Deployment Strategies for Paratransit Computer-Assisted Scheduling and Dispatching Systems: Results from a Focus Group in Illinois

By

Paul Metaxatos
Anthony M. Pagano

Urban Transportation Center (M/C 357)
University of Illinois at Chicago
412 South Peoria Street
Suite 340
Chicago, IL 60607-7036

Tel: (312) 996-4820
Fax: (312) 413-0006
E-mail: pavlos@uic.edu

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ABSTRACT

The level of realized positive impacts from computer-assisted scheduling and dispatching (CASD) systems depends on the specifics of each implementation plan and the overall deployment strategy that is contemplated early in the procurement process. Moreover, with increasing numbers of local CASD system implementations, state departments of transportation have only recently realized the need to incorporate feedback from paratransit providers in developing statewide strategies regarding future deployments of such systems. While considering the variety of needs of Illinois paratransit operators, this paper develops three different CASD deployment scenarios: a centralized, a decentralized, and a regional deployment. The consensus from a focus group was that a hybrid approach that combines the strengths of the decentralized and regional approaches should be further pursued. The total cost of ownership for the preferred alternatives is also developed.

Keywords: computer-assisted scheduling and dispatching (CASD) systems, deployment strategies, focus group, cost

INTRODUCTION

Experience from deployments of computer-assisted scheduling and dispatching (CASD) systems has shown measurable efficiency, effectiveness and quality of service gains and confirmed expectations that such systems provide improvements in dispatching, scheduling, on-time performance and increased passenger satisfaction (*8, 5*). However, the level of realized positive impacts depends on the specifics of each implementation plan and the deployment strategy that is contemplated early in the procurement process (*2*). Moreover, with increasing numbers of local CASD system implementations, state departments of transportation have only recently realized the need to incorporate feedback from paratransit providers in developing statewide strategies regarding future deployments of such systems (*6*). Nevertheless, there is little research on operator reaction to alternative strategies.

This paper examines three different CASD deployment scenarios: a centralized, a decentralized, and a regional deployment. These three approaches were presented to a group of 5311 operators and transit executives in Illinois for their input using a focus group format. The total cost of ownership of each system is then developed.

FOCUS GROUP RESEARCH

Focus group research is an approach to the collection of qualitative information that utilizes open-ended questions to understand perceptions, feelings and the manner of thinking of individuals. Widely used in marketing research, the focus group approach provides an opportunity to probe individual opinions while allowing for a process of group interaction to develop. Focus groups provide qualitative data, but may not provide for consensus development or agreeable solutions to be arrived at. "The focus group presents a more natural environment than that of an individual interview because participants are influencing and influenced by others-just as they are in real life" (*3*). Focus groups allow individuals the opportunity to comment, explain, and share experiences and attitudes.

Focus group research produces results quite different from surveys and structured interviews. Instead of "hard" data, the research provides a set of perceptions, many of which may not be shared by all participants. It provides an understanding of an individual's thinking process, but does not provide data to be imputed into a statistical package. Further information on the focus group method can be found in (*3*), (*7*) and (*4*).

CASD IMPLEMENTATION ALTERNATIVES

In order to obtain feedback from the focus group, three high-level implementation approaches were developed and presented to the group as shown in Table 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

Table 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

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 (*1*). 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 1 shows the structure of this approach.

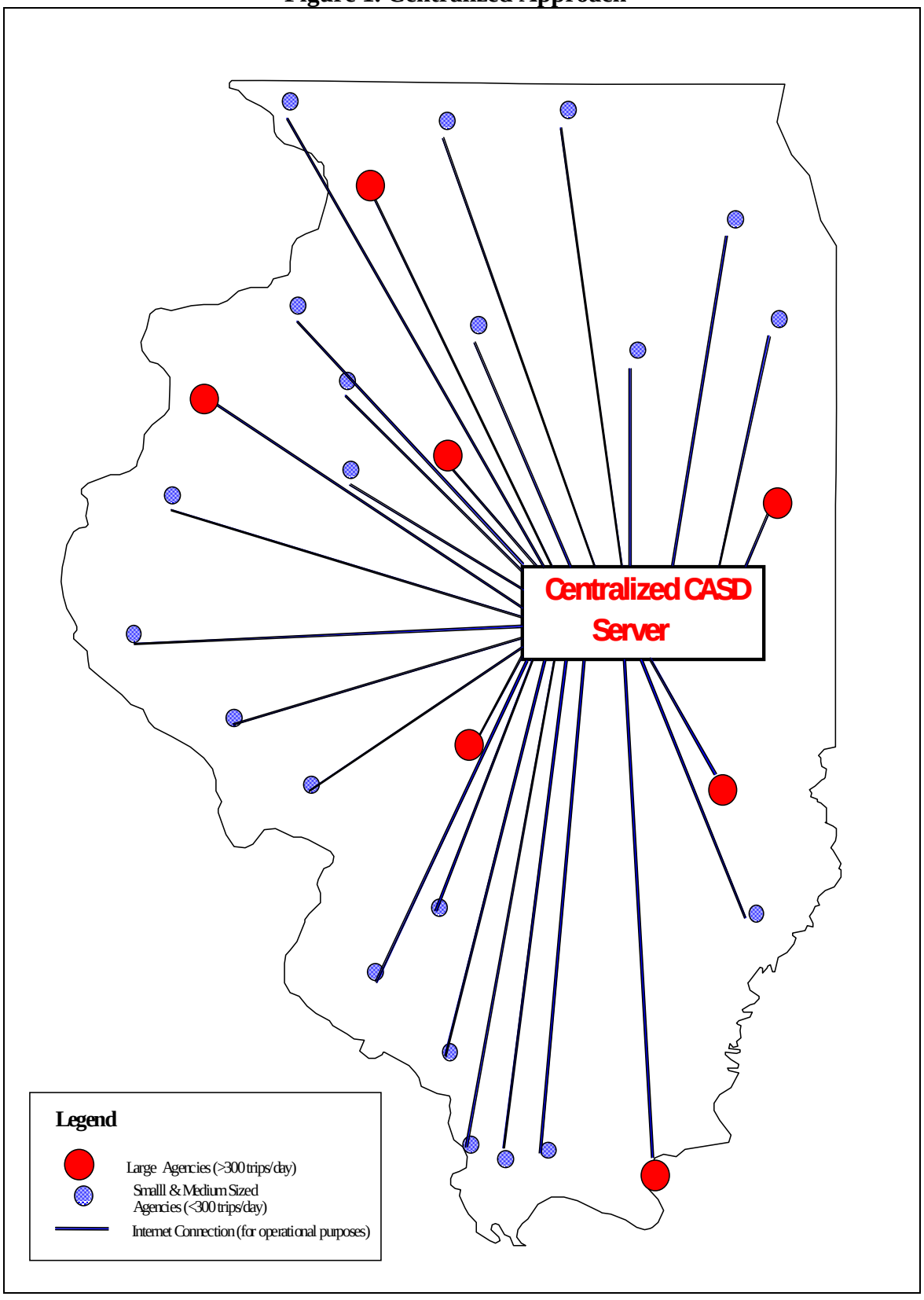
This approach is ideal if coordination and brokerage are to be accomplished at the state level. Other advantages include lower software costs resulting from purchasing all software needed for a statewide CASD from a single vendor. This approach commits to a minimum degree of coordination by ensuring 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 Internet connections, 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 states have successfully completed such an implementation.

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

Figure 1. Centralized Approach



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. Each agency would have its own contract with the vendor, which could increase 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 considerably add 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 would have its own software, coordination among agencies would not be possible without considerable expenditures on software and hardware add-ons for compatibility purposes.

Figure 2 depicts the architecture for this approach. As seen in the figure, there are no links among the various agencies. This is the most common approach to CASD implementation across the country. A combination of the two approaches, presented so far, results in the regional approach, described next.

Regional Approach

A regional approach to statewide CASD deployment envisions implementation of high-level technology components as conceptualized in Figure 3. The following discussion will clarify the role of each component.

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 capable connection 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 State DOT premises.

Figure 2. Decentralized Approach

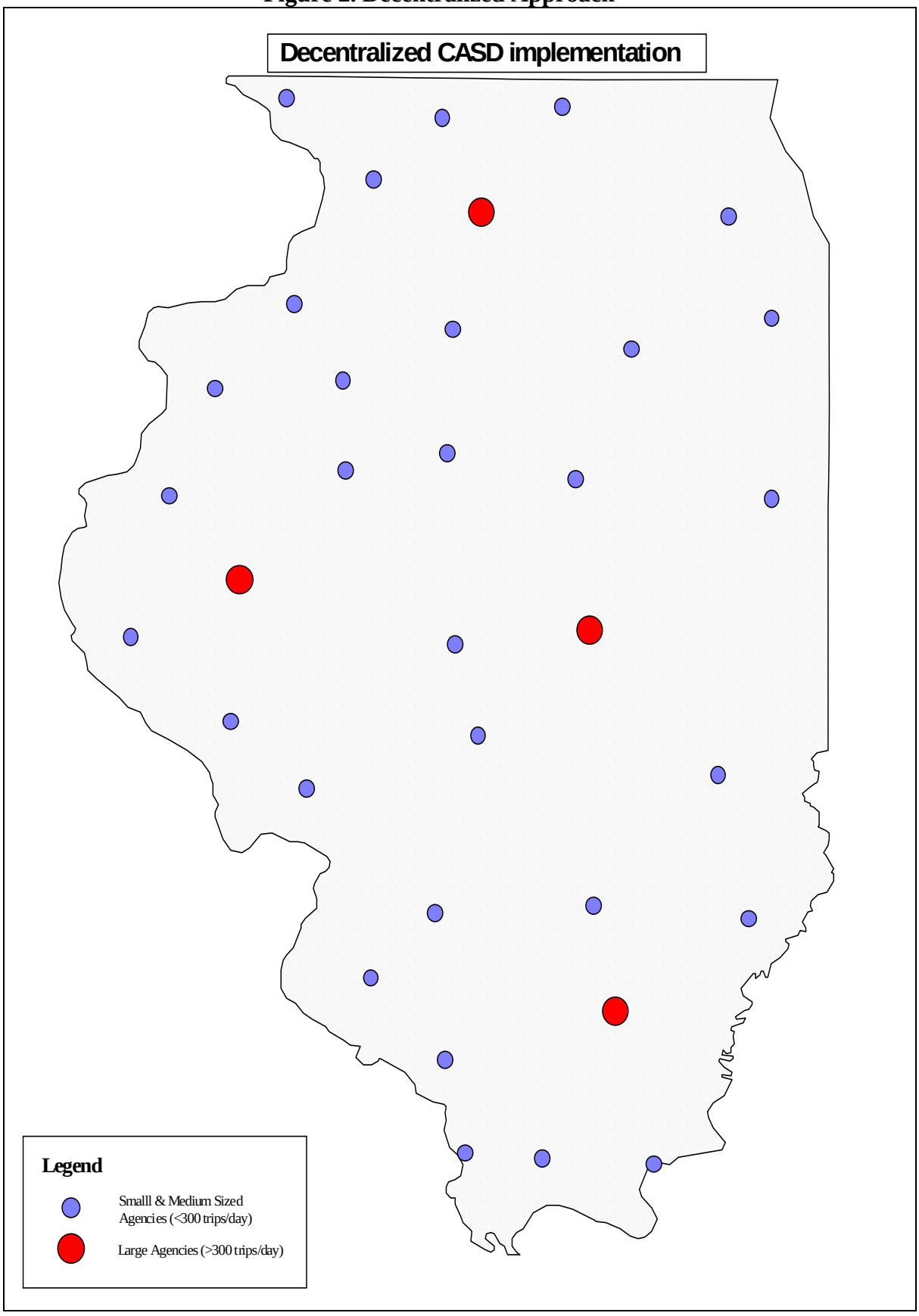
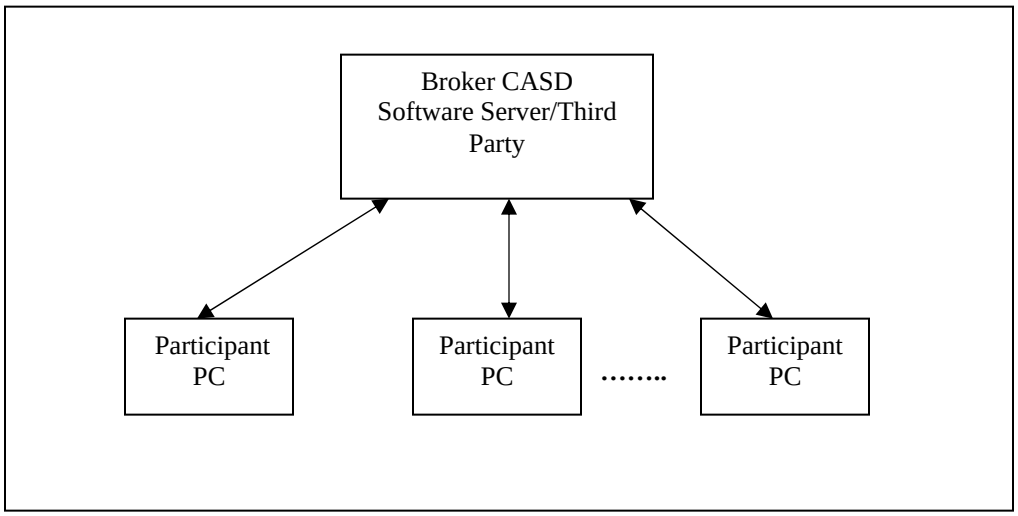


Figure 3. High-level Concept of Statewide CASD Implementation



State DOT Server**:** The DOT 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 State DOT server uploads from each CASD software server all of the information that is required for performance monitoring.

The principal advantages of such an approach include:

- Paratransit operators are relieved from having to worry about maintaining and updating the CASD software and related hardware.
- State DOT's will be able to monitor the contract performance in an objective manner and ensure the transportation needs of rural clients are met.
- If some form of coordination such as brokerage is desired at a later date, then the structure is in place to implement such an approach.
- 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 4.

FOCUS GROUP DISCUSSION AND FINDINGS

The focus group was held at the offices of the Springfield Mass Transit District in Springfield, Illinois. 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 and represented a diversity of Illinois' operators. Altogether, there were 15 participants from a variety of agencies across the state.

After the presentation of each of the three CASD implementation scenarios, 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.

CASD Systems Functionalities in Use or Desired

Scheduling and Dispatching Rides

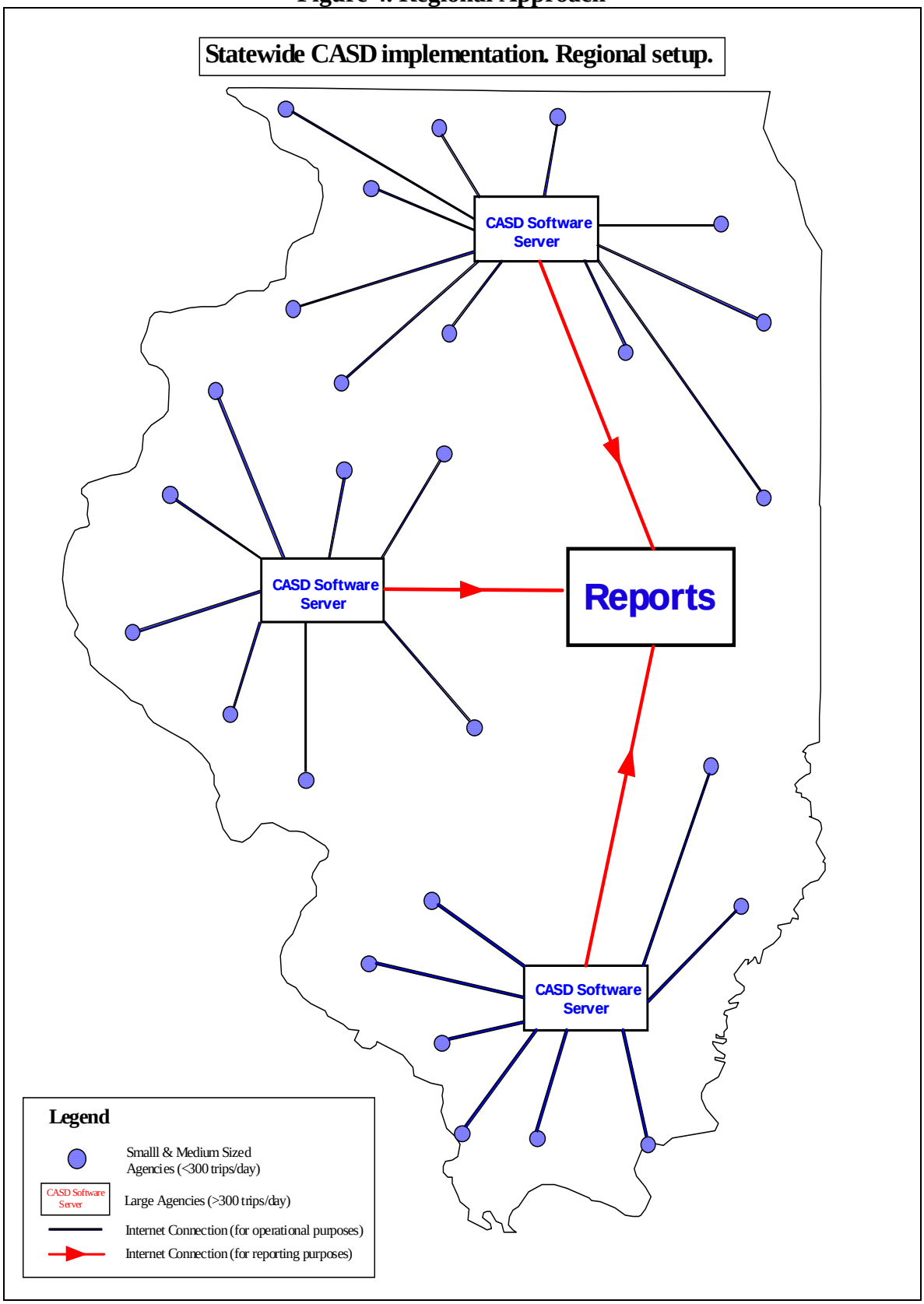
The majority of agencies rely on a fundamental software system that automatically generates a trip list. The computer-generated trip list is then used by at least one or two dispatchers, who pass it on to the paratransit drivers. Updating the list is typically done by hand when a demand response call 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.

Additional Software

The focus group was asked about their interest in additional software including 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." Participants, however, remained concerned with the cost-effectiveness and support availability.

The majority of the participants were concerned with having a system that would automate all of their work but would not be simple enough. 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.

Figure 4. Regional Approach



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.

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.

Coordination

Some operators have expressed their willingness to coordinate with other operators. "It would be nice to communicate with the surrounding counties" was heard a number of times. Presently, one operator is dealing with people in Iowa, mainly over the phone, and would rather be able to communicate with them over a computer system to 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.

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 said "the devil's in the details", referring to two existing barriers: (a) Many of their clients are elderly, and they must be taken care of preferring drivers that they know and have gotten used to. (b) 99% of their clients are elderly/disabled and feel uncomfortable with people they don't know.

Comments on Centralized CASD System Approach

Perception

Participants greeted the centralized scenario with much skepticism, although some did see possible advantages to it. 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.

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 approach.

Willingness to Participate

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 during implementation 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.

Comments on Decentralized CASD System Approach

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 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, 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.

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.

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.

Willingness to Participate

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.

Comments on Regional CASD System Approach

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 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.

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.

Willingness to Participate

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.

Focus Group Overall Findings

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.

Perceptions

Participants seemed more inclined toward the decentralized system. The opportunity to take a leadership role in implementing a regional CASD system 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 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 three approaches, 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.

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 did not seem to 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 should be made and followed through. In another fear regarding the CASD software, 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.

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.

Implementation Issues

Participants voiced a number of concerns regarding possible problems with implementing any form of CASD systems. The main concern 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 cited a well-publicized failed CASD implementation in Illinois. Some, however, were less concerned that the failed attempt would be repeated, conceding that, "another organization (in Illinois) 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. One participant said, "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 (the Illinois department of Human Services) 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 which 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.

Additional Hardware

CASD systems can be equipped with additional hardware including 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.

COST ANALYSIS

One of the most important aspects in deploying computerized systems is the cost associated with it. 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 are very rough estimates. Also, assumptions were made in order to compute some of the costs. This analysis can be used for rough approximations, 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 ASP
- CASD software must be accessible via the Internet
- 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 2 and 3 show the first year costs for the decentralized and centralized approaches.

Table 2. Decentralized Approach - Initial Costs

					Data Conversion				Training		
	Trips / Day	Software Type	Hardware Price	Software Price	Person/ Month	Cost	Support Person (On-site)	Maintenance Price	Windows / Internet	CASD software	**Total Cost of Ownership**
Large 1	600	Fully Automated	3,000	75,000	4	7,680	65,280	1,500		10,500	
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			
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 3. Regional Approach – Initial Costs

					Data Conversion				Training		
	Trips / Day	Software Type	Hardware Price	Software Price	Person/ Month	Cost	Support Person (On-site)	Maintenance Price	Windows / Internet	CASD software	**Total Cost of Ownrship**
Large 1	600	Fully Automated	4,000	135,000	4	7,680	65,280	2,700		10,500	
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					
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**

Tables 4 and 5 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 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 4. Decentralized Approach – Recurring Costs

				Training		
	Trips / Day	Support Person (On-site)	Maintenance Price	Windows/ Internet	CASD software	**Total Cost of Ownership**
Large 1	600	65,280	1,500		10,500	
Large 2	500	65,280	1,500			
Medium 1	200	11,520	500			
Medium 2	300	11,520	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 5 Regional Approach – Recurring Costs

				Training		
	Trips / Day	Support Person (On-site)	Maintenance Price	Windows /Internet	CASD software	**Total Cost of Ownership**
Large 1	600	65,280	1,500		10,500	
Large 2	500	65,280	1,500			
Medium 1	200	0	0			
Medium 2	300	0	0			
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 in the long run. The cost savings comes mainly from the need for fewer maintenance personnel and a cut in the maintenance costs.

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.

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

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