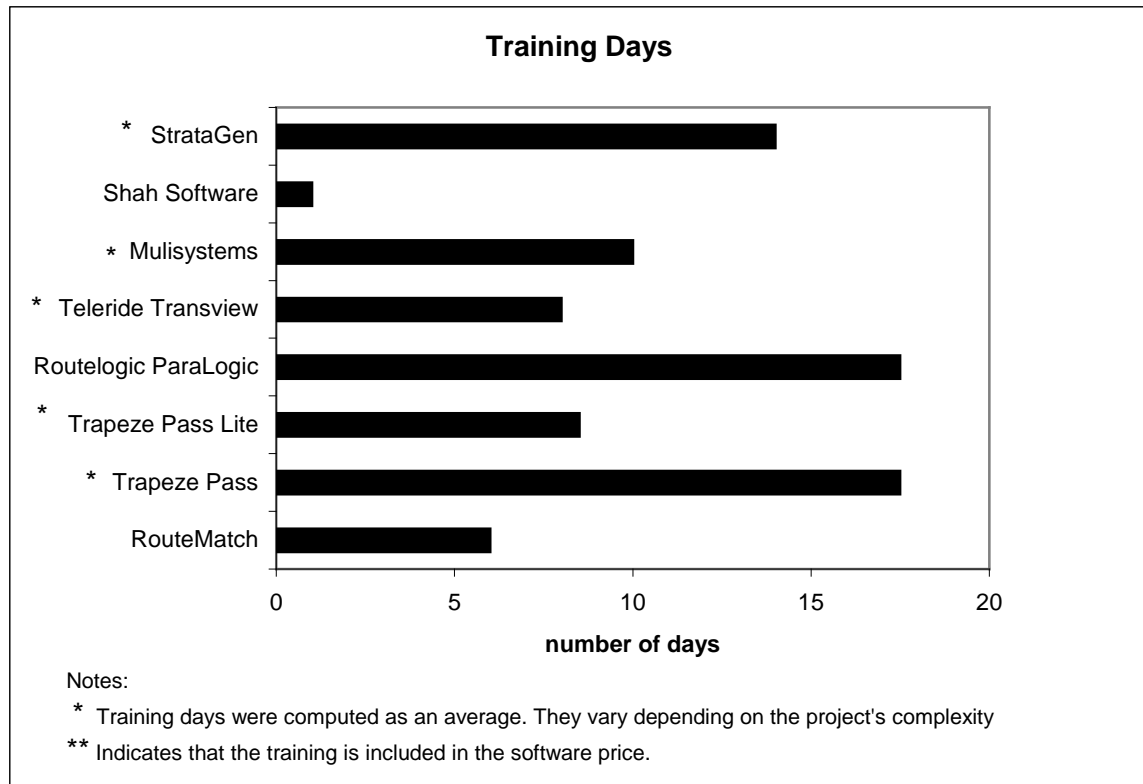
4.4.3.3   Training and Support

Training and support are part of any system implementation and their importance is positively correlated with the system's complexity. Resistance to change has to be acknowledged and dealt with since it is the difference between success and failure. The key to success is to make users comfortable in using the system, which can be achieved through proper training. Vendors are aware of the importance of the training phase in software development and recommend regular training sessions. Well-trained users result in less maintenance and support that leads to savings in post-implementation spending.

Figure 4.3 displays the number of days users are trained. Some systems include training in the software price.
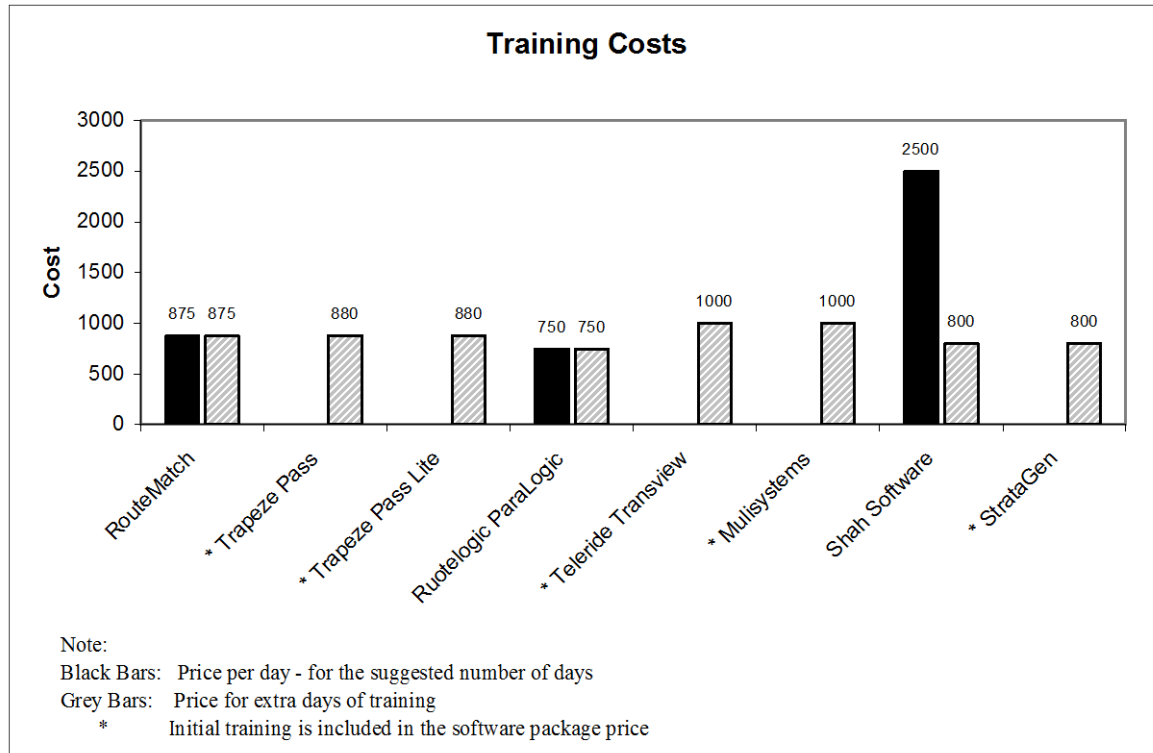
Fig. 4.3 Training days

Training Days

Notes:
* Training days were computed as an average. They vary depending on the project's complexity
** Indicates that the training is included in the software price.

Additional training can be provided when needed. Pricing of additional training days is mostly the same as the regular cost per day, with some exceptions. Figure 4.4 compares initial and supplemental training prices. The amounts displayed in the figure represent the price per day exclusive of the on-site expenses that have to be paid by the user.

Surveyed vendors noted the importance of pre-training skills. Users should be familiar with the MS Windows environment since systems are built on this platform. Prior to taking transportation software training lessons, users should be familiarized with concepts such as screens, cut/paste, minimize/maximize, or menus. This can be achieved by providing training sessions before installing the transportation software. In some cases, providing regular training sessions (e.g. twice a year) is useful because of high employee turnover, especially among dispatchers and schedulers.

Fig. 4.4 Training pricing

Training Costs

Note:
Black Bars: Price per day - for the suggested number of days
Grey Bars: Price for extra days of training
      *   Initial training is included in the software package price

4.4.3.4 Software Licensing

Licenses are legal agreements between user(s) and vendors. They grant the beneficiary usage rights according to the terms specified in the agreement. License agreements for transportation software specify the usual terms and conditions (clearly defines the terms *software, user, etc.*, specifies that users cannot copy, redistribute, reverse-engineer, etc., the software) and they also specify restrictive conditions such as: number of users, number of nodes it can be installed on, number of trips it handles and so on.

Table 4.2 shows the criteria in each of the License Agreements (LA) that vendors use when selling their products.

Table 4.2 License Agreements

RouteMatch Software	Number of users using the software concurrently. They can also sell software for single users.
Trapeze Software	Number of workstations the software is installed on and the number of trips/day the system will handle.
Teleride Inc.	Number of workstations the software is installed on. Additionally, license agreements for *MapInfo* can be provided in case the user does not have one.

RouteLogic	Number of workstations the software is installed on. The license agreement is transferable as long as the total number of users is not bigger than what is specified in the LA.
Shah Software	Number of users (sites installed on). No reselling is allowed.
Multisystems Inc.	Number of users using the software. Also the license agreement is transferable.

4.5   Hardware

Hardware plays an increasingly important role in paratransit. It allows agencies to establish real-time connections and communications with the dispatched vehicles enabling agencies to cut dead-miles and maximize efficiency.

4.5.1   Existing Technologies and Integration

There are many hardware technologies available that can optimize transportation. Of special interest for paratransit are:

- Mobile Data Terminals (MDT)
- Automatic Vehicle Location (AVL)
- Smart Cards

Mobile Data Terminals – Devices that can display short messages received from the dispatching center (e.g. pick up Mr. Jones from home at 10:00am). Drivers can use pre-configured buttons to send pre-recorded messages to the center (e.g. accepted to pick up Mr. Jones) giving software information about trip status. This way software can accommodate more demand-response trip requests because the itinerary and vehicle occupancy can be determined and therefore lead to more precise scheduling capabilities. Depending on the sophistication of the MDT, other functionalities are available, as well.

Automatic Vehicle Location – Devices that provide MDT features plus global positioning. Exact vehicle location can be determined by using GPS technology. This feature provides improved dispatching efficiency, improved reliability, and also improved response times to disruption in service (e.g. vehicle breaks-downs).

Smart Cards – Swipe cards with built-in chips that have high storage capacity (relative to the magnetic card), a central processing unit, and an operating system. The storage and processing capacities are used for holding all necessary information about passengers (demographics, disabilities, fares, eligibility information etc.).

Apart from the above-mentioned devices, other hardware devices are being used to provide primarily the same functionalities. Whereas the functionalities offered by the more sophisticated devices increase an operations' efficiency, the price can be a big

impediment, especially for rural transit agencies. In this case, cheaper substitutes have proved to be efficient and cost-efficient.

Personal Digital Assistants – Can be used as a communication medium and location-positioning device. Using the XML (Extensible Markup Language) standard, the software can communicate with hardware devices, making it easy to adapt them for paratransit operators. Pagers, Internet capable cellular phones, or commercial mobile radios also provide cheaper communication alternatives.

With today's technological advances the market offers a wide range of technologies, which can provide for the needs of each transit agency. These can be combined to get the most out of each, resulting in a cost-effective, functional system. The following two examples illustrate the fact that readily available technologies may provide relatively inexpensive peripheral hardware, especially if the need for real-time scheduling remains low.

The first design is a combination of a personal identification card reader and a PDA. It allows the PDA to be inserted in the card reader containing the interface connector. When the card is swiped through the reader, data is stored directly into the PDA. Application software is available. A pass through the connector allows insertion into the PDA cradle for downloading or charging without removing the PDA card reader. The available designs claim that no batteries are required and that power drain to the PDA is minimal, since the inactivated card reader is in sleep mode. The second design can be coupled with the first one to provide an inexpensive AVL alternative. This design consists of a GPS receiver with a flash-card interface to communicate with a PDA.

4.6   Conclusions

There exists a wide range of software to satisfy all needs. Scheduling and dispatching software is so complex that feature-by-feature testing is needed to determine the most suitable software. Generally, vendors will agree to provide a copy of the software for pure testing purposes.

A good matching is needed. Transit agencies with simpler operations need simpler software whereas those with more complex operations need more complex software. Although peripheral technologies such as MDT and AVL are not necessary for smaller operators that rely heavily on subscription and advance registration trips, advancements in communications technologies may offer inexpensive alternatives that could be deployed early on in the CASD hardware and software implementation cycle.

Procurement, installation, and maintenance should be planned for and performed at the statewide level to benefit from economies of scale.

The deployment process has to be supervised by a knowledgeable entity (e.g. an IDOT group, a third party, etc.) that can provide guidance and ensure that established milestones are accomplished.

Chapter 5 – Survey of Rural Public Transportation Providers

5.1   Introduction

After state surveys and vendor interviews confirmed the variety of approaches to CASD implementation and support, the next step was to interview paratransit operators to assess the degree of operator interest in CASD systems and their readiness to implement such a system. The operator visits revealed a wide variety of the operators' computer capabilities, as well as management and staff's interest in CASD systems and perception of the need for the software.

5.2   Methodology

5.2.1   Provider Selection

A number of organizations provide transportation services to the general public throughout Illinois, including taxi companies and social service agencies as well as regional public transportation districts. The research team visited each 5311 operator to evaluate their technical aptitude and determine their readiness for CASD implementation.

Currently there are numerous 5311 providers within the state, and it was unnecessary to visit all of them. In order to obtain an accurate assessment of the total provider base, nineteen agencies were chosen for on-site visits. They were located throughout the state of Illinois, and were chosen based on whether they received 5311 funding and the size of their fleet. At least two to three providers were chosen from each of the size groups. It was important to analyze a diverse group of agencies based on size in order to understand the differences and/or similarities among them.

In selecting which agencies to visit, the research team considered the ways in which various agencies provided service. The various Section 5311-funded providers include hospitals, retirement homes, and taxi services. The team visited a provider from each category so that no differences in operation or sophistication would be overlooked. In the process, the team found that for many of the agencies, the transportation services division was actually a small facet of the overall responsibilities performed by the providers. Services such as job training, family services, or even food distribution are the main missions of these organizations.

5.2.2   Survey Instrument

The research team developed several survey instruments to determine the operations performed by each individual agency and how they were performed. During each interview, the survey instruments were used to frame a discussion of the agency's central mission and the role of computers and software in the daily tasks of both management, and scheduling and dispatching personnel.

The management survey was used to obtain information from the perspectives of the supervisors and other management personnel. This survey instrument included questions relating to management's familiarity with computers, their daily responsibilities, their opinions on service coordination, and their level of comfort with the idea of a CASD system.

A dispatcher survey was created to evaluate the knowledge and skill levels of the call takers and schedulers within the agencies. These surveys included questions relating to the scheduling and dispatching personnel's day-to-day activities. Both surveys were designed to help the research team evaluate the user's technical sophistication and enthusiasm toward a CASD program.

The technology survey was used to conduct an assessment of the agency's use of technology. The computing facilities and other technology in each organization were inventoried, including a census of computers, printers, copiers, fax machines, etc. available in each office. The inventory noted the existing operating system and level of computer complexity used in each organization.

The survey instruments are shown in Appendices VII, VIII, and IX.

5.3   Analysis of Agencies

Before visiting these nineteen agencies, they were placed into three separate categories. The first category was considered a large operation. Several were chosen with a fleet size ranging from 31 to 58 vehicles. The mid-size category ranges in fleet size from 11 vehicles to 30 vehicles. The last category included the smallest fleets ranging from 1 to 10 vehicles, with the average being 8.5 vehicles. The average fleet size of all agencies surveyed was 16 vehicles, and the average number of trips dispatched per day was roughly 300. Table 5.1 identifies certain characteristics distinguishing the three categories of agencies.

Table 5.1 Agency Characteristics

	Small Operation	Medium Operation	Large Operation
Number in Sample Visited:	10	6	3
Fleet Size	1-10	11-30	31-58
Avg. # trips/day	100	200	700
Provides only Transportation vs. Many Services	Typically involved in many services	Typically involved in many services	Typically involved in transportation only
Avg. # of vehicles dispatched/day	8.5	12.5	42.5
Avg. # of Sponsors	3	10	50
# of Computers	3	9	15
Avg. # of Employees (Total) vs. Transportation	30/14	114/20	60*

Level of Computer Expertise	Various	Minimal	High

Notes: * The number of employees for large operations are smaller than the total number for medium operations because the three large operations only offer transportation, medium operators provide many services in addition to transportation.

Smaller agencies reported providing anywhere from 30 to180 one-way trips per day, and only one or two demand responsive trips per agency per day. The larger agencies provided anywhere from 600 to 1000 subscription trips per day, with typically 25% of the trips being demand responsive.

Medium sized operators did not focus their complete energy on the transportation element of their business. It was actually a very small service that was provided and was not a main priority for the organization. The majority of their attention focused on human services such as counseling and rehabilitation for the people with disabilities and the elderly. Transportation was then provided to those patients that needed assistance traveling to the destinations that provide those services, whether it is with the provider's organization or an outside location. Smaller operators acted similar to the medium sized operators. Many of them were actually a subsidiary of a larger agency, such as a retirement home. The department itself concentrated solely on transportation and had few employees, but the organization, as a whole was much larger.

5.3.1 Services Provided

Subscription service and contract routes constitute the majority of service provided. The greatest portion of the typical providers' clientele is subscription service for frequent users who typically use transportation for routine scheduled medical visits or trips to the grocery store. Demand responsive service constitutes 25% of the typical providers' business. This is shown in Figure 5.1.

Figure 5.1 Percentage of Service Provided
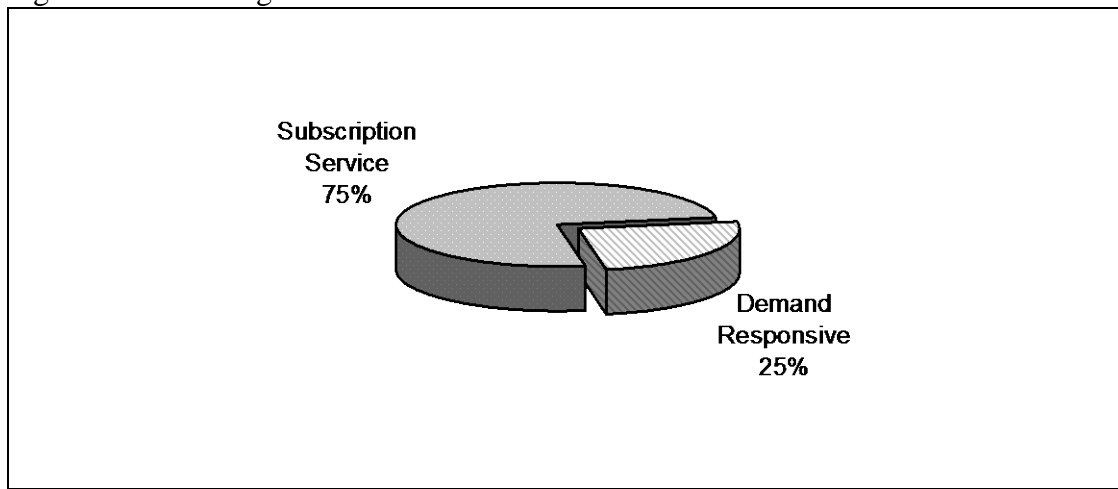
All of the agencies provided service within one county or a neighboring county in their service area. Almost half of those agencies provided transportation to neighboring counties only for medical purposes. The exceptions were the larger regional transit operators, Rides Mass Transit and South Central Transit. These operators have a greater service area, and the size of their operation and the number of vehicles enable them to provide transportation more frequently and to greater distances away from their hub.

Figure 5.2 shows the percentage of those agencies that provide service primarily to their own county vs. those that provide service in other counties in addition to their own.

Figure 5.2 Identification of Service
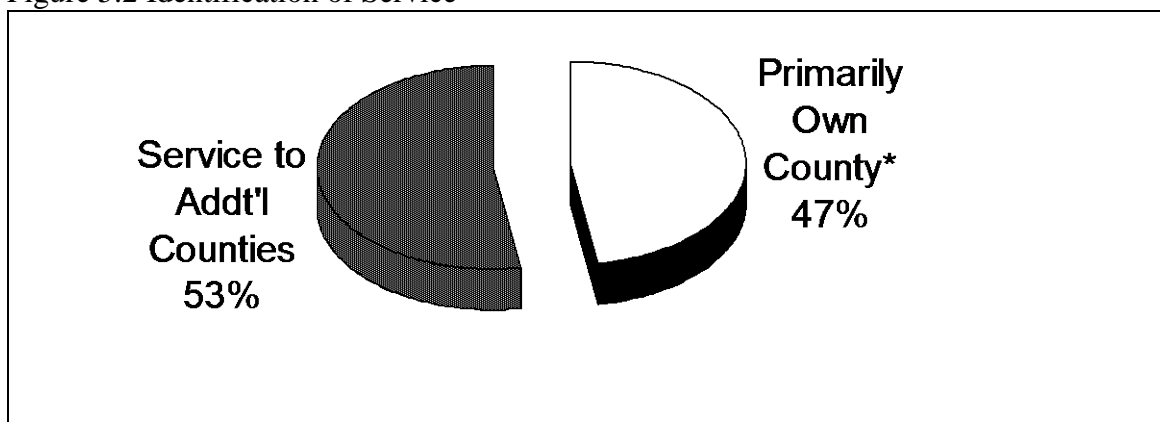
Notes: *Provides service within county borders, but will travel to neighboring counties in special circumstances (medical visits, etc.)

In order to dispatch their vehicles to the proper location, all agencies provide a call taking and scheduling procedure. Typically, for the subscription service, the run sheets are developed a week in advance.

The demand response calls are dealt with differently. Initially, the client calls into the agency, which is answered by the person who develops the driver manifest or run sheet. Generally, the client provides their name, address, date of birth, and destination. Some agencies double-check to confirm the address or paying sponsor, and their ADA eligibility. However, most of the clients are repeat riders so their information is stored in the computer. The caller usually needs to give their name so that the information can then be accessed either on the computer or through a reference card. If the caller is a new client, their information is then taken and stored either in a Word document, or added manually to a list of client files. Agencies reported having, on average, two new customers per week.

Typically, the various drivers' run sheets are then identified in order to assess who is in the area and/or who is capable of picking the client up. The call taker usually reaches the driver by a two-way radio. The information is then repeated, and the driver writes it

down in their personal manifest. This often generates a lot of unnecessary and duplicate paperwork.

5.3.2   Scheduling and Dispatching

A closer look at the way agencies perform their operations revealed three types of operations:

The first type, the most complex, uses CASD software to carry out all operations. Calls are received by call takers/schedulers/dispatchers, who use the screens provided by the CASD system to schedule and dispatch. Basically, operators fill out the screens, and the system then inserts the schedule and dispatches the run. This is done in batch mode for subscription trips and "on the fly" for demand-responsive trips. Contact with the drivers is maintained through radio and/or mobile phones. Report generation is a button-click away, since all the information is stored in the CASD system's database and all the necessary reports are built into the system. Currently there are only two agencies that were visited that were using this type of system, and one of them is a taxi service. These two agencies are Barry's Taxi and South Central Transit.

The second type uses both computers and manual processes. Computers are mainly used for storing information about customers, trips, and vehicles. Scheduling and dispatching are done manually. Typically, when a call arrives operators store customer and trip information into the computer (in a spreadsheet or a small database). At the end of the day an experienced scheduler/dispatcher prepares the driver manifests for the next day. Reports are generated easily since the data is stored in electronic format. However, some reports, that require summarized data or span longer periods of time, might take more time to prepare because there are no readily available reports built into the system. Communication with drivers is mainly done with two-way radios and mobile phones or payphones.

In the last type, operations are performed manually. In this case, operators take the same information, but use ledgers or "run" sheets to store client information. At the end of each day the scheduler/dispatcher uses this information to generate drivers' manifests, which will be picked up by the drivers the next day. Reports usually take longer to prepare because another person would have to take the ledgers and input all data into spreadsheets and then summarize and generate the needed reports. This is usually done every other week, or as often as reports are needed. In one case, as demand response calls were taken, the trips were manually written on at least two different calendars. This created a large amount of overlap and redundancy. However, communication methods are the same as in the previous two cases.

Table 5.2 represents the number of agencies found by the investigating teams in each category that is listed above.

Table 5.2 Number of Agencies in Each Category

	CASD software	Mixed (computer & manual)	Manual
Team 1:	1	2	3
Team 2:		2	5
Team 3:	1	2	3

5.3.3 Reporting and Billing

All agencies must submit a variety of reports to various granting agencies. Each team attempted to determine the type of reports that the agencies must submit and to gain an understanding of the time and effort involved in preparing the reports. Table 5.3 identifies the various reports that are submitted by agencies.

Table 5.3 Reports Submitted by Agencies

1. Operational Reports (Scheduling, training, gas mileage, status of buses, inventory, etc.)
2. Maintenance Reports
3. Cost/Performance Reports
4. Financial Reports
5. 5311 Requisitions (Quarterly & Annually)
6. Job Access Grants
7. Monthly Board Reports
8. Federal & State Reports (IDOT, IDHS, WAAA, etc.)

The most common reports agencies submit are the quarterly and yearly 5311 requisition reports. Agencies also prepare regular fiscal reports. Agencies receiving Job Access Grants must prepare a report on the expenditure of those funds. Many agencies also prepare various operational reports and ad-hoc reports, which do not have to be submitted to the state.

There is a wide gap between automated and manual reporting. Three of the operators reported fully automated reporting systems. Most of the other operators use some automation, typically using spreadsheet software. One reported using a typewriter for the final stage of report preparation. Unsurprisingly, operators with non-automated reporting systems were the most likely to be dissatisfied with their reporting systems. Figure 5.3 represents these findings.

Figure 5.3 Method for Maintaining Billing Records
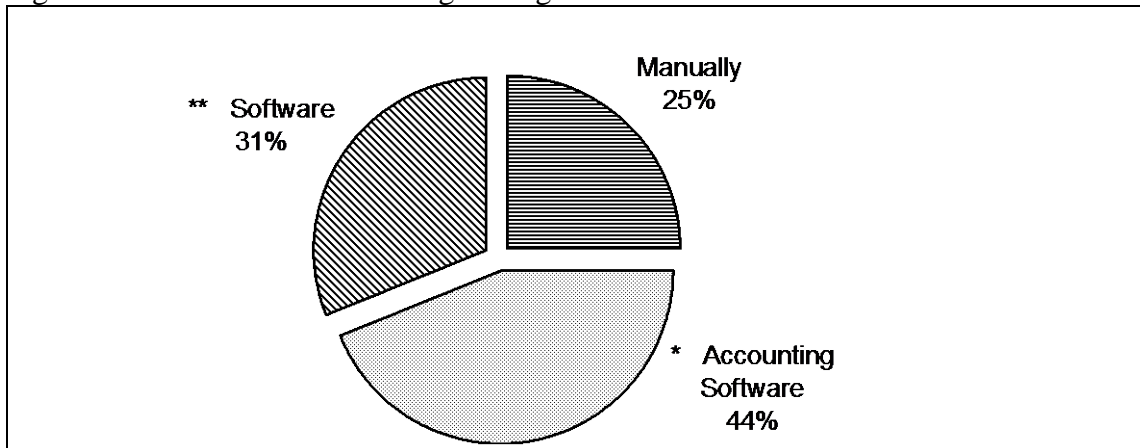
Notes:
      *   Accounting Software: QuickBooks / Peachtree
      ** Software: Any software except from the above mentioned

      The effort and time involved in producing reports vary among agencies. For agencies that have CASD systems in place, generating reports is as simple as pressing buttons. Reports are usually generated in hours, even minutes. For agencies without CASD systems or other streamlined data systems, reporting is a much more involved procedure, requiring considerable expenditures of time and effort to gather and summarize data and assemble it in the required format. Figure 5.4 shows the time needed to prepare reports.

Figure 5.4 Length of Time to Prepare Reports
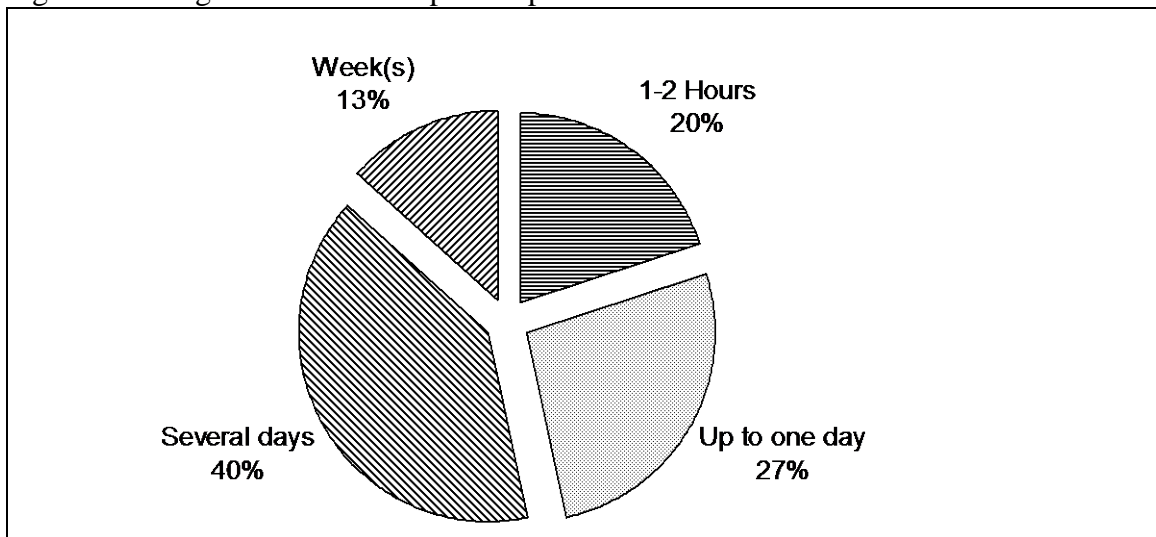
      The non-CASD-using agencies reported that the time required for reporting ranged from one or two days at the low end to one or two weeks (in the case of agencies offering other programs) and typically required more than one person. While some agencies seemed to exaggerate the time required, it was clear to the teams that most

operators, found reporting to be an unpleasant chore, compounded by the variety of reports and grantors.

CASD systems have the potential to make report generation simple and quick. Once all necessary data is in one place, getting the right report is a matter of constructing a reusable data query.   This is usually done prior to installing the system. This advantage would be lessened if the agency uses a variety of software along with CASD systems, such as accounting packages, that do not easily share data with each other.

Primary billing is a significant issue for transit agencies. Some operators work only with one or two sponsors (funding agencies), while others have as many as thirty. Handling billing manually is manageable for the first category, though a computerized system would make it more efficient and perhaps more accurate. For the second category, billing must be an automated process. Some operators bill manually, keeping ledgers and possibly using word processors or spreadsheets to send them. However, most of them use accounting applications (i.e. QuickBooks, Peachtree, etc.), or billing modules of CASD software. Once again, when considering CASD systems, attention must be paid to how it will integrate with other software. Figure 5.5 illustrates the number of sponsors per agency.

Figure 5.5 Number of Sponsors
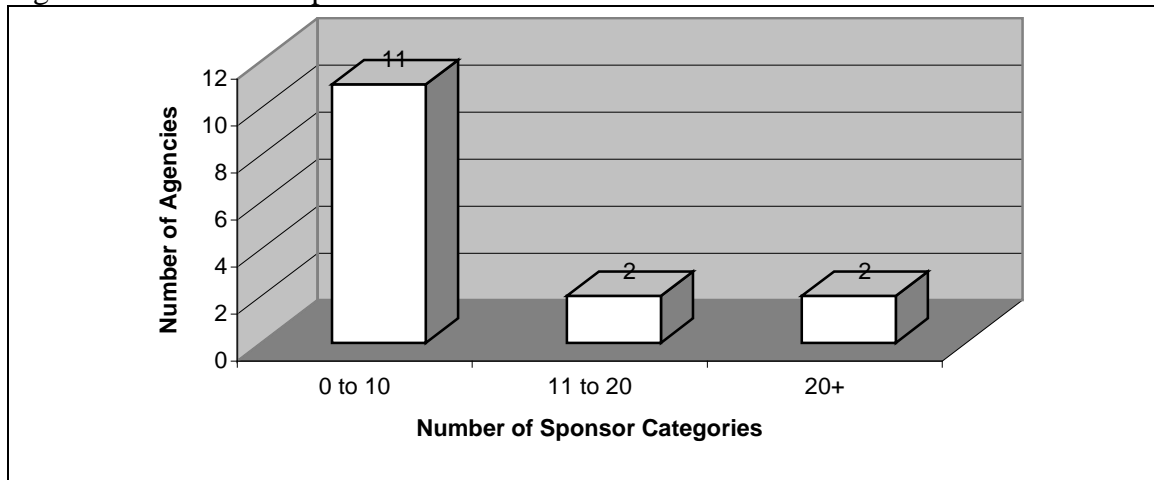
Notes: *The sum of the agencies does not reflect the total amount visited, due to the lack of information provided by the excluded agencies.

5.3.4   Complaint Procedures

All of the large agencies had a formal complaint process. Most agencies with a small number of vehicles and employees reported some sort of formal complaint process, although many interviewees felt that an informal process was sufficient and appropriate for their level of personal service. Eight of the operators reported a formal complaint process that included some sort of form or procedure. One larger operation reported a procedure with formal investigations of all legitimate complaints. Five smaller operators

reported informal complaint procedures. Figure 5.6 shows the claim procedures. In each case, the initial employee to field a complaint is usually the call taker/dispatcher. If this person could not resolve the complaint, it would then likely be passed to a manager.

Figure 5.6 Operator Complaint Procedures
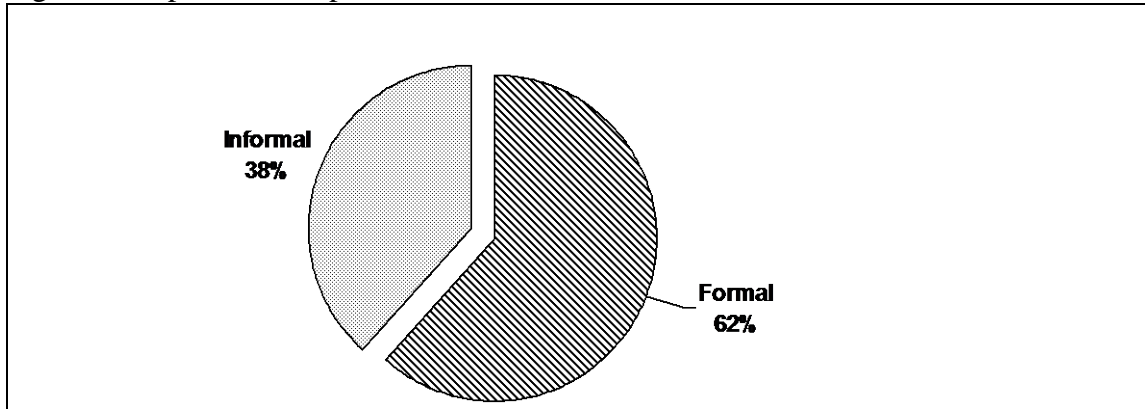
5.3.5   Advance Notice Requirement for Scheduling

        All providers preferred to receive requests at least one day before travel was needed, although most were flexible with this policy if short notice trips could be fitted into the day's departures. Larger agencies tended to discourage last-minute requests, suggesting that in more populous areas, the level of demand was fast approaching what operators can meet with their existing equipment and scheduling systems.

        All but the smallest organizations reported having multiple phone lines available to handle more than one customer call at the same time. The larger organizations typically had a holding or queuing system for the calls. A few of the smaller systems reported having only one line available, with one of those having no voice mail or any way for the operator to return a missed call. Most offices with computers available typically had most non-driving employees using computers at some point in their workday. Due to the growing demand, the larger agencies required up to 14 phone lines. However, the average number of phone lines needed for smaller agencies was much fewer; most needing only three lines. All had the ability to put clients on hold. All reported minimal loss of customers, because they were able to answer almost all phone calls or place their clients hold. Customers would usually call back if left on hold for too long.

5.4   Technology Related Issues

5.4.1   Software Used

        All but one organization reported at least one computer in use at the office. The highest number reported was twenty in the largest operator, with a typical operator using

two or three computers. Most offices with computers had some form of computer networking available. Word processing and spreadsheets are the most commonly used applications, typically Microsoft Excel and Word. A few operators also reported using database software such as Access. Figure 5.7 provides a better representation of this issue. Table 5.4 identifies the tasks performed by employees that use these applications.

Figure 5.7 Percentage of Operators Using Different Types of Software
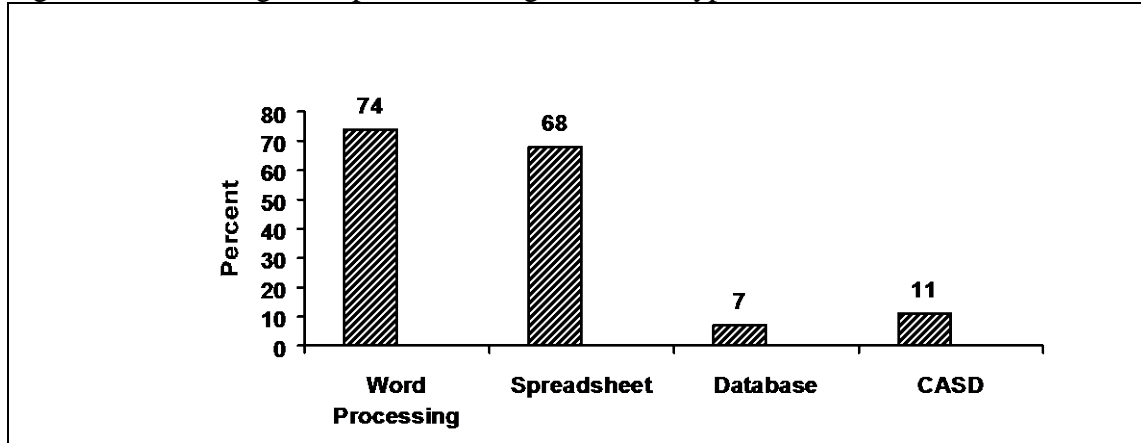
Table 5.4 Tasks Performed

Type of Task:	% of Respondents
Work Processing/Microsoft Office (i.e. customer files, fare keeping)	78%
Accounting/Billing/Bookkeeping	83%
Scheduling and/or Dispatching	27%
Reports to Agencies	44%
E-mail/Internet (MapQuest)	38%

5.4.2   Computer Support

        Small providers typically had no specific arrangements for external computer support, often relying on an informal network or volunteers to handle computing needs. However, as these were typically the least computerized operations, this level of support is likely sufficient. The larger operators tended to have some sort of contracted support available, which was either through their corporate office or through a licensed software/hardware distributor. Ten out of the nineteen agencies had access to either one or two in-house computer experts who could address most support needs, or were able to contact a neighboring college student for further assistance. If a problem with hardware arose, the vendor could be contacted. Surprisingly, two agencies acknowledged using a brother-in-law of an employee or a friend of the company for software/hardware support. None of the interviewees reported any trouble getting computer support when needed.

5.4.3   Computer Skills/Expertise

Most of the agencies that were visited used computers for billing and reporting, at the very least. The percentages can be seen in Figure 5.8. Three managers reported that employees had very minimal computer skills. For the rest of the agencies, the managers were generally satisfied that the employees' skills matched current job requirements, and a few were very complimentary of their employees' skills. When the managers and dispatchers were asked about their level of comfort using computers, generally the answers were positive. Most employees use computers both at home and in the office on a daily basis and are also familiar with using the Internet. The general feeling towards the future implementation of a CASD system is positive, because most are willing to be attend further training sessions in order to become familiar with computers and the system. Employee computer expertise is shown in Figure 5.9.

Figure 5.8 Agencies Using Computers
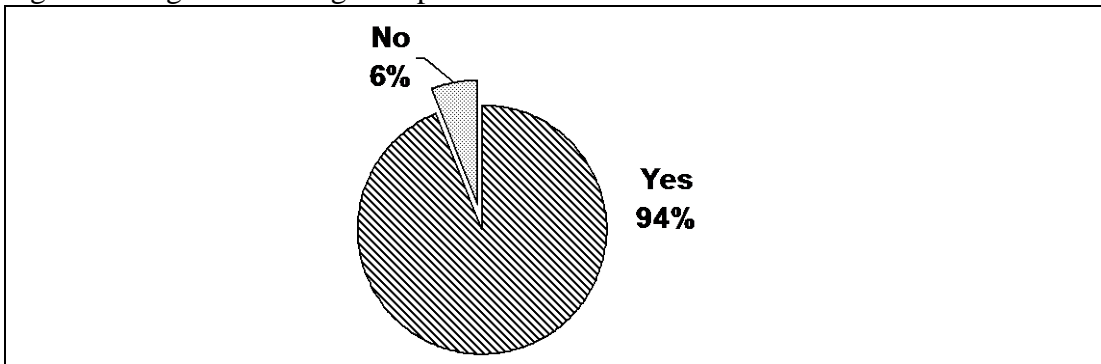
However, most of the employees that were in this survey lacked the expertise that would be required to operate a CASD system. The extent of their computer knowledge consisted of monotonously inputting data into Microsoft Excel or Word spreadsheets. On occasion, they would use templates designed for generating specific reports for various agencies, such as IDOT or IDHS. In addition, some agencies used Quickbooks or a Lotus spreadsheet for their accounting needs, but nothing beyond that. Few to no employees were knowledgeable about the programs themselves. An employee of one system downplayed her level of computer knowledge: "Almost anybody is smarter with computers than I am."

Figure 5.9 Employee Computer Expertise
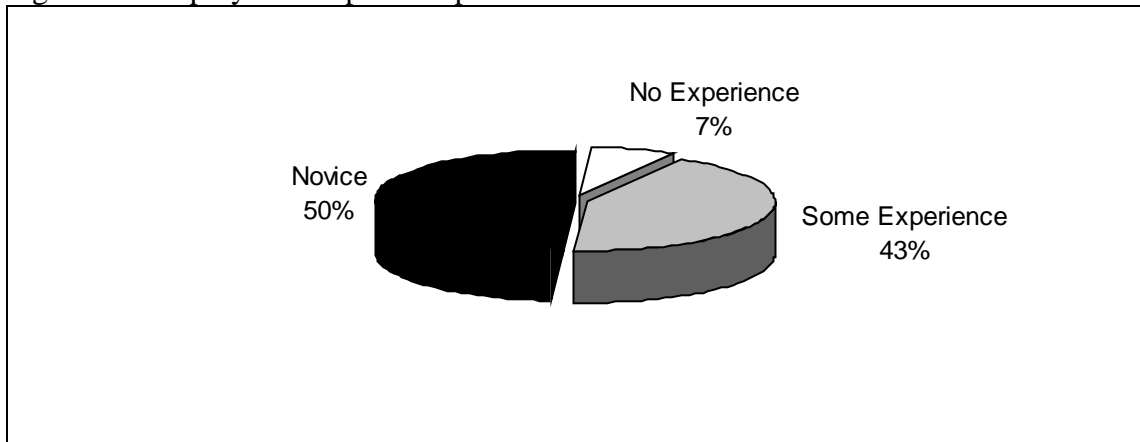
Unsurprisingly, respondents with higher levels of computer expertise were more likely to have a higher level of acceptance of new systems. Those who reported a low level of computer expertise tended to also think negatively about CASD systems, and were also less favorable toward attending training sessions. Of the 19 agencies surveyed, eleven reported a strong disinclination towards implementing CASD.

5.4.4   Managerial Computer Expertise

Implementing a CASD system requires more than merely installing the software. It is a complex undertaking, which in most cases results in re-engineering the call taking, scheduling, and dispatching processes. Completely (or significantly) changing such processes requires management support (sometimes called executive sponsorship) to result in a successful transition. Therefore, it is important to understand management's capacity to support change.

To evaluate this capacity to support change, managers were asked whether they had overseen computer system implementations, and if they did, what was the outcome. Sixty percent of the interviewees had overseen or participated in implementations related to computer systems, but only half of these were convinced that they could successfully manage any other implementation. The remaining 40% have never overseen any such implementation. This is shown in Figure 5.10. For those who have overseen implementation, they expressed problems with the software that was installed. Either the program did not do what it was promised or the software did not address the agency's needs. Additional problems, such as incompatibility with existing printers and massive manual input of data, were reported.

Figure 5.10 Have you overseen Software Implementation?
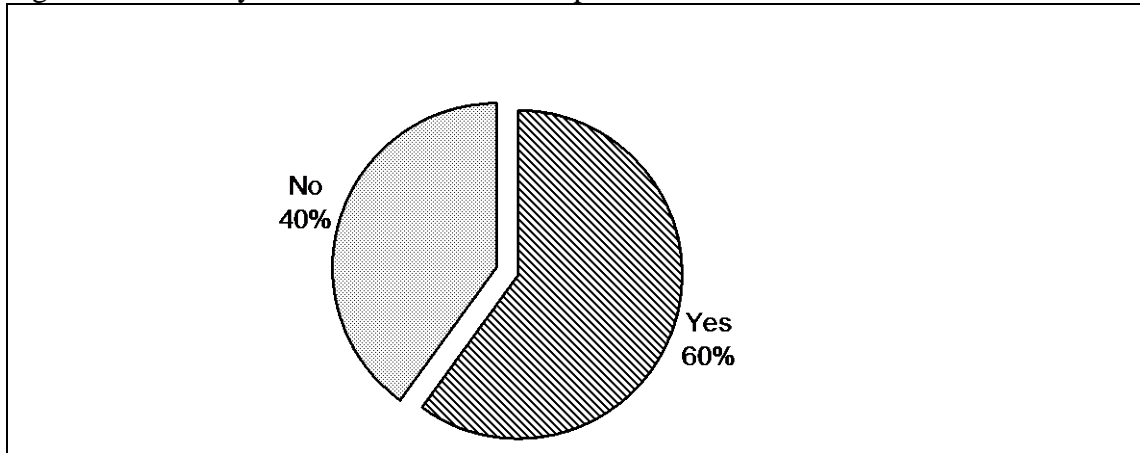
Of all the operators surveyed, 30% would be able to manage an implementation, and 70% would need some external guidance in order to guarantee success (Figure 5.11). This support could either come from either IDOT or a third party (university, consultant, etc.), but IDOT will need to constantly monitor implementation of the CASD systems to ensure a successful transition from manual to computerized operations.

Figure 5.11 Ability to Manage Software Implementation
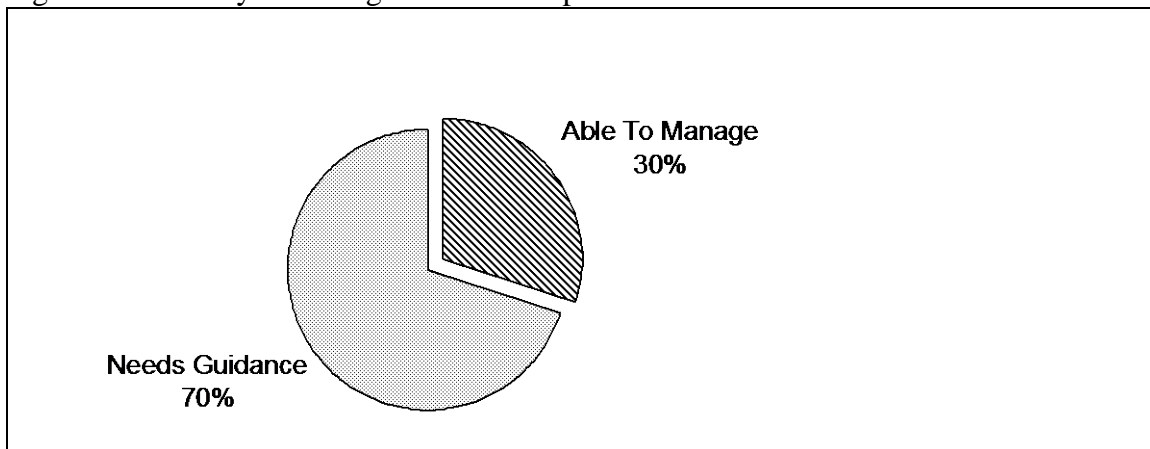
5.5   Hardware and Software Needs

As seen in Chapter 4, paratransit software is expensive. Agencies using CASD systems often lease it because they do not have sufficient funds to buy it outright. Considering the potential funds available, they were asked how would they spend these. Not surprisingly, of the agencies having a CASD system, most had a clear idea of what they would do with the money. Most would purchase software or would invest more in hardware. If the funds were to be spent on software they would invest in the same software they have (or upgrades). These systems include CTS and Adept. One agency

customized Microsoft Outlook for the use of scheduling, maintenance, and billing. It was quite useful to them.

Other agencies would use the funds as well, but it was not clear how they would spend the money, nor did they seem interested in purchasing a CASD system. Among these, several expressed their interest in CASD systems. They also asked for help and guidance from IDOT (or external entities) since they did not have enough expertise. Figure 5.12 identifies the resources agencies would buy if they were given further funding.

Figure 5.12 Target Investment if Given Funds
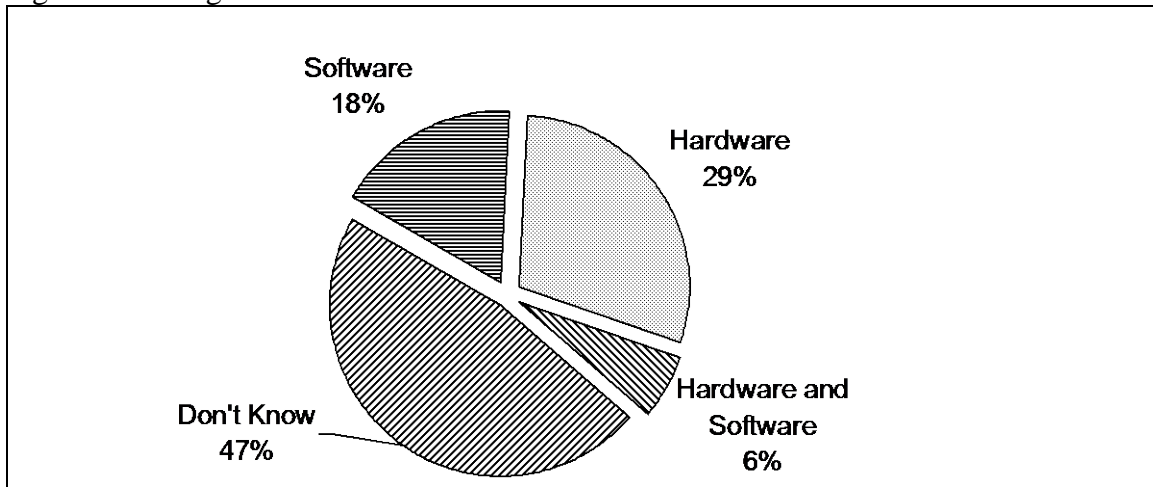
While looking for potential CASD systems, it is important to understand if there are any preferred vendors (or systems). Only two potential vendors were identified; CTS Software and StrataGen Systems Inc. This is because only two operators have CASD systems, so the majority have no knowledge about CASD systems or potential vendors.

5.6   Coordination

Coordination is an important consideration in paratransit for reasons described in Chapter 2. In the sample agencies, coordination tends to be informal, mostly involving neighboring agencies. Three questions in the survey instrument were designed to identify: 1) whether there is a perceived need for coordination, 2) how complex coordination would be, and 3) whether agencies were willing to coordinate.

Most agencies reported some communication with other operators in the same area, or at least some knowledge of other operators. Out of 17 operators, 10 have other entities (nursing homes, senior service agencies, etc.) operating in their service area, and six have taxi companies servicing their area. There were very few agencies that had no other potential operator in their region.

Most agencies have tried to coordinate in one way or another. The most frequent procedure is to refer the client to another operator (taxi, etc.). This is usually done if the operator cannot accept the trip or when it is outside regular operating hours (i.e. late evenings or weekends). Another common practice is to transfer clients at pre-defined locations. Most operators were familiar with the concept of service coordination and had experienced it in some way. In most cases, this coordination is done informally and inconsistently.

Despite the lack of experience in coordination, operators seemed to like the idea, although larger agencies tended to be more open to coordination. This might be explained by their prolonged exposure to coordination. On the other hand, smaller agencies did not have the opportunity to coordinate as often, which led to a general anxiety towards coordination and the perception that there was no benefit to it.

5.7   Technology Assessment

Like the differences in answers among agencies for management and dispatchers, technology varied greatly among the providers. The level of sophistication was extreme at some locations and almost non-existent at others. For example, the higher functioning agencies had an abundance of updated computer hardware and software. Computers were used not only for constructing driver manifests and customer information, but were also used for services provided by the agency such as counseling services and maintenance. At the other end of the spectrum were the less sophisticated agencies. Since transportation of people with disabilities and the elderly is such a small component for the majority of these agencies' day-to-day activities, computers were rarely used. Most of the records were kept manually and frequently updated.

Our technology assessment focused on gathering data from the operators that would best describe their existing technical sophistication. Information was collected and analyzed about factors such as: the number of PCs in use, the type of operating system, and network capabilities. Figures 5.13 and 5.14 show the current number of PCs and the types of operating systems they use.

Figure 5.13 Current number of PCs in use
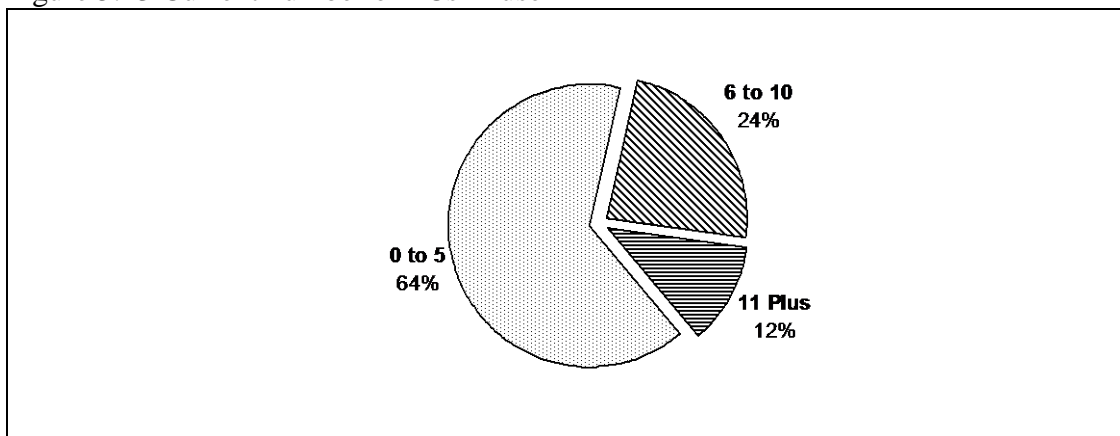
Figure 5.14 Current operating system
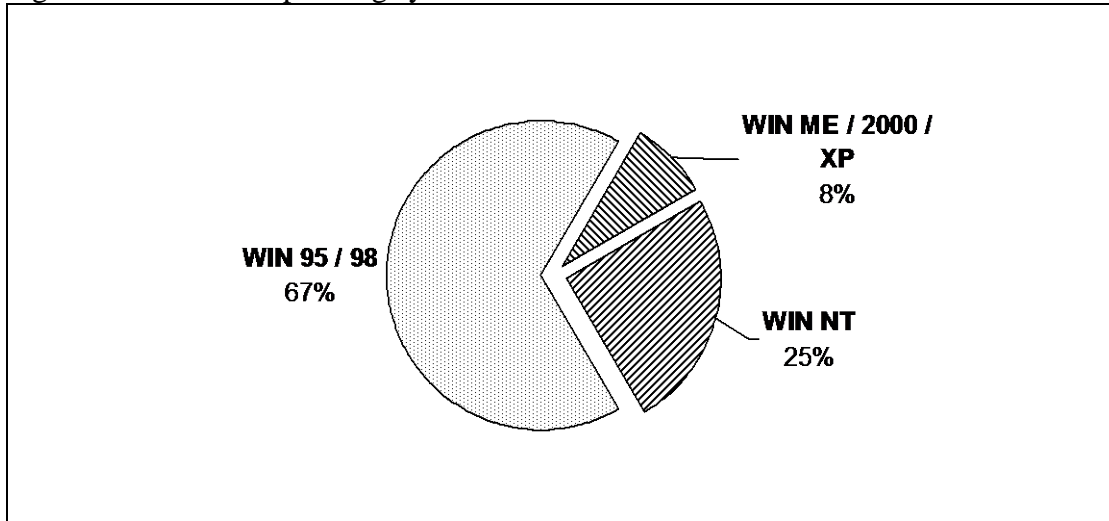
The operating systems are still, by and large, WIN 95 and WIN 98. Newly purchased computers are equipped with WIN ME, WIN 2000, or WIN XP. Only 8 % fall into this category. It is also interesting to notice that 25 % of the computers are equipped with WIN NT, which means they are used (in most cases) as servers.

Having network capabilities is important because most CASD systems must run on networks to enable multiple schedulers, dispatchers, and other users to simultaneously use the system. Not all agencies that have networks used Win NT. Most likely simpler networks, that do not use shared software applications, employed other operating systems, such as Win ME/2000/XP or Win 98. Fig 5.15 displays the percentages of operators having and not having networks in place.

Figure 5.15 Network Capabilities
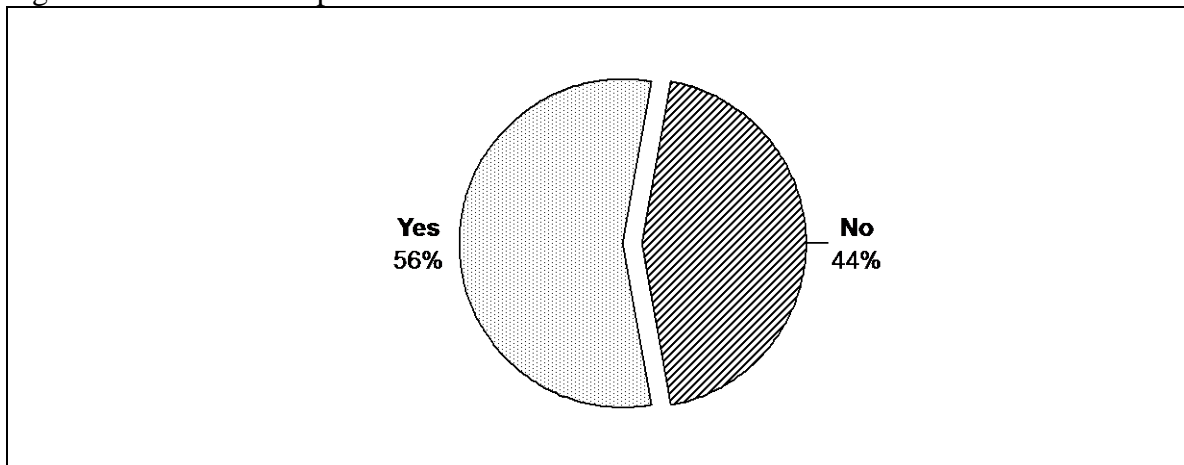
Finally, a technology readiness score was computed. The purpose of assigning scores for the agencies' technological preparedness is to assess whether there is a need to upgrade the hardware, if CASD systems will be installed. The scores were given on an

interval scale: poor, fair, and good. They were computed by assessing a combination of factors related to the surveyed operator's technological capabilities.

The factors were:
- Number of computers used in the agency
- Computer configuration (RAM, HDD, drives, monitor, etc.)
- Operating system
- Networking capabilities (existing network)
- Internet capabilities (modem, high speed)
- Available peripherals (printers, scanners, etc.)
- Overall technological preparedness

Figure 5.16 displays the distribution of the scores grouped into the three intervals.

Figure 5.16 Technology readiness score
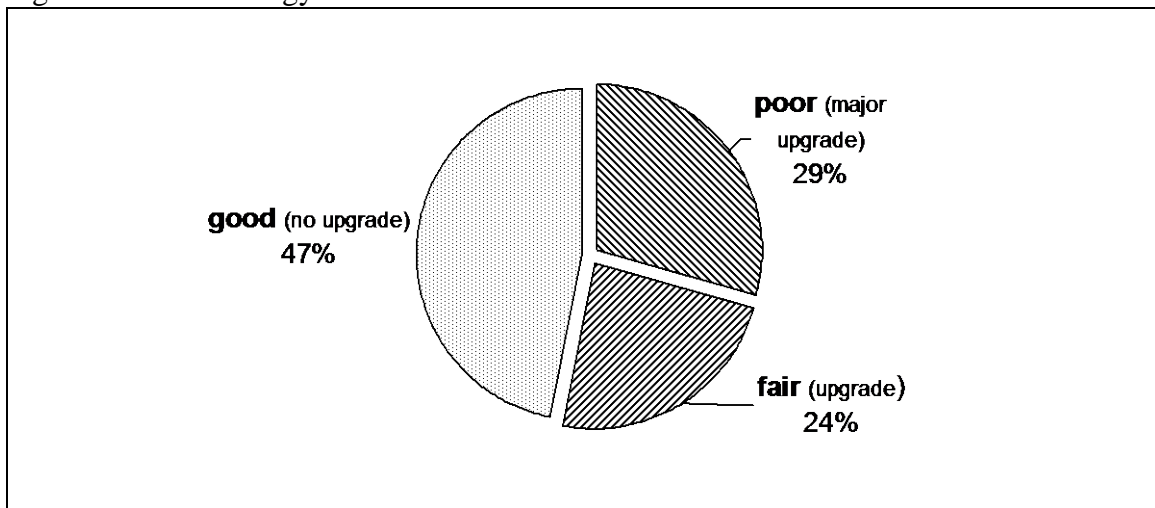
The first category – poor – contains agencies that need major hardware upgrades. This means that they need new computers because their existing ones are either outdated or must be used for other purposes.

The second category – fair – comprises agencies that need upgrades, but not major ones. Here, components such as: operating systems, network cards, and new monitors would be needed.

The third category – good – includes agencies that are technologically up-to-date. In these agencies, only minor changes (proper network configurations, setting up servers, etc.) would have to be made prior to deploying the CASD software.

It is interesting to note that a high positive correlation exists between operation size and technological sophistication. Most of the agencies (except for two) that fall in

the third category have more than 300 trips/day. The two exceptions have between 100 and 300 trips/day.

For a more detailed outline of the specific technology used by agencies refer to Appendix III. In addition, Appendix IV, which was mentioned in Chapter 3, has been used as a guideline to distribute technology among the various transit providers.

5.8   Conclusions

Computer skills and support are geared toward tasks at hand.

Most agencies have some familiarity with computers, and all but one use a computer in some aspect of their operations. They tend to use word processing and spreadsheets, with little daily use of more complicated systems. For most operators, implementing CASD would require developing new computer skills and training existing personnel.

Transportation is a small part of many agencies' everyday operations.

Most agencies providing paratransit services in rural areas are not centered around transportation. They are typically not-for-profit human service agencies that provide transportation services as part of their overall community service mission. While this ensures some level of public transportation availability in much of the state, it suggests that the transportation component may not be the greatest concern of the agencies' leadership.

Reporting is the bane of paratransit agencies.

Though most agencies understand the need for reporting and accept it as a requirement in the use of public funds, few enjoy the process, and most tend to see reporting requirements as complicated, arbitrary, and inconsistent among grantors. Standardizing IDOT and IDHS reporting requirements would go a long way toward easing operator frustration. Moreover, developing ways to accept electronic data submission could be a way to help facilitate the acceptance of CASD systems.

CASD applications must integrate with accounting applications

Most agencies have in-house accounting systems that are based on legacy software that would be difficult to migrate. CASD implementation should be carried out with this in mind, allowing ways for CASD systems and legacy accounting systems to share data.

CASD system installations must be preceded by computer upgrades

The technology assessment revealed that not all agencies possess computers suitable for CASD applications. Therefore, prior to proceeding with system installation, computer configurations must be evaluated more closely and upgraded, if they do not meet vendor specified requirements.

Chapter 6 – Deployment Strategies and Focus Group Findings

6.1   Introduction

While considering the variety of needs of Illinois paratransit operators, the researchers developed three different CASD deployment scenarios. Each of these scenarios attempted to balance advantages and disadvantages. These scenarios consisted of a centralized, decentralized, and regional implementation.   In the centralized implementation, all trips from all participating operators in the state would be scheduled using a single, centralized CASD server. In the decentralized scenario, operators would run their own CASD system. With the regional approach, a number of neighboring operators in a region would be dispatched from a single CASD system.

These three approaches were presented to a focus group of 5311 operators and transit executives. The focus group format was chosen as an evaluation tool over structured interviews and surveys because it allowed user interaction and open-ended questions. The focus group allowed the participants a chance to share their opinions and experiences with both the researchers and other participants. Further information about the focus group method can be found in Kruger (1994), Stewart and Sahmadasani (1990), and Morgan (1993).

Section 6.2 describes the characteristics, advantages and disadvantages associated with each of the three CASD deployment alternatives. Section 6.3 presents an estimated cost analysis for two of the three approaches. Section 6.4 describes the focus group and its findings. Finally, Section 6.5, presents the conclusions reached in the process of conducting the focus group and presents the alternatives.

6.2   CASD Implementation Alternatives

The three implementation approaches were presented to potential users in a focus group, allowing the researchers to evaluate their receptivity toward each of the scenarios and to determine which of the scenarios were not acceptable. These are shown in Table 6.1.

Table 6.1: Overview of Alternatives Presented to Operators

CASD Scenario	Hardware	Software
Centralized	One central server serves all operators	One statewide system
Decentralized	One server per operator	One or more different systems
Regional	One server per region	One or more different systems

6.1.1   Centralized Approach

This approach uses a centralized system for scheduling and dispatching paratransit operations. With this approach, one central location would act as an Application Service Provider (ASP). An ASP is an entity that manages and distributes software-based services and solutions to customers across a wide area network from a central data center (http://www.webopedia.com, 2002). In this scenario, the ASP would be a data center at a yet-undetermined location that would host CASD software for all paratransit operators in the State of Illinois. It would provide application services for all three categories of operators (small, medium, and large), take care of such tasks as database backups, and software maintenance, and ensure service continuity in the event of any disruption.

The centralized approach would necessitate a statewide implementation. All operators would be equipped with some form of the CASD system according to their operation. A single vendor would provide both client and server software. Software purchasing would be centralized, enabling the state to take advantage of the economies of scale. The State would assume coordination responsibilities and would set the coordination standards or the goals for coordination. Figure 6.1 shows the structure of this approach.

This approach is ideal if coordination and brokerage are to be accomplished at the state level. Other advantages include lower software costs resulting from purchasing all software needed for a statewide CASD from a single vendor in a single purchase. This approach commits to a minimum degree of coordination by ensuring that all agencies are using compatible software systems. Most CASD systems facilitate reporting, however, this approach further simplifies this task by making all data available in one location in the same format. This approach is scalable since it can accommodate any new operators without having to install new software, requiring instead merely the opening of a new account. The centralized approach is also affordable for smaller operators, as it does not require them to purchase or maintain an on-site CASD system.

Disadvantages of this approach include the need for reliable connections (high-speed connections such as ISDN, DSL or cable modem) especially for large and medium-sized operators. Agencies might fear that participation in the centralized system could jeopardize their control over the operations and services they provide. One of the more compelling disadvantages is that to-date, no other states have successfully completed such an implementation.

Fig 6.1 Centralized Approach

Statewide CASD Implementation. Centralized Location.

Legend

🔴 Large Agencies (>300 trips/day)

▣ Small & Medium Sized Agencies (<300 trips/day)

— Internet Connection (for operational purposes)
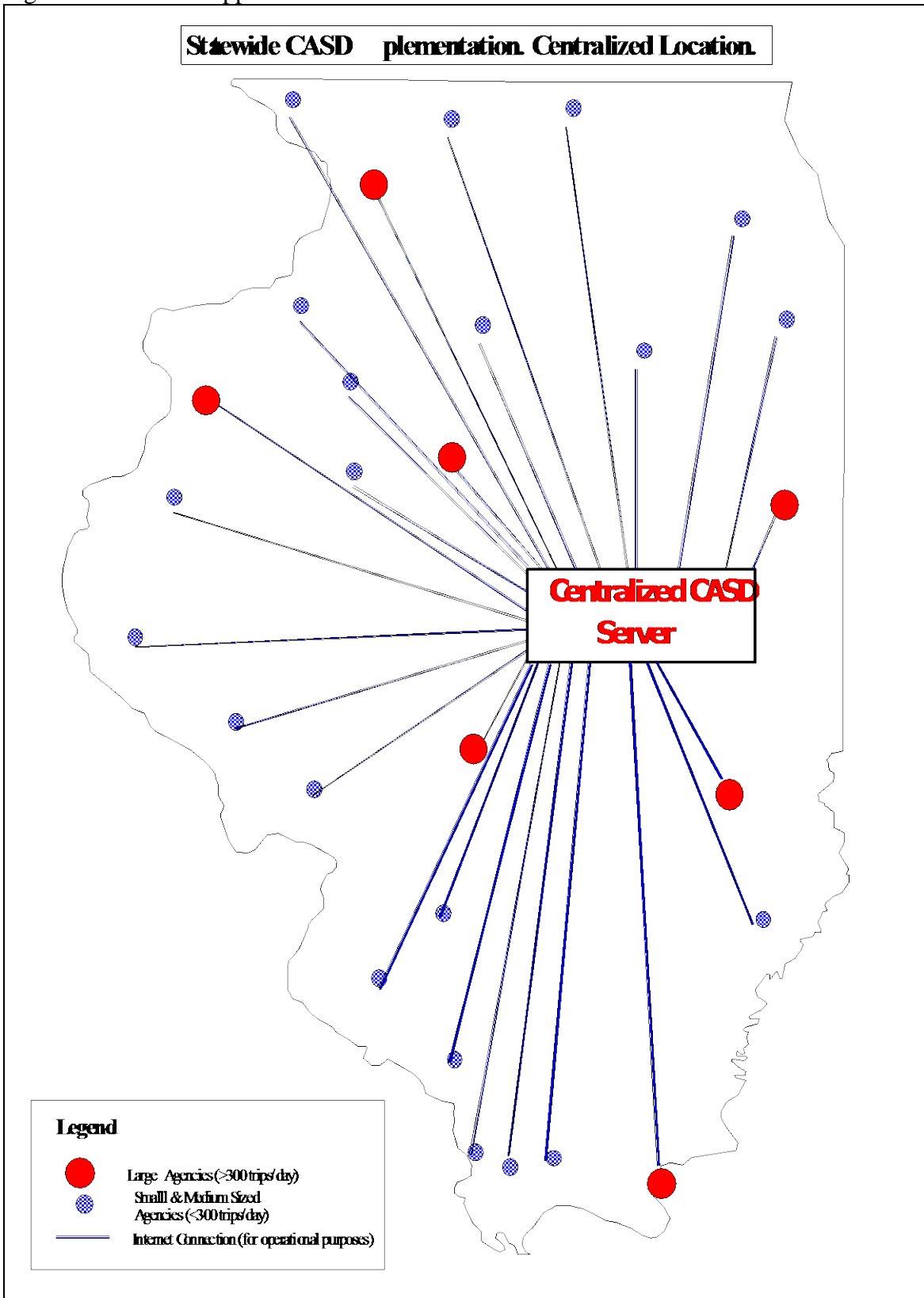
6.1.2   Decentralized Approach

This approach is the opposite extreme of the centralized approach. In the decentralized scenario, all paratransit operators would operate their own software without being interconnected. Each agency would implement their own CASD system, train their users, and perform maintenance including software updates, and bug fixes, and other related tasks. This can result in significantly higher implementation and post-implementation costs that could increase total cost of ownership.

This method implies local software implementation. Software would be purchased locally with minimal state involvement, resulting in a wide number of single contracts (each agency would have its own contract with the vendor) that can boost up the total cost of ownership. However, the state DOT can arrange for a single vendor that would be selected based on a set of predetermined criteria. This way, economies of scale could still be achieved, but implementation and post-implementation costs would still make a significant contribution to the total cost of ownership.

One of the advantages of this approach results from operators having their own CASD system, which eliminates the need for network connections, especially high speed. Another advantage is that this approach offers strong local control.

Disadvantages of this approach include the need for more onsite technical support both in the implementation and post-implementation stages, and the possibility of having multiple standards. However, the most important disadvantage is the difficulty to coordinate. Since each agency has its own software, without being interconnected, coordination among agencies is not possible without major changes. The necessary changes consist of linking those systems that would share resources.

Figure 6.2 depicts the architecture for this approach. As seen in the figure, there are no links among the various agencies. A combination of the two approaches, presented so far, results in the regional approach, described next.

Figure 6.2 Decentralized Approach

Decentralized CASD implementation

Legend

Smalll & Medium Sized
Agencies (<300 trips/day)

Large Agencies (>300 trips/day)

6.1.3   Regional Approach

A regional approach to statewide CASD deployment envisions implementation of high-level technology components as conceptualized in Fig. 6.3. The following discussion will clarify the role of each component.

Fig. 6.3. High-level concept of statewide CASD implementation
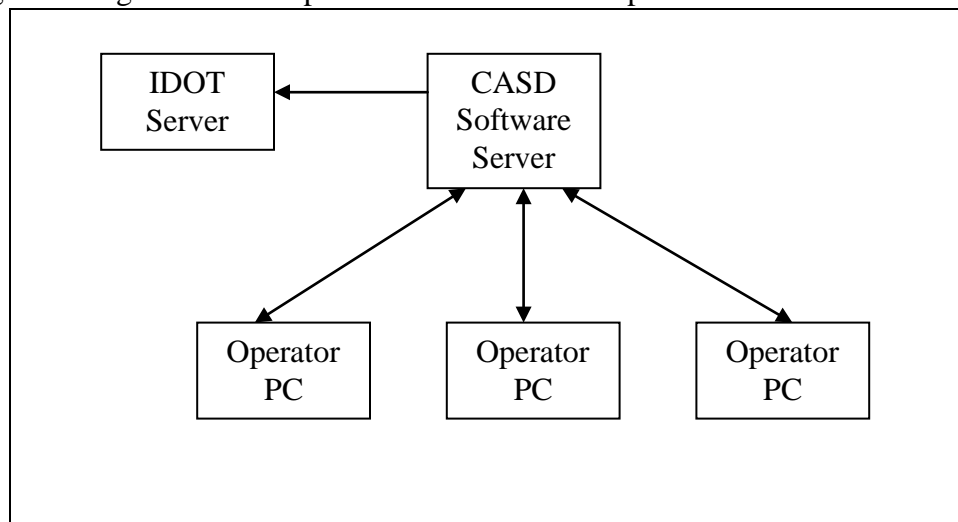
Operator PC**:** Operator PCs are the personal computers for the dispatcher(s). For larger paratransit agencies with multiple dispatchers, these computers can be tied together on a LAN with the CASD software server. The dispatcher computers need to have a 56k modem to connect to the software server if the software server is physically in a different location that cannot be accessed by a LAN.

CASD Software Server**:** The CASD software server has two basic components installed: (a) the CASD software and communication capabilities with the operator PCs via a LAN or a modem; and (b) software and communication capability to connect to the IDOT server. Larger operators, especially those with CASD implementation experience, could possibly have the CASD software server on their premises. Smaller operators could possibly use a modem to access a CASD software server located at a larger operator in the same region or on IDOT premises.

IDOT Server**:** The IDOT server could have the following components installed: (a) communication ability with the CASD software server for monitoring performance and billing purposes; and/or (b) the CASD software to serve smaller operators.

The above concept can be exemplified in the following scenario.

- A client (individual rider or human service agency) requests a ride. The call could be placed with a dedicated 800 number. In such a case, the call needs to be redirected to the appropriate service provider.
- The dispatcher checks the client's eligibility in the CASD database via a LAN (if the CASD software is on the local premises) or a modem (for remote locations). Billing options are also verified during this transaction. New clients and existing client information can be updated in the database at this point.
- The dispatcher examines vehicle and driver availability in regard to the specific rider request, re-optimizes scheduling given up-to-that-point committed rides and gives a time window for arrival and drop off.
- Once a week or once a month, the IDOT server uploads from each CASD software server all of the information that is required for performance monitoring.

Two major steps are necessary for successful implementation of such an approach:

- First, IDOT must certify and select a CASD vendor for statewide implementation. This critical step will probably require technical assistance (even at the contract negotiations stage) to ensure that the vendor will be able to successfully implement the necessary technological components for a statewide CASD deployment. Operators with existing CASD software could choose to continue using their software, but the selected vendor should ensure that communications between the existing CASD software and the IDOT server are seamless.

- Secondly, IDOT would commit to monitoring performance. During the initial contract period with the CASD vendor, it would monitor the performance of the contract based on criteria established in the contract.

The principal advantages of such an approach include: (a) Paratransit operators are relieved from having to worry about maintaining and updating the CASD software and related hardware. (b) IDOT will be able to monitor the contract performance in an objective manner and ensure the transportation needs of rural clients are met. (c) If some form of coordination such as brokerages is desired at a later date, then the structure is in place to implement such an approach. (d) Maintenance, training and service of client software can be accomplished by the server, which would be in close proximity to the client.

The main disadvantage of such a system concerns problems of data communication, but on a smaller scale than the centralized approach. An illustration of the regional implementation can be found in Figure 6.4.

Fig 6.4 Regional Approach

Statewide CASD implementation. Regional setup.

Legend

- Smalll & Medium Sized Agencies (<300 trips/day)
- CASD Software Server — Large Agencies (>300 trips/day)
- Internet Connection (for operational purposes)
- Internet Connection (for reporting purposes)
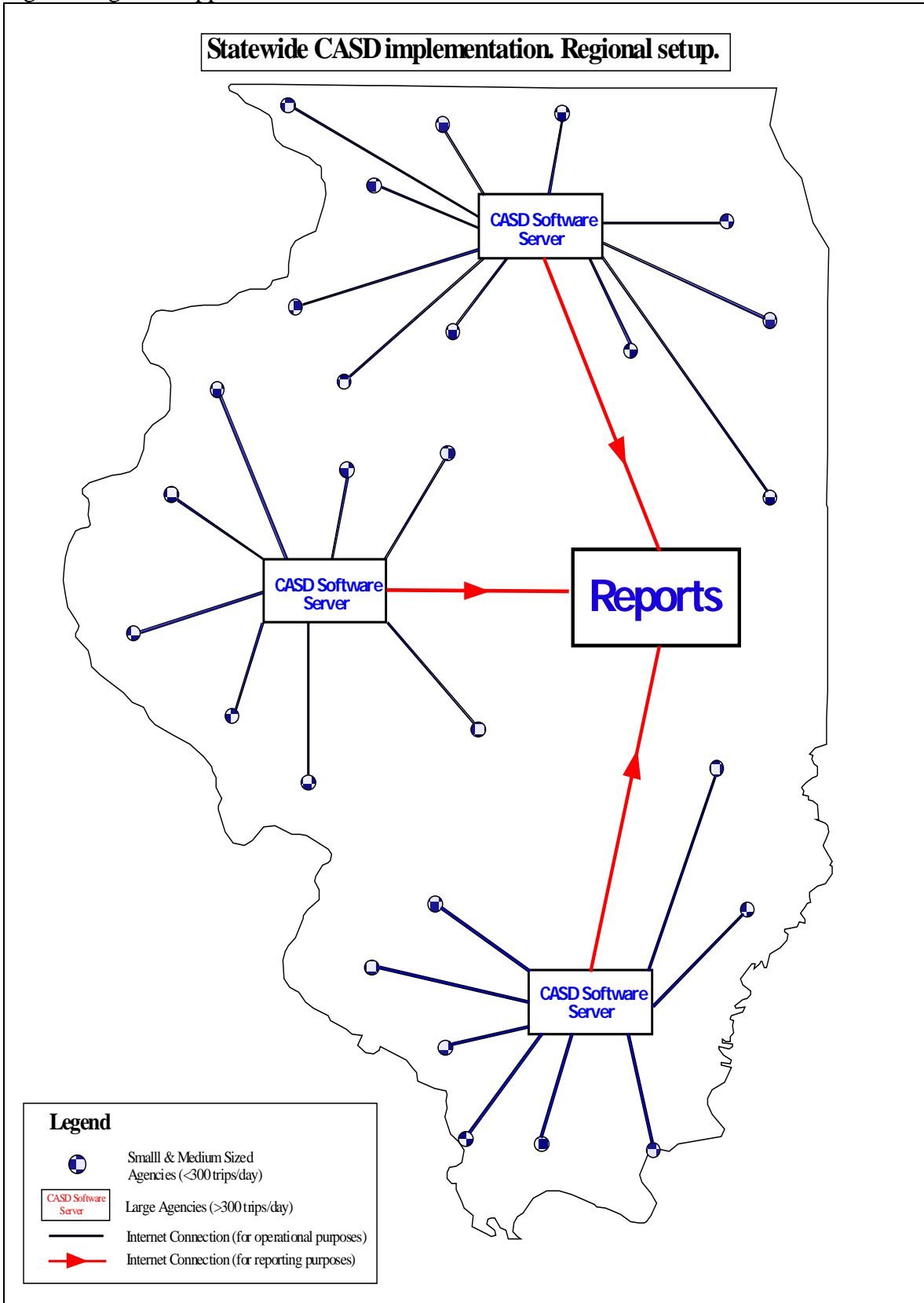
6.2   Summary of Focus Group Discussion and Findings

The focus group was held in Springfield, Illinois on May 14, 2002, at the offices of the Springfield Mass Transit District. The location was chosen to maximize convenience for as many potential participants as possible.

The participants in the focus group were selected from paratransit agencies and mass transit districts so as to represent the diversity of Illinois' operators. Table 6.2 lists the participants and the name of their agency.

Table 6.2 List of Participants

	Last Name, First Name	Agency Name
1	Childers, Bob	Williamson County
2	Jung, Bill	RIDES Mass Transit
3	Hollingsworth, Mary Jane	CRIS Senior Services
4	Ashby, Tom	South Central Transit
5	Holland, Valerie	Williamson County
6	Jennings, Bob	MetroLINK
7	Starwalt, Susan	Coles County
8	Oger, Judy	Access Springfield
9	Weishaar, Ron	Piatt County
10	Dick, Laura	SHOWBUS
11	Fix, Richard	Springfield Mass Transit District
12	Fawell, Tom	Illinois Department of Transportation
13	Harris, Jo Ann	City of Galesburg
14	Lucero, Orlee	City of Galesburg
15	Podeschi, Linda	Illinois Public Transportation Association

The participants were first presented with an overview of the CASD research project. Presentations of each of the three CASD implementation scenarios were then made. After each presentation, participants discussed their impressions of the scenario and how they felt it would work. Finally, participants were asked to discuss all the scenarios and to indicate which one, if any, would be most appropriate for their agency.

6.2.1   Types of CASD Systems and Functionalities

a) Scheduling and Dispatching Rides

The majority of agencies rely on a fundamental software system that automatically generates a trip list. These systems include Adept by StrataGen, Microsoft Office, StrataGen, CTS, and PTMS. However, the operator that uses PTMS does not currently use their system because it is too complex. Operators using the StrataGen software, Adept, are extremely satisfied with it and would continue to use it. Adept is used as a centralized dispatch center by another agency, which has tried several other

systems prior to implementing this one. They regard StrataGen software as the most user-friendly. In addition, this system is well-equipped to handle their 40-50 billing contracts. Some agencies reported that they had no billing capabilities with their current software. The billing was done either by an in-house person, or by their outside accounting department.

The computer-generated trip list is then used by at least one or two dispatchers, who pass it on to the paratransit drivers. Updating the list is typically done by hand when a demand response call is received, and typically takes about three minutes to enter a new client into the system. One agency uses an "800" number in place of the initial call taker, which eliminates the filling and training of this position. The agencies that do not have a system in place do everything manually. Some use a clipboard and others use a slot system, where the incoming call is written down on a list and given to the driver that is available.

b) Additional Software

The focus group was asked about their interest in additional software. This software includes off the shelf software, a custom database application, a semi-automated CASD system, and a fully automated CASD system. The overall attitude was positive, and the interest in AVLs and MDTs was extensive. One operator stated, "Our big distances demand it." Although they were typically interested in these software components, they were concerned with the cost-effectiveness and support available for such components.

The majority were concerned with having a system that would automate all of their work, but it must be simple. Training is a major issue among the operators, and it must be carefully considered. Generally, the employees are not resistant to training, but it is an extremely expensive endeavor, and needs to be paid for by the State.

A couple of additional concerns were expressed. A few agencies did not like the idea of having a third party creating software for their operations. They would rather develop the software in-house. One agency said they were looking into an SQL server; possibly a web-based application. Also, agencies were concerned with insuring that the proper hardware is in place prior to implementing a complex software system.

c) Useful Functionalities

Operators were asked which functionalities would be helpful to their operations. These functionalities include client registration, scheduling, billing, trip booking, dispatching, and reporting. Surprisingly, the operators expressed a unanimous concern with the billing component of the various software systems. Billing must be done in a specific way for each agency; therefore, the billing function must be customizable and flexible. Also, support must be in place to support this function. StrataGen was the vendor that was voiced by a couple of agencies as having great software, training, and support.

d) Coordination

Some operators have expressed their willingness to coordinate with other operators. However, it would depend on which operators they were coordinating with. It was stated, "It would be nice to communicate with the surrounding counties." Presently, one operator is dealing with people in Iowa, mainly over the phone. They feel that it would be helpful to be able to communicate with them over a computer system. It would make it faster and easier to coordinate trips as they are requested. Overall, this coordination effort must be mutually beneficial for both parties.

An operator voiced a concern that other agencies were unable to serve their existing clientele, because there were no neighboring agencies with any excess capacity.

e) Willingness to Act as a Brokerage

Two operators stated that they would be willing to act as brokerages, however, they had two stipulations. First, the software purchased must have the capabilities necessary for them to act as a brokerage. Second, they would be willing to act as a brokerage, but "the devil's in the details"; meaning barriers exist. This means that many of their clients are elderly, and they must be taken care of. They prefer drivers that they know and have gotten used to. They are a public transit operator, but 99% are elderly/disabled and feel uncomfortable with people they don't know.

6.2.2   Centralized CASD

a) Perception

Participants greeted the centralized scenario with much skepticism, although some did see possible advantages to it. Recent flooding in the Springfield area prompted one participant to respond that a centralized service could be useful in "extreme weather, like today." The overall view of this scenario was that it would be heavy-handed in implementation and insensitive to local needs: a one-size-fits-all approach that wouldn't fit anybody well. One participant noted that the centralized approach felt like an urban solution inappropriate to rural needs.

b) Concerns

Participants generally found little to like in the centralized scenario. The statewide centralization was disturbing to many participants, particularly those with little interest in CASD to begin with. "A human is your best scheduler," one participant remarked. Other participants were concerned that the lack of high-speed data communications in rural areas would make system implementation difficult.

Despite operational similarities, many operators feel that the service they provide is unique and special, and felt that this type of CASD system would be particularly

damaging to their ability to provide caring service. Several reported a need for special information, such as the relationship between clients and drivers, that they felt would not be served by this scenario.

c) Willingness

Because no participants greeted the centralized scenario with enthusiasm, willingness to participate was gauged to be low. One participant felt that the combination of problems presented by the implementation scenario would ensure its failure: "It won't work." Another felt that the system would be risky to implement and that her organization couldn't risk a failed implementation.

6.2.3   Decentralized CASD

a) Perception

Participants seemed to like this approach. Notably, participants from smaller agencies have clearly supported this idea. Those from bigger agencies have also endorsed it. Participants typically found the decentralized approach to be more realistic. As one of the participants put it, "I prefer this one over the centralized one."

However the topic of customization proved to be a source of concern. Most participants wanted to make sure that the software would be customized for their own business operations. Whereas a new software changes the way people carry out their daily operations, it should not affect operations or tasks that are key for their operations, nor should it impose constraints on them. For example, if it is important to have the capability of assigning specific drivers or vehicles to specific clients, than the software should support this requirement. "We've gotten customization with some effort" explained another participant emphasizing the need for customization. His agency is currently using a CASD system that had to be adapted for their specific needs. The process of tailoring the products is easier if the proposed system is a partially open source (i.e. having access to the source code and the database architecture), so that modifications can be built into the system. The same person said "we've gotten customization with some effort" restating the need for customization and the ease of implementing it if the software is partially open source.

Another important issue is maintenance. A question was whether the smaller agencies, with less software experience, would be capable of providing the necessary maintenance. One of the participants said: "Support is a pain – if I'm constantly calling, then they are constantly charging" suggesting that problems might arise in the post-implementation period.

b) Concerns

While most of the participants had no concerns about implementing a decentralized system, some of them articulated concerns in the following areas: costs and expertise. One of the participants said: "Hardware and software costs would be a problem. We'd rather run our own computers," suggesting that they would prefer to have their own hardware and software although it was not clear whether they could afford it.

c) Willingness

With this approach, there was strong support coming from the smaller operators. Bigger operators, some of which already are operating in this mode, were somehow eager to move forward, towards a regional approach.

6.2.4   Regional CASD

a) Perception

Participants in general had a positive reaction to the regional CASD concept, but remained skeptical throughout the session toward the implementation details. In particular, some operators thought such an approach would raise the level of comfort with the software because smaller operators would have the assistance of the regional CASD provider. Other operators thought that the up-front cost would be smaller for the centralized and regional approaches, but the later costs would be higher. Others thought it would be more cost-effective to start with the decentralized approach and grow into the regional approach.

b) Concerns

The concerns regarding this approach were not unlike those expressed for the other approaches: funding, sustainability, detailed implementation plan, and software issues. "Decentralized is cheaper if we look at the big picture. I don't think there's any economy of scale," said one participant. "I like the way this keeps things closer to the operators," said another. "Good for us," said a third one.

c) Willingness

None of the participants would have a major problem with this approach provided that all of their concerns are addressed upfront. Overall, operators were in agreement as to the potential of such an approach to better coordinate their resources.

6.2.5   Group Overview of Three Alternatives

Of the three alternatives discussed in the focus group, the centralized approach, was unanimously considered too complex and too difficult for the smaller agencies to handle. Thereafter, discussion centered on the remaining two approaches.

a) Perceptions

Participants seemed more inclined toward the decentralized system, though were somewhat interested in the possibility of regional coordination. The opportunity to take a leadership role in implementing a regional CASD seemed to interest some participants, even a few who seemed less interested in joining a regional network run by another agency. Yet ultimately, this interest did not seem to outweigh participants' skepticism toward any degree of centralization. Acknowledging a fear of a losing control, one participant conceded some advantages of a more centralized system, but asked, "Can we take the threat out of it?"

When comparing their impressions of the various scenarios, participants generally favored a decentralized approach, but with a certain amount of standardization. Most felt that working with IDOT in the purchasing process and selecting a single vendor would result in lower overall costs and better service from the vendor. Participants also liked the idea of building in a CASD infrastructure that could later be interconnected. "I like to start decentralized," said one.

When asked if they would feel comfortable starting with a more decentralized approach and then moving to a more coordinated approach, participants had different opinions. Some of them, the ones with little computer experience, enjoyed the idea. One of the participants suggested that other implementation approaches be reviewed.

b) Fears

Among the major fears was the loss of control. None of the agencies agreed to the idea that somebody else might have access to their own information. The turf issue seemed not be the biggest concern. One of the participants noted: "The most important thing is to get clients to their destination, even if this requires working with other agencies." Other fears were targeted towards more technical problems, such as the fear of having "half-way" implementations, that the projects would not be fully funded. Some participants felt that accurate plans be designed and followed. Another important fear regarded the CASD software. As one of the participants mentioned: "Software must do what it is supposed to do," referring to past unpleasant experiences with vendors assuring them that the software would provide certain functionalities, when it did not.

c) State's Role

When asked what IDOT should do to convince them to use CASD systems all participants agreed on money. They would all like to see IDOT pay for the software, hardware, implementation, and data conversion costs. Also some of them wanted to be provided with technical support, while others wished to see IDOT taking a proactive role in dealing with vendors.

6.2.6   Implementation Issues

Participants voiced a number of concerns regarding possible problems with implementing any form of CASD. Chief among these was that a changeover to a CASD system would somehow fail or not be completed. A number of participants, concerned that nothing would be accomplished with a halfway implementation, wanted assurance that the entire process would be carefully planned and executed. Many participants voiced a concern with "following the Door-to-Door example," citing a well-known failed CASD implementation. Some, however, were less concerned that the Door-to-Door experience would be repeated, conceding that, "another organization did better."

A number of participants expressed concern that CASD would result in precarious dependence on a fragile technology. " The server crashes and we're stuck," said one participant. The process of changing from legacy systems to a CASD system raised concerns for data conversion, with one participant describing the data entry process as "a humongous issue," and expecting that benefits would eventually outweigh the effort involved in changing over to a new system. "It's got to be self-sustaining." Another echoed the concern that changing to CASD would require substantial effort with little in the way of benefits.

Ongoing funding was a concern for a number of participants, both with CASD systems and with general paratransit funding. One participant described a nightmare scenario in which his agency makes an investment in CASD, and then "IDHS pulls the plug" on paratransit funding. Others wanted IDOT to commit to fully fund a CASD program over the number of years needed for a full changeover. When asked what it would take to get them to participate in a CASD implementation program, a number of participants gave a one-word response: "Money."

Although participants favored a less-centralized approach, many liked the idea of a single software vendor for all operators. One operator liked the idea of a scalable package that they could grow into. Another expressed the hope that the CASD software would work with their fleet management software, noting the problem that their fleet management software covered other vehicles besides the paratransit fleet.

Training was viewed as an important part of system implementation and post-implementation. The need for complete and accurate training was re-stated. One participant thought that different levels of training should be available, depending on the operation's size and computer expertise of people using the system. All would definitely participate in training sessions. Establishing user groups was another greatly appreciated idea. As far as post-implementation support is concerned, one participant mentioned: "Fix it when it's broken", suggesting the need for a reliable system.

6.2.7   Additional Hardware

CASD systems can be equipped with additional hardware (MDT, AVL, SmartCard, and PDA). Their purpose is to automate processes, facilitate or enhance

communication between vehicles and the scheduling/dispatching center, enable fast data transfer, cut paperwork, and other related tasks. Using these additional hardware technologies would presumably increase the paratransit operators' efficiency and accuracy.

Group members seemed very enthusiastic about using any and all of the additional hardware. Four participants expressed their interest in using MDT and AVL technologies. Three were interested in using "smart card" technology, and three found PDA technology very attractive and affordable. Overall, the group agreed that there is a need to cut down paperwork, which slows down operations and is prone to typos. One of the participants noted: "It would be nice to bypass reading bad handwriting" sharing the group's view. The group also accentuated that all of the additional hardware would be useful to their operations and that they would be willing to use it.

6.3   Cost Analysis

One of the most important aspects in deploying computerized systems is the cost. Accordingly, a cost analysis was carried out for the two approaches that were of interest to the focus group: the decentralized and regional approaches. The dollar values used in this cost analysis were obtained in December 2001 and are very rough estimates. Also assumptions were made in order to compute some of the costs. This analysis can be used for rough estimations, or as an example of the types of costs that need to be included when planning for CASD system deployment.

The assumptions considered in our cost analysis are as follows:

Decentralized implementation:
- One or two statewide approved vendor(s) for all agencies
- Training can be done in bulk rather than separately at each agency
- As many software installations as agencies
- Software deployment can be done simultaneously

Regional implementation:
- One or two statewide approved vendor(s) for all agencies
- Large agencies would become the Application Service Provider (ASP)
- CASD software must be accessible via the Internet (web enabled)
- Medium and small agencies have no responsibilities for installation and maintenance of the software
- Training will be done at once for all agencies in the region

Large agencies have:
- Three to five schedulers/dispatchers using the system simultaneously
- One system administrator
- One manager occasionally logging into the system

Medium agencies have:
- One to two schedulers/dispatchers using the system simultaneously
- One administrator/manager

Small agencies have:
- One scheduler/dispatcher/administrator/manager using the system

Other assumptions:
- Full time employee will be paid $20/hr plus benefits.
- Hourly based employee (data entry, IT help, etc.) will be paid $12/hr
- Windows/Internet training will be conducted locally (community colleges)
- There will be two CASD system training sessions every year for newly hired users of the systems (users that had no prior training)
- All hardware will be new (no reuse of existing hardware)

Tables 6.3 and 6.4 show the first year costs for the decentralized and centralized approaches. Tables 6.5 and 6.6 show the second and subsequent years costs for the same two approaches. Second year costs are different because there are two major costs that will not be incurred: software price and the costs of data conversion. In an attempt to plan for the worst-case scenario, the costs of additional training were still included. Additional training will not be needed, once users will become experienced in handling the software. The same experienced users will be able to provide the necessary training for new users, substituting for the formal training sessions. Also, a CASD system user group could be established, which will help in sharing knowledge, tips, tricks, and other related information.

Table 6.3 Decentralized Approach - Initial Costs

	Trips / Day	Software Type	Hardware Price	Software Price	Data Conversion Person/ Month	Cost	Support Person (On-site)	Maintenance Price	Training Windows / Internet	CASD software	Total Cost of Ownership
Large 1	600	Fully Automated	3,000	75,000	4	7,680	65,280	1,500			
Large 2	500	Fully Automated	3,000	75,000	4	7,680	65,280	1,500			
Medium 1	200	Semi Automated	2,500	25,000	2	3,840	11,520	500			
Medium 2	300	Semi Automated	2,500	25,000	2	3,840	11,520	500		10,500	
Medium 3	30	Semi Automated	2,500	25,000	2	3,840	11,520	500			
Medium 4	60	Semi Automated	2,500	25,000	2	3,840	11,520	500			
Small 1	90	Custom database	1,500	10,000	1	1,920	0	200	300		
Small 2	30	Custom database	1,500	10,000	1	1,920	0	200	300		
Total			19,000	270,000		34,560	176,640	5,400	600	10,500	516,700

Table 6.4 Regional Approach – Initial Costs

	Trips / Day	Software Type	Hardware Price	Software Price	Data Conversion Person/ Month	Cost	Support Person (On-site)	Maintenance Price	Training Windows / Internet	CASD software	Total Cost of Ownrship
Large 1	600	Fully Automated	4,000	135,000	4	7,680	65,280	2,700			
Large 2	500	Fully Automated	4,000	135,000	4	7,680	65,280	2,700			
Medium 1	200	Browser	1,500		2	3,840					
Medium 2	300	Browser	1,500		2	3,840				10,500	
Medium 3	30	Browser	1,500		2	3,840					
Medium 4	60	Browser	1,500		2	3,840					
Small 1	90	Browser	1,500		1	1,920			300		
Small 2	30	Browser	1,500		1	1,920			300		
Total			17,000	270,000		34,560	130,560	5,400	600	10,500	468,620

Table 6.5 Decentralized Approach – Recurring Costs

	Trips / Day	Support Person (On-site)	Maintenance Price	Training Windows/ Internet	Training CASD software	Total Cost of Ownership
Large 1	600	65,280	1,500			
Large 2	500	65,280	1,500			
Medium 1	200	11,520	500			
Medium 2	300	11,520	500		10,500	
Medium 3	30	11,520	500			
Medium 4	60	11,520	500			
Small 1	90	0	200	300		
Small 2	30	0	200	300		
Total		**176,640**	**5,400**	**600**	**10,500**	**193,140**

Table 6.6 Regional Approach – Recurring Costs

	Trips / Day	Support Person (On-site)	Maintenance Price	Training Windows /Internet	Training CASD software	Total Cost of Ownership
Large 1	600	65,280	1,500			
Large 2	500	65,280	1,500			
Medium 1	200	0	0			
Medium 2	300	0	0		10,500	
Medium 3	30	0	0			
Medium 4	60	0	0			
Small 1	90	0	0	300		
Small 2	30	0	0	300		
Total		**130,560**	**3,000**	**600**	**10,500**	**144,660**

The cost analysis for the two approaches shows that the regional approach is more cost effective both in the short-and long-run. The cost savings comes mainly from the need for fewer maintenance personnel and a cut in the maintenance costs.

6.4   Conclusions

Focus group participants voiced a large number of fears and a small number of hopes for CASD implementation, yet only a few were completely unwilling to consider it. The larger operators already running CASD systems were generally happy with the technology, if not always enamored with their specific system.   A number of others, while acknowledging

fears of the problems a change to CASD could cause, also felt that in the long-run they would eventually need to implement some form of CASD. A few felt that the size and nature of their operations did not warrant any form of CASD.

Of the scenarios presented, the decentralized approach was most appealing to the largest number of participants, though some acknowledged interest in the regional approach. The centralized CASD scenario was generally not well received. Considering the merits of all the scenarios, participants favored a decentralized scenario with some of the standardization and bulk-purchasing aspects of the regional and centralized approaches, keeping control and operation of the system local while allowing for eventual cooperation and coordination with neighboring and regional agencies.

A crude cost analysis concluded that CASD implementation is expensive, but that the regional approach may be more cost-effective than the decentralized approach.

Chapter 7 – Conclusions and Recommendations

Conclusions

1. **CASD is worthwhile for medium and larger systems.** The research literature suggests that the benefits of CASD are proportionate to the size of a transit operator. The larger operators surveyed as part of this study concur that implementing CASD has been beneficial to their operations.

2. **Some benefits of CASD can be realized at smaller systems**. While CASD doesn't offer much in the way of operational efficiencies to operators with less than five vehicles, it can streamline reporting and record-keeping tasks. However, the benefits yielded from a low-level CASD system are likely to be limited, and could come at a considerable cost.

3. **CASD Facilitates Coordination and Brokerage.** The combination of service coordination with CASD implementation offers the possibility of even greater efficiency and service improvements. Additionally, implementing a regional or statewide transit brokerage plan can greatly increase the transit services offered in Illinois.

   However, the benefits of coordination and brokerage are typically realized only after meeting and overcoming a number of well-documented barriers. If the possibility exists for eventual coordination and brokerage, either at the statewide level or among regional systems, planning the state's CASD systems around that possibility can help streamline the eventual transition.

4. **Peripheral technologies may not be cost-effective for smaller operators.** Although peripheral technologies such as MDT and AVL are not a necessity for smaller operators that rely heavily on subscription and advance registration trips, advancements in communications technologies may offer inexpensive alternatives that could be deployed early on in the CASD hardware and software implementation cycle.

5. **Few states have implemented a CASD program.** Although many states are interested in pursuing this concept, it is met with skepticism by paratransit providers and many legislators. Those states interviewed can be used as guidance for Illinois when implementing its own CASD program.

6. **Most 5311 operators have only rudimentary knowledge of computers.** Computer skills and support are generally geared toward tasks at hand: Most agencies have some familiarity with computers. Most use computers for word processing and spreadsheets. Implementing a CASD system would require developing new computer skills and training of existing personnel.

7. **Transportation is a small part of most agencies' everyday operations.** The majority of their attention is focused on providing human services such as counseling and rehabilitation for the elderly and handicapped.

8. **Reporting is the bane of paratransit agencies.**   Standardization of reporting requirements from both IDOT and IDHS would go a long way toward easing operator frustration, in addition to developing ways to accept electronic data submission.

9. **CASD applications must integrate with accounting applications**. Most agencies have in-house accounting systems that are based on legacy software. CASD implementations must allow for CASD and accounting software to share data.

10. **CASD system installations must be preceded by computer upgrades**. Many agencies have outdated hardware and would not be able to support a complex CASD system.

11. **There exists a wide range of software to satisfy all needs**. Scheduling and dispatching software is so complex that feature-by-feature testing is needed to determine the best suitable software. Generally, vendors will agree to provide a copy of the software for testing purposes.

12. **Some of the Illinois paratransit operators have already installed CASD systems**. In some instances, the long process helped lead the successful software to failure. The experiences gained from in these instances should be capitalized on so that common mistakes can be avoided.

13. **Most of the software is built to function in client-server architecture**. With the advancement of Internet technologies, software is moving towards a multi-tiered approach where the Internet is the information transportation medium.

14. **Most operators are skeptical but also hopeful, especially in the longer run.** Focus group participants voiced a large number of fears and a small number of hopes for CASD implementation, yet only a few were completely unwilling to consider it.

15. **Most operators prefer a decentralized or regional CASD implementation.** Focus group participants favored a decentralized scenario with some of the standardization and bulk-purchasing aspects of the regional and centralized approaches, keeping control and operation of the system local while allowing for eventual cooperation and coordination with neighboring and regional agencies.

Recommendations

Given all the above factors, the best strategy for implementation of a computer assisted scheduling and dispatching program in the State of Illinois is the following:

1. **IDOT should try to implement a hybrid CASD program in the State of Illinois.** This program would combine the decentralized system with the regional system discussed in the previous chapter. Some agencies should be provided with standalone computer systems, while others should use regional systems. Regional systems

should be implemented in areas that are already served by a regional transit district, and in those areas of the state where an agency is willing to host such a regional system.

2. **For standalone systems the following guide should be used to decide which type of equipment is appropriate**: Table 7.1 depicts what type of software (described in chapter 4, section 4.4.1) should be deployed for each category of operators.

Table 7.1. Recommended Software Implementation by Operator Size

Operator Size	CASD Software Type
Large (>300 trips/day)	Fully-Automated
Medium (100 – 300 trips/day)	Semi-Automated
Small (<100 trips/day)	Customized database

3. **For regional systems, the host agency should be supplied with a fully automated CASD system and contracted to operate it.** In the regional approach some of the large agencies will become Application Service Providers (ASP) – i.e. host agencies. The CASD software will be accessed online by the agencies that are part of the respective regional system. Considering that some of the agencies in a regional system will be different sizes, the ASP will have to provide different types of CASD software (i.e. semi-automated and customized databases). The final architecture will be decided from the proposals submitted by participating vendors.

4. **Peripheral equipment should be assigned to agencies based on size**.

   AVL: (Automatic Vehicle Locator) Given the characteristics of most of the paratransit operations in the state (i.e., low productivity, lengthy dwell times due to passenger characteristics, predominantly prescheduled operations) the value of real-time vehicle location information is relatively low. Besides, AVL systems despite becoming less expensive (<$500 per vehicle) are still a new technology that is challenging to implement and prone to complications. Simply stated, if an agency does not make most of its scheduling and dispatching decisions in real time, the economic rationale for investment in AVL technology is limited.

   MDT: (Data Transmitter)Although the cost of acquiring MDT capability has been declining, it is still relatively expensive. MDTs would probably cost more than $1,000 per unit, including RF modem, automatic odometers, transmission transducers, and installation. In-vehicle computers would probably cost a few hundred dollars more. In addition, a paratransit operator will need to acquire a communications server and communications software to handle digital data communication between the central control system and the mobile units. This would cost anywhere from under $5,000 to over $30,000 more, plus the cost of computer hardware to host the communications system. For a 50-vehicle operation, the total

cost could range from $70,000 to over $150,000. This exceeds the cost of a CASD system that provides the basic value of the combined system. The added value of an MDT system is uncertain unless an paratransit operator is experiencing serious radio capacity problems (i.e., in the taxi industry). As many operators rely predominantly on subscription trips and advance reservations, the need for real-time trip insertions and schedule modifications is ostensibly minimized.

Smart Cards: Card-based data/fare collection systems are even less mature as a technology for paratransit operations than MDT or AVL technologies. No approach has demonstrated any significant market appeal to date. No off-the-shelf solution exists without technological (and economic) uncertainty. The technological complexity involved creates a potential mismatch between operator capabilities and system requirements. The value of smart cards may not be commensurate with the costs of the required technology, particularly in view of the low productivity of paratransit systems.

PDAs: (Personal Data ….) This technology is constantly evolving and can offer a low cost solution for many operators. For example, a combination ID card reader and PDA has been developed.   The design allows the PDA to be inserted in the card reader containing the interface connector. When the card is swiped through the reader, data is stored directly in the PDA. Application software can be provided. A pass through the connector allows insertion into the PDA cradle for downloading or charging without the need to remove the PDA card reader. The particular design claims no batteries are required and that power drain to the PDA is minimal, since the inactivated card reader is in a sleep mode. A second technology can be coupled with the first one to provide an inexpensive AVL alternative. The design is a GPS receiver with a flash-card interface to communicate with a PDA.

Given the above, the deployment of such peripheral technologies, except for PDAs is probably not warranted except for the most technologically advanced paratransit operators, and those that are bound to become regional operators. The brokerage capability would potentially add to that need.

5. **Implementation of these recommendations should follow a five-year schedule.** At the end of five years, all 5311 operators will have some type of CASD system in operation, with most operators participating in a regional system.

6. **IDOT should utilize a single vendor for all CASD systems and custom database systems.** It may be necessary for two vendors to form a joint venture, with one providing the CASD system and the other providing the custom database software. It is important that there be compatibility between the two systems in order to ease the upgrade process as an operator's needs increase.

7. **The following functionalities should be included in each type of system**: As part of our study, the research team has summarized the capabilities of the various CASD software packages. Because successful implementation is as dependent on human

factors as well as on technological ones, the research team has not attempted to evaluate the relative performance of the various packages. However, the research team suggests that when selecting a software vendor for statewide CASD implementation, the vendor should be able to provide software with the characteristics listed below.

Scalability
The software should be scalable to a variety of operator sizes. The research team suggests a minimum of three levels of software capability.

At its simplest, the software should have an easy-to-use data entry interface that will allow operators who don't need or use CASD capabilities to log services provided and produce reports using data collected for IDOT and IDHS.

The middle level should provide for simplified computerized scheduling, without requiring use of a geographic database or mapping package. At this level, an operator of five or more vehicles should be able to schedule trips with the computer to ensure that drivers and vehicles aren't overscheduled.

The highest level of software should be capable of providing a full assortment of CASD features. Scheduling should include a geographic component. Route optimization capability should be available and easily implemented.

Peripheral Hardware Support
The systems should be capable of supporting a variety of hardware peripherals such as AVL systems and PDA data systems, yet also be capable of operating without such hardware until such a time that the operator can benefit from the hardware.

Brokerage Capability
CASD systems provide a technological platform for implementing service brokerage. The systems deployed should be capable of allowing individual paratransit operators to participate in brokerage systems if the state or local operators should decide at a later date to implement such a system.

Coordination capability
While most paratransit operators in rural Illinois now operate independently of each other, many currently provide a degree of informal coordination with neighboring carriers. The CASD system selected for implementation should support and encourage this type of informal coordination, as well as provide for the eventual adaptation of whatever degree of formal coordination is planned for in Illinois.

Support Capability
The selected system should include on-site support prior to going live and during the first days of operation, as needed. The vendor should also provide training in Illinois for software users and transit system managers, and telephone support during the hours of operation of the state's rural transit systems. These services can be provided

using either vendor personnel or subcontracted support personnel capable of ensuring that the system performs satisfactorily.

Appendix X displays a more detailed list of functionalities with their description as well as the three different types of agencies (large, medium, and small), along with the functionalities each type would need. The functionalities were grouped into the following subcategories:

- Client Registration
- Trip Booking
- Scheduling
- Dispatching
- Billing
- Reporting
- Other Capabilities

This list is not complete. However, it can be used as a starting point, or as a framework for grouping existing or additional functionalities.

One advantage of using CASD software is the ease of generating reports. Vendors typically ship their products with many built-in reports and they can also create additional built-in reports, tailored to the agencies' needs. Therefore, it is important to identify all the reporting needs, especially the common reports (i.e. reports used by all or most participating agencies), and ensure that these reports are included in the initial software installation. The additional reporting tools included in the CASD software packages offer the capability of generating additional reports, but building the most used reports into the system will substantially reduce the report generation time, streamlining this function.

8. **IDOT should fund the entire cost of computer hardware, software, maintenance, and data conversion for each of the agencies converted each year.** Operators have indicated a disinclination to participate in the absence of a funding commitment from the state.

9. **Training and support are integral parts of a successful computer software implementation. IDOT should provide adequate funds for both.** The legacy of failed implementations demonstrates the problems of attempting CASD implementations without sufficient training of management and users alike. The research team therefore recommends a training program that trains both initial users and administrators.

In many smaller operations, with just two or three non-driving employees, administrators are the backup schedulers. For these systems, it will be essential for administrators to fully understand the CASD system and be able to use it capably in the absence of the usual operator. Because the scaled-down system will not be

particularly complicated, training for both administrator and the main user will require only a minimum of time.

In larger operations, the research team recommends a more specialized training program, with different approaches for management and scheduling personnel.

Management
Where software system implementation projects succeed, they do so with the support of management personnel that are fully committed to the project. This will only be achieved by showing management the full spectrum of potential benefits of CASD implementation. The research team therefore recommends that management training be included and be mandatory for participation in the state CASD program.

The training for administrators and managers should emphasize the day-to-day operations of the software. They will also need to be familiar with the reporting functions and be able to obtain reports from the software and verify their accuracy.

As in the smaller systems, the research team expects that management personnel in the larger systems will serve as backup schedulers. To the extent that they do, they will need training in the day-to-day operation of the scheduling system.

Key Users
The "key users" of the CASD system are the personnel who currently perform scheduling duties. Because they know what needs to be done to successfully deliver service, they will know early on if the CASD system is performing as expected. As their comfort with the system increases, the research team anticipates that they will be able to provide in-house training to their back-up personnel.

Automation often raises the fear among employees of their jobs becoming redundant. Accordingly, training of key users should emphasize their importance to the organization, ensuring that they will accept the challenges of their new responsibilities.

10. **While CASD systems need not be coordinated, most forms of coordination require some elements of CASD**. Given the investment required for CASD implementation, it is important that the state consider in advance of the implementation, the degree to which the various CASD systems should be coordinated with each other.

11. **The statewide implementation plan should emphasize medium and large operators.** The rural transit operators of Illinois vary greatly in fleet size and number of trips delivered. Since our research shows that the benefits of CASD increase with the number of vehicles and trips, the research team recommends that the statewide implementation plan emphasize medium and large operators (operators that provide 100 or more trips per day).

At the same time, the research team must emphasize that while smaller operators do not derive the same benefits from CASD as the larger ones, they still benefit from having access to a standard database system that eases the burden of reporting needs. Furthermore, increased coordination among rural transit operators will eventually mean that having the smaller operators linked to a regional CASD system will provide greater efficiency for operators and more service for passengers.

Lastly, the enthusiasm of some operators to participate in CASD implementation should be capitalized on. The simplicity of implementing CASD on a small scale opens up the possibility of generating success stories that will help promote further operator interest in CASD. Including the small and medium-sized urban areas in a statewide implementation plan will ensure that operators of all sizes will be able to benefit from the experience of a comparably sized operator's CASD implementation. Yet the desirability of involving all operators in the state must be weighed against cost considerations. Accordingly, the research team recommends a prioritization that emphasizes implementing CASD first in systems that meet the largest number of these criteria:

- Operating A Large Number Of Vehicles: The experience of many CASD implementations shows that benefits are greatest when the number of vehicles is the largest.

- Serving A Large Number Of Clients: Where resources are scarce, the priority should go to the operators that can pass along the benefits derived from CASD implementation to the greatest number of riders.

- Providing A High Percentage Of Non-Subscription Trips: The unpredictability of demand-response service suggests the greatest benefits are likely to come from using CASD to more efficiently manage this service.

- Showing A Commitment To Using CASD and Its Features To Improve And Increase Service: The success of a CASD implementation depends greatly on the willingness of an organization to make it happen. The small scale of benefits from a smaller organization can be offset by a strong commitment to CASD.

- Having a high degree of technological readiness: The research team has developed a technological readiness measure for each of the 5311 operators in the sample. This measure could be used or questions could be asked in the application process to ascertain this information.

12. The following steps should be taken to Implement CASD at participating operators:

    a. **Pre-implementation preparation.** The CASD systems should be prepared well in advance of the anticipated go-live date. Much of this work involves transferring data from legacy data systems (whether computerized or not) into

the CASD system and can be done off-site, preferably through the main contractor or by third-party vendors. For the larger systems equipped with geographic databases, it will be important to have the users verify the accuracy of geographic information that off-site consultants may not be completely familiar with.

b. **Going "live".** Experience shows that the first days are the most critical in implementing a new software system. At this stage, consultants should be on-site, at the operator, to directly address any problems, and most importantly, to ensure that the system is not allowed to fail. The importance of having support available at this key stage cannot be overemphasized. After the first few implementations, both the State and its contracting consultants will have a better idea of what can be expected in the first few days of the new system's service.

c. **Plan for problems, especially with early implementation**. Implementing CASD means changing the way an organization performs its functions and the ways employees and managers do their jobs. Much can be done to smooth this transition, yet some unforeseen complications are inevitable. Both the State and the vendor should plan for ways to solve problems as they arise, rather than letting them put a site's implementation at risk.

d. **Evaluate the Results.** Evaluating results of the implementation will allow IDOT and the transit operators to verify any efficiency improvements and cost savings. Knowing that CASD has helped a transit operator will be an important part of that operator's satisfaction with the system. It will also enable IDOT to identify which operators have benefited the most from CASD and in what ways.

Two types of evaluations are recommended. In the first stage, to be completed when the CASD system is running, a post-implementation evaluation should be conducted to let the State and implementation consultants know which aspects of implementation are working and which should be modified or reconsidered in subsequent sites. The second should be conducted when the system has had sufficient time to impact the transit operation. This evaluation will show whether the CASD implementation has had a favorable impact on operating costs and employee time spent on tasks such as scheduling and reporting. As some of the benefits of CASD are thought to be long-term in nature, not all operators are likely to post immediate efficiency improvements, but most should show that time spent on functions such as reporting has decreased. The results of the final evaluation will also allow IDOT and operators to plan any changes to the system, and to determine if further improvements are appropriate.

Implementation Strategy

CASD systems should be phased in over a five-year time frame. An implementation strategy over five years is shown below. The timing can be adjusted depending on budget availability.

Year One

1. **Write specifications for vendor bids.** Specifications for bidding on CASD systems should be written out in detail. These should include functionalities to be included, training, assistance with pre-implementation preparation and on-site presence on go live dates. The research team cannot emphasize enough the importance of writing detailed specifications for each system category and for each group of operators. Often technical specifications can be developed in an earlier stage before procurement and actual deployment by an outside vendor. If IDOT opts to outsource this process, the assistance of an independent expert organization could help obtain the best possible bids from interested vendors.

2. **Evaluate vendor bids.** The evaluation should include both a quality and cost evaluation. Previous clients should be contacted, and a hands-on evaluation should be done. The hands-on evaluation should be done with data supplied by one of the transit operators in Illinois. The evaluation could be conducted by IDOT or independently by an expert third party. Selecting and later monitoring the most qualified vendor is critical for the success of the overall deployment effort.

3. **Award bid to a single vendor for the entire state.**

4. **Develop a process to select participating operators.** Operators submitting applications for CASD software and equipment should include information on their number of vehicles, number of clients, number of non-subscription trips, and a statement of management commitment to use the new technology. Additionally, operators should submit whatever information is needed to evaluate their readiness to implement new technology, such as the level of computer expertise of the employees and managers who will use the system.

5. **Develop a first year budget for software, hardware, etc.** The research team estimated that the following costs would result, for typical decentralized and regional systems.

Table 7.2 Decentralized System

	Large	Medium	Small	Total
Trips/Day	600	200	90	
Hardware Price	3,000	2,500	1,500	7,000
Software Price	75,000	25,000	10,000	110,000
Data Conversion	7,680	3,840	1,920	13,440
Support (On Site)	65,280	11,520	0	76,800
Maintenance	1,500	500	200	2,200
Training/Windows	0	0	300	300
Training/CASD		10,500		10,500
Total Cost of Ownership				**220,240**

Table 7.3 Regional System

	Large	Medium (2)	Small	Total
Trips/Day	600	200	90	
Hardware Price	3,000	3,000	1,500	7,500
Software Price	75,000	0	0	75,000
Data Conversion	7,680	7,680	1,920	17,280
Support (On Site)	65,280	0	0	65,280
Maintenance	1,500	0	0	1,500
Training/Windows	0	0	300	300
Training/CASD		10,500		10,500
Total Cost of Ownership				**177,360**

For the decentralized system, the costs were computed with the assumption that participants would include one large, one medium, and one small-sized agency. For the regional approach, it was assumed that one large operator, two medium-sized and one smaller operator would participate. These cost estimates are extremely tentative and do not take into account single vendor discounts, cost savings from learning how to best train and support such software, etc. Actual costs will be determined in the bidding process.

10.   **Announce and Promote CASD Program.** Details of the program should be communicated to providers through a variety of approaches including a presentation at the RTAC meeting.

11.   **Fund first year recipients.** Applicants should be prioritized based on the results of their applications. If the budget does not allow funding of all qualified applicants, place the remaining applicants on top of next year's applicant list (the application process should be repeated in case operational characteristics have changed). Peripherals should not be funded in the first year. Rather, there should

be at least one year of experience with CASD software in place before peripherals are included in the program.

12. **Plan for non-applicants.** Allocate a portion of the budget to bring non-applicants up-to-date with regard to computer use. Training for both managers and schedulers should include basic Windows and MS Office training.

13. **Establish a user group for managers.** A user group can be very helpful in providing valuable information to users on applications, implementation strategies, new technology, uses for the CASD system, etc. It provides an opportunity for users to share ideas, successes and failures, and strategies for improving the performance of their system. A user group should be established and it should meet twice a year. A user group meeting could be held in conjunction with the RTAC meeting, or in another venue.

By the end of year one:

- A number of large operators have purchased and begun implementing a CASD system
- A number of small operators have purchased and begun implementing a custom database.
- Non-applicants have advanced their computer readiness.

Year Two

1. **Evaluate costs of deployment and success or failures of first year's implementations.**

2. **Develop second year budget.** Typical budgets would include all costs presented in tables 7.2 or 7.3. However, **t**he budget for the second year could be considerably lower than in the first year, provided that most system implementations have been completed in the first year. Since the costs for any new system implementations would be the same as in the first year, the focus should be on the recurring costs such as maintenance, on site support and training costs. Therefore, the second year's budget can be inferred from tables on pages 19 and 20, for new system installations. For systems implemented in previous years, second year costs can be estimated from the recurring costs, described in the tables shown below. Budgeting for the second year should also account for price changes over time, both in equipment and software costs as well as employee costs.

Table 7.4 Recurring Costs (Decentralized System)

	Large	Medium	Small	Total
Trips/Day	600	200	90	
Support (On Site)	65,280	11,520	0	76,800
Maintenance	1,500	500	200	2,200

Training/Windows	0	0	300	300
Training/CASD		10,500		10,500
Total Cost of Ownership				**89,800**

Table 7.5 Recurring Costs (Regional System)

	Large	Medium(2)	Small	Total
Trips/Day	600	200	90	
Support (On Site)	65,280	0	0	65,280
Maintenance	1,500	0	0	1,500
Training/Windows	0	0	300	300
Training/CASD		10,500		10,500
Total Cost of Ownership				**77,580**

3. **Announce and Promote CASD Program.** Include in the announcement that peripheral equipment will also be funded, if available.

4. **Fund second year recipients.**

5. **Evaluate program and make changes as appropriate.**

6. **Conduct two user group meetings and expand the number of managers in the group.**

By the end of Year Two:

- The operators that acquired a system in the first year have gone "live", and have obtained training in that first year.
- The second wave of operators that are in line to acquire a system have done so and started implementing it.
- A few of first year non-applicants have become computer ready, acquired a system and begun implementation.
- Second year non-applicants and remaining operators continue to advance their computer readiness.

Year Three

a. **Evaluate costs of deployment and success or failures of second year's implementations.**

b. **Develop third year budget.** Compute similarly to the second year budget.

c. **Announce and Promote CASD Program.** Include in the announcement that peripheral equipment will also be funded (for operators with at least one year of "live" CASD operation).

d. **Fund third year recipients**

    e. **Evaluate program and make changes as appropriate**

    f. **Conduct two user group meetings and expand the number of managers in the group.**

By the end of Year Three:

- The first and second waves of operators have gone "live" with their system.
- A third wave of operators have acquired a system and begun implementation.
- One or more qualified regional operators have begun implementing the regional strategy.

Year Four

    a. **Evaluate costs of deployment and success or failures of third year's implementations.**

    b. **Develop fourth year budget.** Compute similarly to the second year budget.

    c. **Announce and Promote CASD Program.** Include in the announcement that peripheral equipment will also be funded (for operators with at least one year of "live" CASD operation).

    d. **Fund fourth year recipients**

    e. **Evaluate program and make changes as appropriate**

    f. **Conduct two user group meetings and expand the number of managers in the group.**

By the end of Year Four:

- All operators have acquired, implemented and routinely use a system in day-to-day operations.
- All regional operators have begun implementing the regional strategy.

Year Five

    a. **Evaluate costs of deployment and success or failures of fourth year's implementations.**

    b. **Develop fifth year budget.** Compute similarly to the second year budget.

c. **Announce and Promote CASD Program.** Include in the announcement that peripheral equipment will also be funded (for operators with at least one year of "live" CASD operation).

d. **Fund fifth year recipients**

e. **Evaluate program and make changes as appropriate**

f. **Conduct two user group meetings and expand the number of managers in the group.**

By the end of Year Five:

- The regional strategy has been implemented in full
- Evaluation has identified program successes and appropriate changes.

Appendices

Appendix I   STATE SURVEY

Contact Name _____   Contact Number _____

State_____   Date _____

1. What is your state's strategy for implementation of CASD systems in paratransit?
2. Has the strategy been implemented? If so, how long did it take to implement?

3. Was paratransit coordination a part of your state's CASD implementation strategy?
4. (If yes), was CASD used to promote coordination?

5. What are the benefits of your state's CASD/coordination strategy?

6. Who qualifies (all 5311's/other organizations) under the state's current CASD
    strategy?

7. (If implemented) How many paratransit providers participated in the CASD efforts?

8. What were some of the problems encountered in the planning stage? How did you
    deal with them?

9. What were some of the problems encountered in the implementation stage? How did
    you deal with them?

10. What were some of the problems encountered post-implementation? How did you
    deal with them?

11. If you could implement the CASD/coordination program all over again, with the
    knowledge that you have now, what would you have done differently?

12. Were there any political problems encountered? (What were they?)

13. Were there any administrative problems encountered? (What were they?)

14. Were there funding problems encountered? (What were they?)

15. Were there any software problems encountered? (What types?)

16. Did you choose a particular vendor for CASD? Who?

17. How does your state deal with vendors? Do you have a state approved list of
    vendors, or do you deal with just one vendor?

18. What components of the CASD software were installed? Was AVL installed?

19. What components of the CASD software installed are currently being used?

20. How was the CASD implementation strategy funded?

21. Are there any complaints from operators after CASD/overall strategy implementation? What are they?

22. Can you supply a copy of your state's program report?

Thank you for your time.

Appendix II: FTA & 5311 Contact List

FTA Contacts

Raymond Keng
FTA
Office: 1-202-366-6667

Mac Lister
FTA
Office: 1-202-366-9292

TCRP
Office: 1-202-334-3224

ITS America
Office: 1-202-484-4847

Douglas Gerleman
FTA – Regional
Office: 1-312-886-1621

5311 Contacts

Rides Mass Transit
Ms. Betty Green
Executive Director
Main Street
Rosiclare, IL 62982
(618) 285-3342 or (618)285-3370
FAX: (618)285-3340

Vehicles: 57
Ridership/Month: 19,000

Shawnee Development Council
Ms. Cheryl Vanderford
Executive Director
School Street
Karnak, IL 62956
(618)634-2201 or 2373
FAX (618) 634-9551

Vehicles: 19
Ridership: 7650

Williamson County Programs on Aging
Robert Childers
Executive Director
212 E. Walnut
Herrin, IL 62948
(618)988-1585
FAX (618) 942-6993

Vehicles: 9
Ridership: 2924

South Central Transit
Tom Ashby
Managing Director
235 N. Walnut Street
Centralia, IL 62801
(618)532-8076
FAX: (618)532-8078

Vehicles: 44
Ridership: 10,750

CEFS

Linda Mitchell
1805 S. Banker St.
Effingham, IL 62401
(217)342-2193 ex. 120
FAX: (217)342-4701

Vehicles: 16
Ridership: 2963

Show Bus

Ms. Laura Dick
Meadows Mennonite Home
R.R. 1
Chenoa, IL 61726

(309) 747-2454
FAX: (309)747-2944

Vehicles: 25
Ridership: 3000

Piatt Cnty Mental Health

Ms. Susan Lochbaum
Program Director
1921 N. Market Street
Monticello, IL 61856
(217)762-5371 or (217)762-7521

Vehicles: 9
Ridership: 3200

Warren Achievement

Mr. Bob Ray
Transportation Director
1360 S. Main Street
Monmouth, IL 61462
(309)734-6001

Vehicles: 17
Ridership: 5486

Coles Council on Aging

Susan Starwalt
204 S. 21st Street
Mattoon, IL 61938
(217)348-5355
FAX: (217)234-3410

Vehicles: 7
Ridership: 6844

We Care

Mr. Jim Thompson
Transportation Director
622 W. Jackson Street
Morton, IL 61550-0016

(800) 538-6906 or (309) 263-7708

Vehicles: 21
Ridership: 5600

Barry's Taxi Service

Ms LuAnne Barry
302 S. Mechanic St.
Macomb, IL 61455

(309)833-1700

Vehicles: 3 vans, 3 cars
Ridership: 5019

American Red Cross

Ms. Nancy Rutledge
Vice President
1224 Maple Ave.
Macomb, IL 61455
(309)837-1594

Vehicles: 7
Ridership: 4050

Voluntary Action Center

Mr. Thomas Zucker
Executive Director
1606 Bethany Road
Sycamore, IL 60178
(815)758-3932

Vehicles: 33
Ridership: 13,333

Abilities Plus

Mike Zerull
319 N. Main Street
Kewanee, IL 61443
(309)852-4626
FAX: (309)852-0805

Vehicles: 8
Ridership: 1667

St. Margaret's Hospital

Ms. Janyce Stukert
Transportation Coordinator
600 E. First Street
Spring Valley, IL 61362

(815)664-5311
 FAX: (815)664-1184

Vehicles: 3 vans
Ridership: 538

Jo Daviess Workshop

Mr. Rich Machala
Transit Manager
706 West St.
Galena, IL 61036
(815) 777-2211 ex. 23 FAX: (815)777-3386

*Ridership – Represents trips/month

Boone Cnty Council on Aging

Ms. Anna Gray
Executive Director
306 Buchanan
Belvidere, IL 61008
(815)544-9893

Vehicles: 7
Ridership:

Galesburg HandiVan

Ms. JoAnne Harris
Human Services Coordinator
150 E. Simmons
Galesburg, IL 61401
(309)345-3634   or (309)345-3686
FAX: (309)343-2493

Vehicles: 4 medium duty; 4 walk-ons
Ridership: 7300

Gateway Services

Paul Kautz
Executive Director
406 S. Grosse Blvd.
Princeton, IL 61356

(815) 875-4548 ex. 25
FAX: (815) 875-8602

Vehicles: 9
Ridership: 2000

Appendix III: North Carolina's Breakdown for Technology Assessment

Technology Plan for NC Transit Systems					
Categories: 1 A	**1 B**	**2 A**	**2 B**	**3 A**	**3 B**
Small Rural	Medium Rural	Regional Rural	Small Urban	Med / Large Urban	Regional Urban

Advanced Technologies

1 A	1 B	2 A	2 B	3 A	3 B
				Multi-Modal ITS Regional Integration	
				Real Time Information	Real Time Information
				Stop Annunciators	Stop Annunciators
				AVL / Real Time	AVL / Real Time
				Interactive Voice Response Telephone	Interactive Voice Response Telephone
			Electronic Fare Collection	Electronic Fare Collection	Electronic Fare Collection
			APCs (post processing)	APCs	APCs
	Scheduling Software / Custom DBs	Scheduling Software	Scheduling Software	Scheduling Software	Scheduling Software
Electronic Manifest	Electronic Manifest / MDT	Electronic Manifest / MDT	Electronic Manifest / MDT	Mobile Data Terminals	Mobile Data Terminals
Client ID - Bar Codes	Client ID - Bar Codes	Client ID - Bar Codes / Mag Stripe	Client ID - Bar Codes / Mag Stripe	Client ID - Mag Stripe / Smart Cards	Client ID - Mag Stripe / Smart Cards

Baseline / Foundational Technologies

1 A	1 B	2 A	2 B	3 A	3 B
GPS - Client Set Up	GPS - Client Set Up	GPS	GPS	GPS	GPS
Service Bureau: GIS	Service Bureau: GIS	GIS	GIS	GIS	GIS
Service Bureau: Maint	Service Bureau: Maint	Maintenance Software	Maintenance Software	Maintenance Software	Maintenance Software
Templates / Accounting	Templates / Accounting	Templates / Accounting	Templates / Accounting	Templates / Accounting	Templates / Accounting
Computer Upgrades	Computer Upgrades	Computer Upgrades	Computer Upgrades	Computer Upgrades	Computer Upgrades
Voice Mail / Email	Voice Mail / Email	Voice Mail / Email	Voice Mail / Email	Voice Mail / Email	Voice Mail / Email

Appendix A

Appendix IV: Technology Assessment Inventory

AA1	• Has (31)workstations & (1) server o Server type: NT, Outlook package is 2000 • Specific computer tasks: billing, reports, run processing, driver manifest, (scheduling and dispatching) • CPU Type: Pentium III • Operating system: Windows 98 • Drives: o 3.5" Floppy o HDD: Disk Space 58% free o CD-Rom o Zip Drive • Ram Memory: 127 MB • Monitor: Gateway, EV 700 • Modem: Dial-up, 1 line o Will eventually have a high speed modem through network • Printers: o 3 HP Office Jet G55xi printers (networked), in offices o 1 Scanner/Printer: HP, in transportation coordinators office • Peripherals: o 2 copy machines
AA2	• (6) Workstations, located in garage & administrative offices • Computer tasks performed: Internet, e-mail, Word • CPU Type: Pentium III • Operating system: Win Office 98 • Drives: o 3.5" Floppy o HDD: 20 GB o CD-ROM • RAM: 64 MB • Monitor: AOC Spectrum • Modem: Dial-up • One user of computer • Printers: o 2 HP DeskJet 672C printers in Jim's office o Xerox printer in hallway • Peripherals: o Copy Machine in hallway
AA3	• Has 1 workstations & 1 server (broad, general database server & only in front office • Tasks performed by computer: Corel WP, Quattro Pro • CPU Type: Pentium II, Pentium 4 • Operating system: Win 95, Win XP

	- Drives: 3.5" Floppy - HDD: 74.4 GB - CD-ROM: Quad 3 speed - RAM: 32 MB, 512 MB - Monitor: Samsung 7e, DELL - Modem: (Dell only) dial-up (slow) 4 users of computers - All four computers are used for different purposes - Printers: - HP DeskJet 1220C (front office) - Epson Stylus 580 (back office) - Peripherals: - Non-hooked up Paperport 6100 (in a box in bathroom) - Intellifax 770 (Laura's office) - Copy machine- Toshiba 1376 (back office)
AA4	- Has (4) Workstation & (1) Server - Server Type: Database server, in the process - Use of computer: (Tasks) Dbase - CPU Type: ASUS - Speed: 350 Mhz - Operating system: Win 98 - Drives: 3.5" Floppy, HDD Disk space: 83% free - CD-Rom - Ram: 128 MB - Monitor: KDS (visual sensations) 15" - Printers: 3 Hewlett Packard (DeskJet) 930c printers: located in offices - Modem: 56k x 2 v. 90 - Network card: PCI 10/100 mbps (Plug & Play) - Number of users: 3
AA5	- Has (2) workstations & 1 server (Infoban) - Computer tasks: STAT TRAC, Win Office programs used - CPU Type: Authentic AMD – k6 3D - Operating system: Win 98 - Drives: 3.5" Floppy - HDD – 2 GB - CD-ROM - RAM: 28 MB - Monitor: Inteva - Modem: dial-up - Printers: - HP DeskJet 660C (located in office)

AA6	• Not available

KV1	• Has 3 servers – 2 are linked
	   o Application servers, QuickBooks, Novell Client Server
	• Desktops with Pentium or greater
	• CPU speed varies, depending on how new the computer are
	• OS Win 9x, ME
	• Drives:
	   o 3.5" Floppy
	   o HDD: enough space available
	   o CD ROM in most computers
	• RAM: enough available
	• Monitors: 15" and 17"
	• Network Cards: 3COM, 100 Mbps
	• 25 desktops, 18 networked, 7 standalone
	• Every workstation has a printer (DOT, inkjet, and laser)
	• Scanner, Digital Camera, Camcorder
	• Laptops, Projector (mainly used for PowerPoint presentations)
	• Internet access through modem 56Kbps (gateway on the administrative server)
	Note: Technologically well equipped. Hardware would not be an issue in case of new computerized system (no MDT, AVL, IVR). Did not ask about the backup system, but I don't think it would be an issue.
	• There is a computer Guru in the organization.

KV2	• Contract Routes (subscription service) & demand responsive. They are trying to go mass transit.
	
	• 5 computers, 4 transportation, 1 maintenance
	• Run Trax-It software on the server, use the rest for reporting and maintenance
	• Computers are networked; brand new network, 100Mbps.
	• CPU: Pentium II/III
	• OS: Win 98 / NT (on the transportation server)
	• Drives:
	   o 3.5" Floppy
	   o HDD: enough space available
	   o CD ROM in most computers
	   o ZIP
	• RAM 128 / 96 MB
	• Monitors: 15"
	• 2 Inkjets (Lexmark)
	• Scanner;
	• Internet Gateway (it is not clear what was the speed, but presumably 56Kbps)

KV3	• 2 desktops, one used for reporting purposes, the other for financial purposes (latter is for the whole agency, not only transportation) • No network in place (looking forward to install a network, when grant will be approved) • CPU: Celeron / Pentium II; 333 MHz • OS: Win 98 • Drives: o 3.5" Floppy o HDD: 4 GB (171MB free) / 6 GB (4.38 GB free) o CD ROM in most computers o JAZZ Drives in both computers • RAM 64 / 64 MB • Monitor: 15", 15" • Modem 56 Kbps • Printer: Laser (Samsung) Note: They were looking into getting two brand new computers, pending on a grant that they were approved for. • Computer assistance is provided by an acquaintance outside the organization.
KV4	• 2 standalone computers • Used for daily and monthly reports • CPU: Pentium II, 400 MHz • OS: Win 98 • Drives: o 3.5" Floppy o HDD: 6GB (4GB free) o CD ROM in most computers o JAZZ Drive • RAM 64 MB • Monitor 15" • Modem 56 Kbps • Network Card: DLink even though no network is available. • Printer: HP LaserJet 1100 • Note: They were looking into installing a network, although the expertise is questionable. Might need consulting in information systems.
KV5	• Have a network in place, which hosts StrataGen Adept 2.2 paratransit software. • Organization with in-house computer expertise. • Hardware fairly new, with Pentium III or above, Win 98 / NT, dispatcher workstations well equipped (RAM 128 MB, Monitor 17", etc.) • All computers are networked • Internet Gateway • Using PC Anywhere among the 5 counties they service

	• 2 Laser printers • Individual (not networked) Ink Jets • Old Scanner, not using it. • Modem: 56 Kbps (gateway) Note: Organization has a computer Guru, covering software and infrastructure. • Might need some financial assistance (they are currently leasing the Adept 2.2 because it is too expensive to buy. Also looking into fixing some bugs that might be fixed with the new version of StrataGen's software)
KV6	• Have computers, not clear what configuration – did not have the chance to look it up; • Networked for other programs they provide, not for transportation • Not clear whether they would like to expand on the transportation area or if they would like to automate this function. • Note: Hardware available for a smaller system.
EP1	• CPU type: Inteva, 686 type • Mhz: unknown • OS: Win 98 • Drives: 3.5" floppy, 7GB HD, CD Rom, Zip, CDRW, • RAM: 128 MB • Monitor: 17" • Modem installed, unknown speed • Comments: Internet via modem. No network available
EP2	Manager computer: • 17" monitor • CPU: p5, 200 MHz • HD: 7 GB • RAM: 64MB • Network: wireless Dispatcher computer: • 19" monitor • Win98 • PIII • 128MB • 15GB
EP3	New computer: • HD: 13 GBN • RAM: 64 MB • CPU: K6 • OS: Win 98 • 17" monitor • Laser printer • No network

	• No internet • No dialup • Maybe have network card Other computer, used by bookkeeper: • 32MB • 7GB • W95 • 17" • Uses 123 for billing, manually re-key data from printout.
EP4	• 14" Monitor • CDROM installed • CPU: Pentium • RAM: 48 MB • HD: 1 GB, 1/3 free • No modem • On hospital network • No internet • Compaq ProLinea 5100e
EP5	•
EP6	•
EP7	Server: NT OS, PII Client: • OS: W98 • 1 floppy • HD: 8 GB • RAM: 64 MB • Modem available • Network card installed

**Initials represent codes for each team and the places they visited

Appendix V: List of Contacted Vendors

No.	Company name	Status
1	Teleride Inc.	Interview completed
2	RouteLogic	Interview completed
3	Trapeze Software Inc.	Interview completed
4	RouteMatch Software Inc.	Interview completed
5	StrataGen Systems	Interview completed
6	Multisystems Inc.	Interview completed
7	Shah Software Inc.	Interview completed
8	Kernel Software Inc.	Interview partially completed
9	Intelitran	See Multisystems Inc.
10	GIRO Inc.	Interview not completed
11	CTS Software	Interview not completed
12	Computer Technology International	No response
13	Decision Science, Inc.	No response
14	Micro Dynamics Corporation	No response
15	Advanced Transit Solutions	Phone disconnected. No Web Site
16	Analyst Management Inc.	Phone disconnected. No Web Site
17	PC Solutions, Inc	Phone disconnected. No Web Site
18	Henson Consulting	There is Henson residence

Appendix VI: Phone Survey Instrument for Vendors

Company name:
Name of person:
Title of person:
Phone:
Fax:
Company address:
Website:_____
Company
 Product

1.   Does your company offer Paratransit software?
        Yes, Prod name:
        Prod description:

2.   Do you provide a user's manual? If yes, what does it cover?
        ☐ Setup   ☐ Training   ☐ Maintenance

3.   What operating systems is your product compatible with?

        ☐ DOS/W3.11   ☐ W9x   ☐ WMe/2000   ☐ UNIX
        ☐ Others

4.   What are the minimum computer configuration requirements?
        Server   **Client**
        Processor: Processor:
        RAM: RAM:
        Screen: Screen:
        HDD: HDD:

5.   Minimum/Maximum no of vehicles the software supports?

6.   How many trips per day can the system handle?
        One-way: Round Trip:

7.   Has this product been interfaced with other technologies, such as:

        ☐ AVL   ☐ MDT   ☐ Smart Card
        ☐ Others:

8.   Does your product use GIS to geocode addresses?
        If yes, which GIS product:

9.   Is a billing component included in your software?

If yes, what type of billing?

10.   Does your product output reports and tables into any of the following formats?
      ☐ dBase   ☐ ASCII   ☐ Lotus/Excel
      Others:

11.   Can users create their own reports based on the outputted data?

12.   Does your product create performance indicators?
      ☐ Trips / (Hour)Day   ☐ Trips / Mile
      Others:

13.   What communication standards does your product use to communicate with other products?
      ☐ SAE J1708   ☐ SAE J1587   ☐ SAE J1455
      Others:

14.   What level of computer expertise do users need to have to use the product efficiently?

15.   Software cost:

16.   Hardware cost:

17.   In vehicle cost:

18.   Is initial training included in the product price?
      If yes, how many days: If no, how many days do you recommend: training cost per day:

19.   What is the daily rate for any additional training:

20.   What is the annual maintenance fee:

21.   What does the annual maintenance fee include:

22.   Do you offer customer support
      If yes, is it Phone, Web, or On-site based:

23.   What is the cost of software interface to other technologies, if any:

24.   Are there any other costs associated with the product:

25.   What is your company's Licensing Agreement, if any:

26. Do you consider price adjustments depending on the number of sites the product is installed:

27. Have your product been implemented at state / regional level?
    If yes, please name the state(s) / region(s):

   Are there any other issues that were not addressed:

Appendix VII: Survey Instrument – Manager

Manager – Survey of Paratransit Operators

Survey Participant Name / Title ┌─────────────────────────┐

Organization ┌─────────────────────────────────┐

Date ┌─────────────────────────────┐

1. Please describe the kind of operations your organization provides (paratransit, fixed route, subscription or/and demand responsive services)?

2. Please define your service area?

3. How many vehicles are in your fleet (currently, future purchases)

4. How many vehicles, on average, are you dispatching per day?

5. On average, how many one-way trips per day does your organization provide? Please list demand responsive and subscription separately?

6. How many personnel are employed by your organization?

7. How many of the employees are involved in the Paratransit operations (call takers, schedulers, dispatchers, etc.)

8. Describe how your operations are being carried out (dispatching, scheduling, reporting, billing, driver manifests, etc.)?

9. How many new customers do you have on average (per week, per month)?

10. What information do you store about customers?

11. Per total, how many different Sponsors do you interact with?

12. How do you receive and process customer complaints?

13. How much in advance do customers have to place their trip request?

14. How many computers (networks) do you currently have?

15. What file formats (ASCII, Spreadsheets, Dbase, Lotus, etc) do you use for storing the information needed to run your operation (customer information, vehicles information, etc.)?

16. How many phone lines do you have available for interacting with customers?

17. What kinds of tasks do you perform on the computers (general, scheduling/dispatching, book keeping, etc.)?

18. How many of your employees work on computers, and what tasks they are responsible for?

19. Who (person / vendor) provides the computer support?

20. What is the computer expertise of your employees (especially call takers, dispatchers, schedulers)?

21. Briefly describe the set of reports you usually use in your organization (operational reports, inventories, accounting / book keeping, etc.)?

22. How many of the reports are generated automatically, and how many are generated manually (use percentage if no exact count is applicable)

23. What type of reports does your agency have to submit to the Federal / State government?

24. On average, how long does it take to process/prepare these reports?

25. How do you maintain your primary billing records?

26. Do you use computers in your work? How?

27. Have you overseen implementations of a computer system at your organization? If yes, what was it used for? What kind of problems did you encounter?

28. If you were given funds to purchase a computer system, what would you buy? What would you use it for?

29. Are there potential computer scheduling and dispatching systems that you like?

30. Are there any other organizations providing service in/near to your service area?

31. Have you ever tried to coordinate? If yes, what was your experience?

32. If no, would you consider coordination of your operations with other agencies?

33. Please list any other issues you think are important and were not addressed.

Appendix VIII: Survey Instrument – Dispatcher

Dispatcher and Scheduler Survey

Survey Participant Name / Title [   ]

Organization [   ]

Date [   ]

General

1. Briefly describe your position and the activities you perform (call taker, scheduler, dispatcher, what activities you are responsible for – list)?

2. Please describe how you perform the activities listed above (detailed description)

3. Do you currently use computers (either at office or at home)?

4. Do you currently use computers at work to perform your tasks? If yes, briefly describe the tasks you perform on computer.

5. What software applications are you familiar with (Word, Excel, etc. - list)?

6. How often do you use them?

7. Do you have an Internet connection (at home or at work)? If yes, do you use Internet to perform your tasks?

Operations

8. Please describe the process of developing runs.

9. Do you have to frequently change your runs (to accommodate new customers, or demand, etc) and how much does it affect your scheduled runs?

10. How do you access information that you need to perform your job (manually, workstation, specialized databases on LAN, etc.)?

11. How do you generate the driver manifest (manually, automatically), and how many persons are involved in this process?

12. How do you maintain contact with the drivers i.e. route changes, status reporting, (by cell phone, radio, etc.)?

13. Is locating the customer address an issue (if the driver does not know get there how do you proceed)?

14. How are vehicles assigned to drivers (are they assigned, or it is their choice)?

Customers

15. Do you directly interact with customer (describe how)?

16. How do you currently insert new customers in your system?

17. For how long do you keep the information about customers?

18. Please describe the process of checking the ADA eligibility? (what forms the customers complete, how long it takes, etc.)

19. Do you have an automated phone system where you can put the client in hold if you are busy?

20. Did you ever have to decline customers, or "loose" them while they were on hold? If yes, how often, and describe the circumstances?

21. Do your responsibilities require you to know the client's characteristics (types of disabilities, what kind of assistance they need), or this only concerns drivers?

Problems & Issues & Miscellaneous

22. What are, if any, the drawbacks in the processes that you carry out?

23. Do you think that a computer system would make your tasks easier?

24. How would you feel about using a computerized scheduling and dispatching system?

25. Do you feel it would be helpful in your job?

26. Do you have any worries about using such a system?

27. Are you willing to attend training session for such a system?

28. Please list any other issues that were not addressed?

Appendix IX: TECHNOLOGY INVENTORY

Physical Location of the computer:

[ ] Workstation   [ ] Server

Use of computer:
☐ Specific task (describe):

☐ Server type (e.g. database server, file server):

CPU Type (e.g. 486, PentiumIII, etc.):

_____

CPU Speed (Mhz): _____

Operating system: _____

Drives
  ☐ 3.5"Floppy   ☐ 5.25"Floppy
  ☐ HDD1: Disk Space _____   Free space: _____
  ☐ HDD2: Disk Space _____   Free space: _____
  ☐ CD-ROM: Speed: _____
  ☐ ZIP Drive
  ☐ CD-RW: Speed: _____

RAM Memory (MB): _____

Monitor (brand name, size, resolution):

_____

Additional Information
  ☐ Modem (baud rate):_____
  ☐ Network Card (type):_____

User Information (number of users):

Comments:

HARDWARE QUESTIONNAIRE

Number of workstations:

Number of servers:

List all printers (make , model, location)

Printer Make/Model	Check if Networked	Location

List all other peripherals (Scanner, Bar Coder, etc.)

PERIPHERAL Make / Model	Location

NETWORKING QUESTIONNAIRE

Is there a network installed:

Are there any plans to install a network system?

Internet access (gateway, per computer, etc, IP address, mailing protocols)

Speed of the Internet connection

☐ 28.8Kbps   ☐ 56 Kbps

☐ ISDN ——————   ☐ DSL ——————

☐ Cable ——————   ☐ T1

☐ T3   ☐ Other:

List any other networking issues that were not addressed

Appendix X: CASD Software Features

Features – CASD software	Operator size		
	Small	Medium	Large
Client Registration			
Client database – information about all clients will be stored in tables in a database in a consistent way. Databases will be compatible among the different levels of software (i.e. customized databases, semi-automated, and fully automated)	Yes	Yes	Yes
Problem passenger information – the system will store information to show that a client is problematic (e.g. frequent no-shows, on board behavioral problems, etc).	No	Yes	Yes
Client eligibility check – the system will facilitate all information gathering process to determine if a client is eligible for ADA service.	No	Yes	Yes
User defined fields – users will be able to add additional information (attributes) to the client tables to tailor service or to perform special analysis.	Yes	Yes	Yes
Trip Booking			
Customer eligibility check – entering customer name on the trip booking form will automatically check if the customer is eligible for the trip.	Yes	Yes	Yes
Customer data retrieval – entering customer name into the trip booking form will automatically fill out the form with all necessary information.	Yes	Yes	Yes
ADA service eligibility – entering the customer name on the trip booking form will automatically check if the customer and the trips are eligible for ADA service.	No	Yes	Yes
Frequent destination list – the system will generate a list with the customer's most frequent destinations; this will help in the trip booking process, cutting down the time spent on the phone.	No	Yes	Yes
Concurrent users – the system will be handle more than one concurrent users performing any legitimate operations (trip booking, scheduling, generating reports, etc.) without conflicting with one another.	No	Yes	Yes
Place name recognition – when booking trips users will be given a list of all places with similar spelling as they enter letters from the name of the place. (e.g. if the first letter is "A" all places that begin with "A" will be displayed, and so on)	No	Yes	Yes
Address verification – all addresses will be checked against the database to ensure that they exist and to clear all potential mistakes (e.g. 800 North Ave. is not the same as 800 North St.).	No	No	Yes
Real time estimates – the system will automatically calculate the estimated pickup time for passengers when they are booking trips. In low-end software, unlike in high-end software, the estimate will not be made on actual vehicle assignment.	No	Yes	Yes
Partial name/address entry – partially inputting names or addresses will automatically suggest completed names or addresses; speeds up the trip booking process.	No	Yes	Yes
Recent ride history – a list of all recent ride history for each customer will be maintained so that trips booking operations can be speed up.	No	Yes	Yes
Scheduling			
Callback confirmation – patrons who have scheduled trips are called for confirmation or for changes in the scheduled trips	No	Yes	Yes

Vehicle selection for customer needs – the software will prompt the user to select only vehicles that suite the customer's needs (e.g. vehicle needs wheelchair, etc.)	No	Yes	Yes
Batch scheduling and dispatching – perform trip scheduling for using route optimization for all outstanding reservation. Usually done a day in advance.	No	No	Yes
Call-Back list – the software will generate a list of customers with their telephone numbers so that their scheduled trips may be confirmed in order to cut the no-shows, and unnecessary waiting times.	No	Yes	Yes
Route optimization – automatic route selection for all outstanding trips based on algorithms that increase system efficiency.	No	No	Yes
If there are more customers with the same information the user will be prompted to select the customer.			
Fully computerized scheduling/dispatching – the system will be capable of performing scheduling and dispatching operations with no human intervention.	No	No	Yes
Passenger prioritization – the system will be capable of assigning passenger priority levels to passengers so the their trips can be scheduled accordingly. This feature is probably not allowed in a pure ADA service, but ADA passengers might be assigned higher priority when combined with non-ADA passengers.	No	Yes	Yes
Personalized loading times – provides loading times for each customer in part so that more accurate schedules can be built.	No	Yes	Yes
Redundant reservation warning – schedulers will be warned if an attempt is made to schedule trips that are redundant.	No	Yes	Yes
Dispatching			
In-vehicle data capture – system must be able to capture information from the vehicle, such as: waiting time, exact pick-up/drop-off times, exact distances, etc. This can be done either automatically (using MDT, AVL, etc.) or manually (having the driver collect the information and the scheduler/dispatcher entering it into the system)	Yes	Yes	Yes
Fixed route transfers – includes in the trip planning the meeting of fixed route buses to facilitate transfers between demand responsive and fixed route services.	No	Yes	Yes
Trip grouping – the system will group trips that consist of customers traveling on the same or close routes.	No	Yes	Yes
Keyword search and sort capabilities – the ability to search for any and all passengers who have common characteristics, such as: mobility aids or destinations; can be useful for grouping trips or helping passengers.	No	Yes	Yes
Override scheduled trips – will allow users to override schedules generated by the software	No	No	No
Passenger transfer – the software will be able to schedule and dispatch vehicles such that passenger transfers can be effectuated between two or more vehicles, if needed.	No	No	Yes
Trips displayed on layered maps – the system displays trips on maps showing street networks with the possibility to chose the needed level of detail (zoom in or out).	No	No	Yes
Vehicle information – the system will store information about the vehicles so that specific information, such as: vehicle capacity, wheelchair enabled, etc. can be accounted for when dispatching.	Yes	Yes	Yes
Speed as function of traffic, time, geography – vehicle speeds used by the software for scheduling and dispatching purposes are relative to various factors stored as system-wide constants. Various levels of sophistication are possible from simply assigning a constant speed on a street to changing the speed function of time of day, bridge delays, weather, etc.	No	No	Yes

Zonal system – an operating procedure that assigns vehicles to operate in designated areas.	No	No	Yes
Billing			
Fare calculation – fares are automatically calculated for each ride, regardless of the different attributes, such as: time of day, rider type, or any other attributes	No	Yes	Yes
Sponsor billing – allows for summarizing costs of rides per sponsoring agencies, to bill the sponsor for all trips taken in the same timeframe.	Yes	Yes	Yes
Billing codes – assigning codes to either trips or passengers to be able to summarize costs, trip frequencies, and other similar parameters	Yes	Yes	Yes
Flexible invoice formatting – the ability to customize invoices to reflect the standards of different paying agencies or providers.	No	Yes	Yes
Split billing – Allocation of the cost of a trip so that different sponsoring agencies can be billed for their clients. The allocation should be based on some logical methodology, such as trip miles, etc.	No	Yes	Yes
Reporting			
Ad hoc reporting – the ability to generate non-standard reports (i.e. reports that were not built into the system by the vendor)	Yes	Yes	Yes
System performance monitoring – allows users to generate reports based on different statistical parameters to assess the system performance.	No	Yes	Yes
DOT and DHS reports generation – system will have built in reports required by DOT and DHS programs.	Yes	Yes	Yes
Performance measurements reporting – the system will have built-in reports providing data for the most common performance measures (e.g. revenue-miles, dead-miles, no shows, trips/vehicle, etc.)	Yes	Yes	Yes
Section 15/NTD reports – the system will have built-in reports to provide transit system information for agencies receiving federal funding.	Yes	Yes	Yes
Others			
What if module – allows the software to simulate different scheduling and dispatching situations without affecting the actual ones; useful for tweaking parameters	No	Yes	Yes
Purge of inactive customers – automatically identifies customers that became inactive, based on predefined criteria, and moves them from the active database into archive files.	No	Yes	Yes
Costly trips – flagging costly trips (relative to other trips) because a vehicle serving other cannot serve them trips or because they are unusually long.	No	Yes	Yes
Address geocoding – all addresses will be identified with a unique geographical position; this will be used in the route optimization.	No	No	Yes
Import/Export capabilities – the system will be capable of reading and writing from/into the following file formats: ASCII, spreadsheets, and rich text.	Yes	Yes	Yes
User level security – the system will provide different users (or groups of users) different privileges (e.g. insert, delete, modify, install, etc.)	Yes	Yes	Yes
Menu help available – the system will provide help by selecting it from the menu bar, which can be accessed without having to exit any current screens or stopping any ongoing processes.	Yes	Yes	Yes
Pop-up menus / multiple widows – a menu of activities from which the user can choose appears when the user selects a heading with the mouse; the system will be able to handle more than one windows concurrently (e.g. client registration, scheduling, reports, etc.)	Yes	Yes	Yes
Remote terminal access – remote access to the computer over the Internet or	Yes	Yes	Yes

intranets is possible			
Simulation capabilities – the system will be able to simulate real life operations for training purposes.	No	Yes	Yes
Support for brokering – the ability to schedule and dispatch trips to vehicles from more than one agency or accommodate passenger requests from other agencies	No	No	Yes
Support for TIGER files – the system will have to be able to read and use geographic information from TIGER files.	No	No	Yes
User name and date stamping – the system will permanently store the names of the users (schedulers, dispatchers, administrators, etc.) along with the date and stamps to allow for auditing, determining needs for training, etc.	Yes	Yes	Yes
Data validation – all information entered into the database is checked for completeness, accuracy (if there is information to be checked against), data type errors (e.g. phone number cannot contain letters), and legitimacy (e.g. a 200 miles trip is questionable – for high end software)	Yes	Yes	Yes
Software modules – the system will be upgradeable with additional modules, such as: MDT, AVL, IVR, and others, without interference in the ongoing operations.	No	Yes	Yes

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