Trends in Paratransit Technology

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Abstract

In the effort to control costs, increase productivity and provide better service, demand response transit agencies of all sizes are looking to new information technology systems. In the past ten years a number of technology solutions have become available to support most functional areas of a paratransit organization, including service planning, client management, scheduling and dispatch, and daily operations. These applications have typically automated formerly manual processes and have allowed greater management insight into a variety of operational issues. Today, there is a staggering array of new technologies that go beyond basic automation and seem to promise huge gains in efficiency, customer service and the integration of paratransit into the broader mix of transportation services.

This paper looks at three of these new solutions -- mobile computing, spatial analysis and enhanced customer information systems -- and how they might deliver on these promises. The paper also examines the challenges paratransit providers may face in implementing these solutions and where there are realistic opportunities to achieve better service integration.

Beyond the Basics

Within the past ten years, most medium and large paratransit organizations have implemented some form of automation technologies. Typically these are deployed in basic functional areas such as scheduling, routing, dispatching and vehicle and driver assignment. While many agencies were at first sceptical about the productivity and efficiency promises of these technologies, experience suggests that automating basic functions can produce demonstrable long-term benefits.

But these same organizations will vividly recall that these systems were not implemented easily or inexpensively, and that benefits were often obscured by the wrenching organizational changes required to fully or partially automate long-standing manual operations.

Today, paratransit managers are being introduced to the next generation of technology tools, and with previous implementations still fresh in their minds, they are struggling to make sense of the solutions themselves and the immediate and long-term impact they will have on their organizations. They are also, quite reasonably, sceptical about the ability of these technologies to drive service integration between paratransit and non-paratransit operations.

The range of new technologies now on the market is vast, and this paper cannot properly assess all of them. It will, however, look at three current offerings and suggest the ways in which paratransit managers can assess their potential impact both in terms of operational efficiencies and broader organizational goals. Drawing from the experiences of agencies which have adopted some of these technologies and on current research, the paper will also offer some best practices for assessing and implementing them and where opportunities for efficiency and service integration are likely to be found.

Mobile Computing

Mobile computing is a very broad term and can include a number of technology subsets. For the purposes of this paper, we will limit it to automatic vehicle location (AVL) and mobile data computers (MDCs).

Vehicle location technologies have been in use for years in commercial trucking and fixed route transit and are essentially systems that allow dispatchers to pinpoint the location of a given vehicle at any time. A recent survey found that AVL is the technology with the greatest number of planned deployments in American transit organizations.[1] Vehicles are fitted with a transponder that continually communicates, usually via radio or cellular network, the vehicle's GPS (global positioning system) coordinates. Depending on the scheduling and dispatch back-end systems, this data may or may not be displayed on a map and automatically monitored to alert staff to delayed or off-route vehicles.

Knowing where vehicles are and the extent to which they are deviating from plan has obvious immediate benefits to almost any paratransit organization. These include the ability to adjust schedules in real time, dispatch emergency assistance, reroute other vehicles to pick up demand and track operator performance. Perhaps the key benefit is to deliver accurate, real-time

[1] John A. Volpe National Transportation Systems Center, Advanced Public Transportation Systems Deployment in the United States: Year 2000 Update, U.S. Department of Transportation, Federal Transit Administration, Office of Research, Demonstration and Innovation, June 2003.

information to customers calling to find out where their ride is. Reservationists no longer need to query the driver directly, but can locate the vehicle instantly on their screen and convey accurate information back to the passenger.

AVL systems can be purchased alone, but more commonly this feature is included in a mobile data computing solution. MDCs allow a wide range of data to be communicated to and from the vehicle in real time. This data includes vehicle location, manifests, driving directions, client information, schedule changes, and operator status. Some systems can be expanded to also monitor vehicle status such as engine temperature, door open and close, idle time and so forth As with AVL, there are considerable convenience and safety benefits; however, the bottom line benefits extend well beyond the day-to-day considerations, and can be very compelling.

Immediate benefits include a reduction in voice radio traffic, which can improve dispatcher and operator productivity. Via Metropolitan in San Antonio, TX reported an 80 percent reduction in radio communications following an MDC implementation.[2] Wheels of Wellness in Philadelphia, PA also noted a substantial reduction in radio traffic and was able to increase the number of vehicles per dispatcher from 25 to 35 or more.[3]

No-shows and late cancellations are a constant problem for all demand response providers, and in this area, MDCs can have a profound impact. Drivers are able to notify dispatch quickly if a passenger is not at the pick-up point, and dispatchers are able to inform drivers if a passenger cancels late. In some installations, a single button in the vehicle can trigger an automated telephone system to call the client if they fail to show up for a ride or even to let them know to be ready a few minutes before the vehicle arrives. With the AVL component, dispatchers are able to quickly revise the day's routes and schedules to ensure maximum productivity for vehicles and to accommodate late requests for service.

Another labor-intensive challenge for paratransit operations is the need to input data manually. With MDCs, virtually all paper can be eliminated, along with the data entry errors that inevitably occur. Manifests can be downloaded directly to the vehicle, and drivers update their manifests and records electronically in real time rather than filling out reports by hand at day's end that are later re-keyed. At Paratransit Inc. in Sacramento, CA, managers estimate that each driver saves up to half an hour a day in paperwork, and at Via Metropolitan, data entry staff has been reduced by two – an operating cost reduction of about $40,000.[4]

Looking beyond operational efficiencies, MDCs and AVL deliver even greater benefits in the form of accurate data which can be analyzed and used for planning and management purposes. Among the elements that can now be examined accurately are schedule adherence, operator performance and vehicle performance. When schedules and routes are examined using spatial analysis tools, paratransit agencies are able to identify service patterns which may help with ADA planning and integrating paratransit with fixed route services.

For agencies that contract out some or all of their services, this data can be used to monitor contractor performance as well. Risk management is another area in which this data can prove extremely valuable. At Accessible Services in Seattle, WA, managers point out that if passengers

[2] Joel Volinski,, "A Review of the Cost Benefit of Mobile Data Terminals in Paratransit Operations," Center for Urban Transportation Research, July 2002.
[3] Joel Volinski,, "A Review of the Cost Benefit of Mobile Data Terminals in Paratransit Operations," Center for Urban Transportation Research, July 2002.
[4] Joel Volinski,, "A Review of the Cost Benefit of Mobile Data Terminals in Paratransit Operations," Center for Urban Transportation Research, July 2002.

file lawsuits alleging poor service and breach of federal requirements, mobile data can be used to validate or refute complaints to reduce legal expenses. [5]

Other experiences demonstrate that by analyzing vehicle location data, routes can be further optimized for increased passengers served and reduced vehicle miles required. Operators who habitually deviate from routes can be identified and re-trained. Where services are interrupted by a breakdown, the nearest vehicle can be pinpointed and re-routed to pick up passengers who might otherwise have their rides cancelled or delayed.

Challenges of Mobile Technologies

The primary barrier for most agencies considering mobile technologies is cost. MDCs are priced in the range of $4500 to $7000 per vehicle[6] including installation, training, software customization and so on. Most agencies prefer to run pilot projects, installing mobile technologies in a portion of the fleet to test both the efficacy of the concept as a whole and to evaluate solutions from different vendors.

Beyond cost, however, some agencies have also faced considerable internal challenges from dispatchers and reservationists who are resistant to the changes. Drivers are often also very much opposed to the increased surveillance AVL and MDC makes possible. Most agencies, however, seem able to work through these issues by focusing on the benefits such as increased driver safety, less radio traffic, fewer no-shows and reduced paperwork.

Another significant challenge is the need to fully integrate mobile systems with back-end scheduling, client management and passenger information systems. In some cases, this requires a standard interface to be installed, while in others, particularly older installations, there is extensive customization required to make sure all the systems are able to communicate.

Key Benefits

- Accurate, real time information about vehicles and passengers
- Improved productivity
- Reduced data entry costs
- Better adaptability to no-shows and late cancellations
- Ability to offer same-day or real-time dispatching
- Better monitoring of operators and contractors
- Ability to develop accurate data for planning
- Improved reporting capabilities

Best Practices

- Start with a pilot project to evaluate both concept and vendors
- Demonstrate commitment of top level management
- Be prepared for internal push-back and be sure to sell the benefits to employees
- Ensure hardware is fully compatible with existing software systems such as scheduling and client management

[5] Joel Volinski,, "A Review of the Cost Benefit of Mobile Data Terminals in Paratransit Operations," Center for Urban Transportation Research, July 2002.
[6] Joel Volinski,, "A Review of the Cost Benefit of Mobile Data Terminals in Paratransit Operations," Center for Urban Transportation Research, July 2002.

- Allow time and budget for integration with software systems
- If MDCs are too costly, consider using only AVL technology with, perhaps two-way pagers

The Bottom Line

Research suggests that mobile communications are proving to be an invaluable tool in improving efficiency and customer service in the paratransit sector. While it is difficult for most agencies to ascribe productivity increases to their mobile systems alone, many have seen a marked improvement since implementing them. Via Metropolitan has noted a productivity improvement from 1.1 passengers per hour to 2.3; Accessible Services in Seattle, WA, saw a seven percent increase in productivity and estimated the full cost of the system would be recovered within three years.[7]

Customer Information

Customer service is as important in paratransit as in any service industry, and most organizations have made substantial investments over the years in their call center operations. The majority of medium and large paratransit organizations have at least some systems that allow reservationists to query schedules for quick trip booking, confirmation and cancellation. In some cases, this is a real-time system in which staff can determine vehicle location, arrival times and so forth, while in most it is at least a fairly dynamic view of the day's bookings.

Along with other industries, however, paratransit providers are being called upon to deliver more information more quickly, over longer periods of time and to a variety of devices. In other words, it is no longer enough to operate a call center from 8am to 6pm. Paratransit users, social service agencies and contractors want to be able to access information around the clock and to do so without having to go through a call center.

Call centers themselves are a concern for most paratransit managers, who spend a good deal of time analyzing call queues, wait times, call lengths and operator training to maximize efficiency without sacrificing personalized service. The truth is, however, the majority of calls are fairly routine requests that could be handled by another medium, such as a web site or automated telephone service.

While there is an abundance of technologies available to enable these types of services and the concept has been proven in industries as diverse as airlines, banking, and retailing, there are still some daunting issues paratransit managers must consider.

Online Services

Web-based services are an obvious extension to the call center. The Internet is accessible from home PCs, cellular phones, handheld wireless computers, kiosks and many other devices, making it a ubiquitous and low-cost medium through which to deliver 24/7 services without human intervention. Most fixed route agencies offer at least schedule and service information on their websites, and many of these are adding interactive trip planning, electronic fare purchase, regional travel itineraries and so forth.

[7] Joel Volinski,, "A Review of the Cost Benefit of Mobile Data Terminals in Paratransit Operations," Center for Urban Transportation Research, July 2002.

In paratransit, however, things are a little different. Given the more personal nature of the relationship between provider and consumer, it can be argued that paratransit customer service has more in common with online banking than with conventional transit.

First, there is the nature of the data itself. Client records contain highly personal information including medical data, billing history and travel history. As with banking, there is a significant responsibility on the part of the provider to ensure this information is protected and that transactions are kept strictly private.

Then there is the back-end data with which the web interface must communicate. In addition to client profile information, which is relatively static, there is the scheduling database which is nothing if not dynamic. Agencies wanting to add services such as online registration, subscription trip booking and same-day reservations have an even greater challenge in bringing together dynamic and static information from a variety of sources including vehicles, dispatching systems and whatever logic they may use to process registrations.

Where operators use brokers and/or contractors, there is the additional challenge of conveying customer requests to and from multiple systems.

Making matters worse, many paratransit agencies do not operate their own websites. Some are subsets of a public transit agency, social services agency or regional planning authority, while others may be owned by the paratransit provider but hosted and maintained by a third party.

IVR Systems

The challenges in implementing an interactive voice response (IVR) system are no less daunting. Many call centers are at least somewhat automated, allowing callers to choose from a menu of actions using their telephone keypads. This is fine for transactions where little interaction is required, such as checking the status on a booked trip or canceling a ride. But when more complicated services are needed, such as changing a pick up location, booking a new trip, updating a profile and so on, most callers will end up with a customer service representative. Where human intervention is required, the service window is reduced to regular call center hours and may lengthen response times.

IVR technologies have evolved in recent years beyond the one-way, menu-driven systems most of us encounter. New products on the market incorporate sophisticated speech recognition technologies that allow users to interact with a variety of systems to complete fairly complex transactions.

Generally, these systems use a voice gateway that interprets verbal and/or keypad instructions and transmits them to the systems and databases with which the user needs to interact. In the case of paratransit clients, the gateway would interface with the client database to identify and verify the caller and then with the scheduling and dispatch system to create, modify, confirm or cancel the trip.

There are a number of IVR systems on the market, though very few have been designed specifically for transportation and fewer still for paratransit use. The more sophisticated systems include natural language technologies which are able to work with the disparate ways in which people speak, including those with accents or speech difficulties. These systems also include much larger vocabularies than older systems. That is, they are able to recognize and process a much wider range of instructions regardless of the way in which the user expresses their request. Many will also support multiple languages and offer features that assist clients with physical or cognitive limitations.

For agencies implementing one or both of these technologies, there are considerable advantages to be found, along with a number of challenges. The primary area in which web-based and IVR customer service can be of immediate benefit is in extending the capabilities of the call center to new media and 24/7 accessibility. These systems allow passengers, social service agencies and contractors to interact with the agency when and where it suits them best. Many cellular telephones now include web browsers, and new handheld devices offer wireless Internet connectivity as well. Kiosks are another excellent portal, particularly if they have been deployed by a fixed route agency or municipal body in high-traffic locations such as shopping malls and transportation terminals. In Flintshire, England, demand response customers are able to book their trips from kiosks installed at large employers' sites.

Another important benefit is the delivery of consistent, accurate information across all media. Where call center staff, the website and the IVR system are all using the same back-end scheduling and client management databases, the information provided by each will be identical. This ensures consistently accurate information regarding services, trips, policies, status and so forth regardless of how the user accesses it.

In addition to providing more convenient, accessible service, these technologies also reduce call center volumes, which has two key advantages. Most obviously, lower call volumes mean improved service in the form of reduced wait times and the ability for reservationists to spend more time with passengers. Reduced volumes also offer the opportunity to reduce call center staff, and the costs attached to them.

Web and IVR are not yet widely deployed in the paratransit sector. However, experience from the fixed route sector suggests a good prognosis. For example, Dallas Area Rapid Transit was able to reduce call volumes by 300-400 calls per day with an online trip planning service,[8] and at Central Ohio Transportation Authority in Columbus, OH, the IVR system is capturing about 25% of calls, reducing costs by approximately $50,000 per year.[9] Results at MTA Long Island Bus also show about 30% of their calls are handled exclusively by their IVR system.[10]

Other efficiencies can be found in making client information available to other agencies such as social service departments and contractors. Client registration and eligibility is often handled by social service agencies, usually with reams of paper forms and records. Some agencies are experimenting with putting these processes online, allowing social workers to register clients more quickly and with less paperwork.

Contractors also stand to benefit from online access to paratransit systems, primarily in the areas of record-keeping and verification. Details such as client preferences, trip history, eligibility status and more can be accessed through secure online interfaces as needed, reducing the burden on paratransit agency staff to prepare reports or handle ad hoc queries. Because the systems integrate with back-end databases, there is no re-keying of updated information, which reduces both staff costs and the possibility for data entry errors.

It seems likely that where agencies are able to reduce call volumes and improve the efficiency and accuracy of data management, there is an opportunity to integrate customer information services between fixed route and demand response services into a single department. NEXUS, in Newcastle-Upon-Tyne, England consolidated its demand response and fixed route call centers, managing to answer more than 97 percent of its 12,000 weekly regional travel information services calls within 30 seconds.[11]

[8] Case Study: Using the Web to Improve Customer Service, Trapeze Software Group, March 2003.
[9] Case Study: Automating Customer Information Services, Trapeze Software Group, July 2002.
[10] Case Study: Building an Infrastructure for Growth, Trapeze Software Group, February 2002.
[11] Case Study: Building an Urban DRT Service, Trapeze Software Group, May 2003.

While the benefits are fairly extensive, both web-based and IVR systems come with a few challenges as well. Existing web infrastructures can be notoriously complicated in terms of back-end technologies, templates and support limitations by in-house or third-party staff. Integrating dynamic information sources, such as a paratransit management system, can be complex, time-consuming and costly, particularly if the new web software is not able to work with existing page templates and corporate identity standards.

IVR systems are complex in their own right, and there can be considerable customization costs involved in adapting a system not designed for transportation use to work with the back-end scheduling and client management applications and databases. There are a number of proprietary standards in the field, some of which are difficult to integrate into an existing paratransit system. The recent emergence of Voice XML, an open and widely adopted standard, is easing this situation.

Other challenges include existing labor agreements which may make it difficult to reduce call center staff levels, complex software customization requirements, particularly for legacy paratransit systems, and a potentially slow adoption rate among long-time users of the call center.

Key Benefits

- Convenient 24/7 customer services
- Access to information by a variety of devices
- Consistent, accurate information regardless of how it is delivered
- Lower call center volumes reduce wait times and abandoned calls
- Staff can spend more time with customers
- Possibility to integrate demand response call center with regional or fixed route services

Best Practices

- Ensure new technologies can integrate well with existing back-end systems
- Look for open standards such as Voice XML to reduce customization costs
- Include in-house or external website staff in planning for the online service
- Look for opportunities to use the systems to build cross-functional call centers
- Identify additional functionality such as automated call-back reminders for clients with booked trips
- Ensure system security is robust enough to comply with all federal, state and local privacy regulations

The Bottom Line

The deployment of web-based and IVR systems in paratransit operations is in its very early stages; however, experience in other transportation sectors suggests that these technologies have much to offer in terms of improved customer service and greater operational efficiency.

Planning

Decades of steady automation in paratransit have created a good news/bad news situation. The good news is there is a large and valuable stockpile of information that can be used to plan for

future services; the bad news is, most agencies lack the tools and resources to properly work with the data.

Few would argue that a close examination of historical passenger, vehicle and route information will reveal areas where greater efficiencies can be found, and fewer still would object to the notion that accurate planning for future services is critical to securing adequate funds. Until recently, agencies were forced to either analyze what data they could by hand or to hire external consultants with the tools and expertise to do the job. A very fortunate minority of agencies were able to have these skill sets available internally or through a related agency.

Planning data comes from a variety of sources. Internal systems contain route, vehicle, driver, client, billing, contractor and other operational information. External data includes census rolls, municipal planning information, commercial databases and maps. The key to putting all of this to work is planning software that can deal with both statistical data and spatial data such as maps and vehicle location information.

Such applications do exist and are in widespread use by urban planners, transportation planners and so forth; however, most of the software requires its users to have extensive education or training in statistics and mapping. These resources have generally been out of reach for most cash-strapped paratransit providers. Newer software packages, however, are available that offer non-technical users the ability to work with their data and produce a number of important benefits.

An examination of historical service data will reveal, among other things, origin and destination information, the types of passengers serviced (e.g. elderly vs. special needs adults), the types of services provided (e.g. door-to-door vs. curb-to-curb), service areas (and the extent to which they may overlap with other paratransit providers) and so forth.

With these new tools, even novice users can readily identify critical trends such as under- or over-served areas, sub-optimal routes, declined trips by origin, destination or service area, and the extent to which the organization is complying with its own service standards such as schedule adherence.

Once a clear picture is developed of the existing service, it is then possible to define and test proposed solutions. A good planning software application will allow users to adjust parameters such as route, vehicle, service area, load times and so on to create a scenario that can then be tested in the software to evaluate the real-world impact such changes may have on service efficiency and passenger satisfaction.

The software should also be able to develop an accurate snapshot of current ridership in terms of ADA and non-ADA clients, subscription versus casual travel, funding sources and the degree to which some passengers may be able to use other services such as conventional fixed route or route-deviated demand response. This, in turn can be used to adjust service windows, the types of vehicles deployed, and integration with neighboring providers.

The other critical part of the planning equation is building an accurate picture of the future. Planning software can apply external data such as census files, municipal development information and so on to estimate near- and long-term paratransit demand and to further identify where that demand is most likely to be found geographically and demographically. It is now fairly simple to examine future demand in the context of population growth, housing stock, planned medical facilities, new roadways, other transit services and so on.

These applications also offer the unique ability to view data not in numbing tabular format but on detailed, color-coded maps where patterns and trends can be quickly identified and worked with (see Figure 1 below) Data can also be exported to other applications such as spreadsheets for further analysis within the organization. Data can be analyzed to identify trends and test schedule modifications and identify the most efficient vehicle and staff deployment.

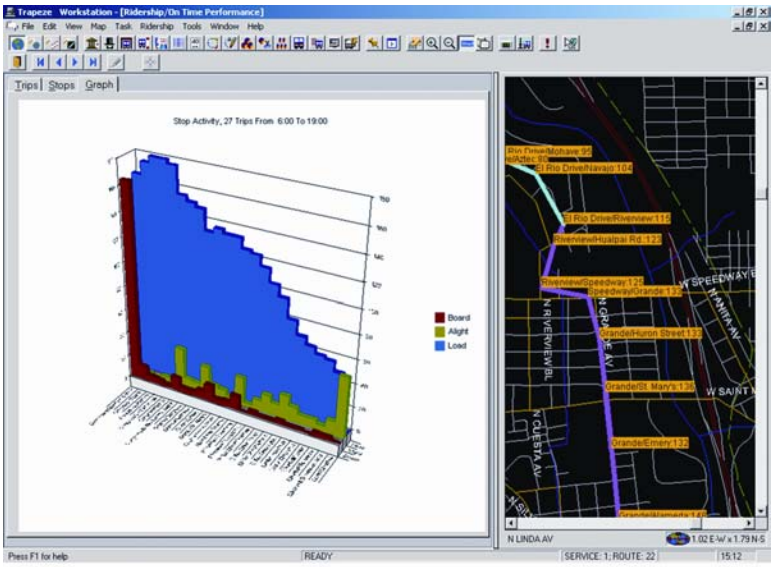

Fig. 1. Planning applications can permit the graphical presentation of paratransit data.

One area in which planning applications can make a significant impact is in the ongoing struggle to more closely integrate paratransit with conventional transit services. Some agencies are using their planning software to map ADA corridors against existing or planned fixed route services to see if there are opportunities to reduce costs by transporting paratransit passengers by other means.

King County Metro Transit in Seattle, WA uses planning software to adjust paratransit services in response to fixed route modifications and to test the impact of these adjustments before they implement them. The software extracts trip data and ridership statistics from the demand response management system to define geographic service areas. Using spatial query tools, the agency can pinpoint where paratransit services must expand to meet the community's needs.

As the new Seattle Light Rail and Monorail project is implemented, some ADA eligible passengers will be able to use the railways instead of the more expensive vans. The rail service will be fully complete in 2007; however, for those who are unable to ride rail, the planning software is being used to identify ADA riders and estimate the ADA ridership obligation around the stops. The transit system will then enter into an agreement to provide service to these rail ADA riders.

The primary challenge in implementing planning applications in paratransit operations has been the cost and complexity of many of the available systems. While these systems provide powerful analysis tools, they have tended to be rather more than most agencies needed and considerably more than they were able to staff.

Another challenge was the ability of these systems to work with the specialized internal data paratransit providers keep. Customizing some of these applications to extract information from back-end scheduling and client management systems was both costly and time consuming.

The newer applications, however, are designed specifically for use by transportation providers and are readily integrated with back-office systems to capture schedule, passenger and vehicle data, including that which comes from mobile devices and passenger information systems. The reduced complexity of the integration has an attendant reduction in cost to use.

Planning applications are priced in the range of $2,500 to $50,000, and it seems likely they will pay for themselves fairly quickly as they identify immediate areas for cost reduction and permit scenarios to be tested prior to implementation.

Key Benefits

- Ability to leverage vast amounts of historical data
- Accurate view of current ridership
- Evaluation of operational metrics such as ADA compliance
- Ability to build and test service scenarios in-house
- Integrated mapping for quick spatial analysis
- Data capture from a variety of internal sources including back-end systems and mobile technologies
- Automated reporting
- Analysis of future service growth by geography and ridership
- Ability to identify integration opportunities with other services

Best Practices

- Look for applications that offer spatial tools including maps
- Ensure the application can be readily integrated with existing or planned systems including scheduling, client management and mobile computing
- Consider the skill level required to operate the software, and ensure staff will be able to become proficient fairly quickly
- Work with other local agencies to ensure data is shared and planning is coordinated

The Bottom Line

Planning software should be at or near the top of the list for most paratransit agencies. The immediate and long-term benefits suggest a rapid payback and, more important, a way to ensure that services are running at optimum efficiency and are capable of keeping pace with changes in demand.

Conclusion

As in any industry, the rate at which new technologies are being introduced in paratransit far outpaces the ability of these agencies to acquire and implement them. The three technologies discussed in this paper build on past automation investments to offer a great deal in terms of improved service, reduced cost and long-term management advantages.

While each of these technologies varies significantly in the ways in which it will affect the organization, and while each comes with considerable challenges, there are a number of best practices that can be used to ensure the right system is purchased and that its return on investment is maximized. At the very least, paratransit managers must focus on a given

technology's ability to integrate with existing systems, and the degree to which existing staff can realize immediate benefits.