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Phase III (Final) Evaluation Report

National Evaluation of FY01 Earmark

Area Transportation Authority of North Central Pennsylvania – Regional GIS/ITS Initiative

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by:

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16. Abstract

This report presents the results of the United States Department of Transportation evaluation of a federally funded earmark project implemented by the Area Transportation Authority of North Central Pennsylvania (ATA). The project implemented a suite of technologies including computer-assisted scheduling and dispatch (including automatic vehicle location and mobile data computers), maintenance management and invoicing systems. Intended benefits of the project consisted of enhanced productivity, safety, and customer satisfaction. The evaluation examined impacts in each of these areas as well as ATA staff perspectives on benefits, challenges and lessons learned. Overall, the deployment has been successful. Of the 19 specific hypothesized benefits that were tested through the evaluation, 10 of them were fully supported, six were partially supported, and three were not supported. Benefit highlights include a 28 percent reduction in dispatchers' time on the radio with drivers; reduction of the lag time for identifying vehicle preventative maintenance from two weeks to less than one day; a 43 percent reduction in the time required to prepare monthly invoices; and a 68 percent reduction in the number of in-service vehicle breakdowns. The evaluation results confirm the value of these sorts of advanced technologies for transit systems, especially rural operators providing demand response service. The results also corroborate similar studies showing that successful technology deployments can take many years to complete and demand a high degree of competency, preparation, and follow-through on the part of the deploying agency.

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Battelle wishes to acknowledge the guidance provided to the evaluation team by Mr. Raj Wagley of Federal Transit Administration (FTA), who serves as the Government Task Order Manager (GTOM), and Ms. Jane Lappin of Volpe for technical oversight of this project.

Battelle also wishes to acknowledge Mr. Mike Imbrogno, Chief Executive Officer (CEO) of Area Transportation Authority (ATA) of North Central Pennsylvania and Ms. Coletta Corioso, Chief Financial Officer (CFO) of ATA (who serves as the evaluation point of contact) for their kind assistance to the evaluation. Appreciation is also extended to ATA staff including Ms. Dessa Chittester, Mr. Mike Trunzo, Mr. Brian Fenton, and Mr. John Lacny for their extensive assistance in collecting evaluation data and facilitating the evaluation. Thanks go as well to all of the hard working staff of ATA for their courteous and generous support to the evaluation.

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List of Acronyms

ATA	Area Transportation Authority of North Central Pennsylvania
AVL	Automatic Vehicle Location
CAB	Call-a-Bus
CAD	Computer-Assisted Dispatch
CARSD	Computer-Assisted Reservations, Scheduling, and Dispatch
CEO	Chief Executive Officer
CFO	Chief Financial Officer
COTS	Commercial Off-the-Shelf
FR	Fixed Route
FTA	Federal Transit Administration
GIS	Geographical Information System
GPS	Global Positioning System
GTOM	Government Task Order Manager
HQ	Headquarters
ITS	Intelligent Transportation System
IVR	Interactive Voice Response
JPO	Joint Program Office
MA	Medical Assistance
MATP	Medical Assistance Transportation Program
MDC	Mobile Data Computer
MSAA	Mobility Services for All Americans
U.S. DOT	United States Department of Transportation

Executive Summary

Introduction

This report presents the findings of the United States Department of Transportation (U.S. DOT) evaluation of the federally funded earmark project "Regional Geographical Information System (GIS)/Intelligent Transportation System (ITS) Initiative by the Area Transportation Authority of North Central Pennsylvania (ATA)." The earmark project was intended to integrate a number of transit ITS technologies to improve the rural fixed-route and demand-response services provided by the ATA in their six-county service area in North Central Pennsylvania.

The problems addressed by this earmark include the typical challenges of rural transit operations, including reservation, scheduling, fleet management, maintenance, and invoicing. The primary expected benefits of the technology focused on productivity and safety although improvements in the already high levels of customer satisfaction were thought possible. Intended productivity impacts included faster preparation of invoices, less time on the phone with customers taking ride requests, faster identification of vehicle maintenance needs, more efficient work processes in the dispatch office, and creation of more efficient, tighter demand response schedules. Intended safety benefits focused on reduced in-service breakdowns and improved communication with drivers. Possible improvements in customer satisfaction focused on perceptions of on-time performance, demand response trip reservation phone calls, and flexibility in accommodating same day trip requests.

The earmark project implemented an extensive suite of transit advanced technology systems intended to improve many ATA activities. Table ES-1 identifies the major technology components of the earmark project and summarizes how they relate to major ATA functions. Figure ES-1 presents a high-level diagram of technology system implemented through the earmark project.

The scope of this earmark is closely in line with the "Mobility Services for All Americans (MSAA)" federal ITS initiative which intends:

> "*...to improve transportation services and simplify access to employment, healthcare, education, and other community activities by means of the advanced technologies of Intelligent Transportation Systems (ITS) and through extending transportation service partnerships with consumers and human service providers at the federal, state, and local levels.*"

The national evaluation is the primary mechanism for assessing the system impacts and performance of this earmark and the lessons learned. The lessons learned from this project are expected to benefit other agencies that are considering similar technologies as well as to inform U.S. DOT policies and programs in this area.

Table ES-1. Mapping of Project Components with Transit Functions

Earmark Project Elements	ATA Functions							
	Demand-Response	Fixed-Route	Fixed-Route w/ Deviation	Medical Assisted	Maintenance Operations	Dispatch	Call Taking	Invoicing
Data/Voice Radio	Communi-cation with vehicles	Communi-cation with vehicles	Communi-cation with vehicles	Communi-cation with vehicles	Communi-cation with service vehicles	Communi-cation with vehicles	N/A	N/A
Mobile Data Computer/ Automatic Vehicle Location	Provide data messaging and vehicle location	Provide data messaging and vehicle location	Provide data messaging and vehicle location	Provide data messaging and vehicle location	MDC facilitates pre-trip inspection	Vehicle locate and data messaging; provide manifest on MDC	N/A	MDC collects service performed data
Computer-Assisted Reservation, Scheduling, Dispatch (CARSD)	Computer assisted reservation; Facilitate scheduling of vehicles and drivers	Facilitate scheduling of vehicles and drivers	Computer assisted reservation; Facilitate scheduling of vehicles and drivers	Computer assisted reservation; Facilitate scheduling of vehicles and drivers	Facilitate scheduling of vehicles	Facilitate scheduling of drivers	Auto-mate call taking	Data input to financial system for invoicing and account payable
Maintenance Management	Receive pre-trip inspection data from instrumented vehicles	Receive pre-trip inspection data from instrumented vehicles	Receive pre-trip inspection data from instrumented vehicles	Receive pre-trip inspection data from instrumented vehicles	Inventory control; maintenance scheduling; pre-trip inspection data	N/A	N/A	Electronic filing of purchase orders
Financial System	N/A	N/A	N/A	N/A	Automate purchase orders	N/A	Receive data from CARSD	Automate invoicing to third party agencies

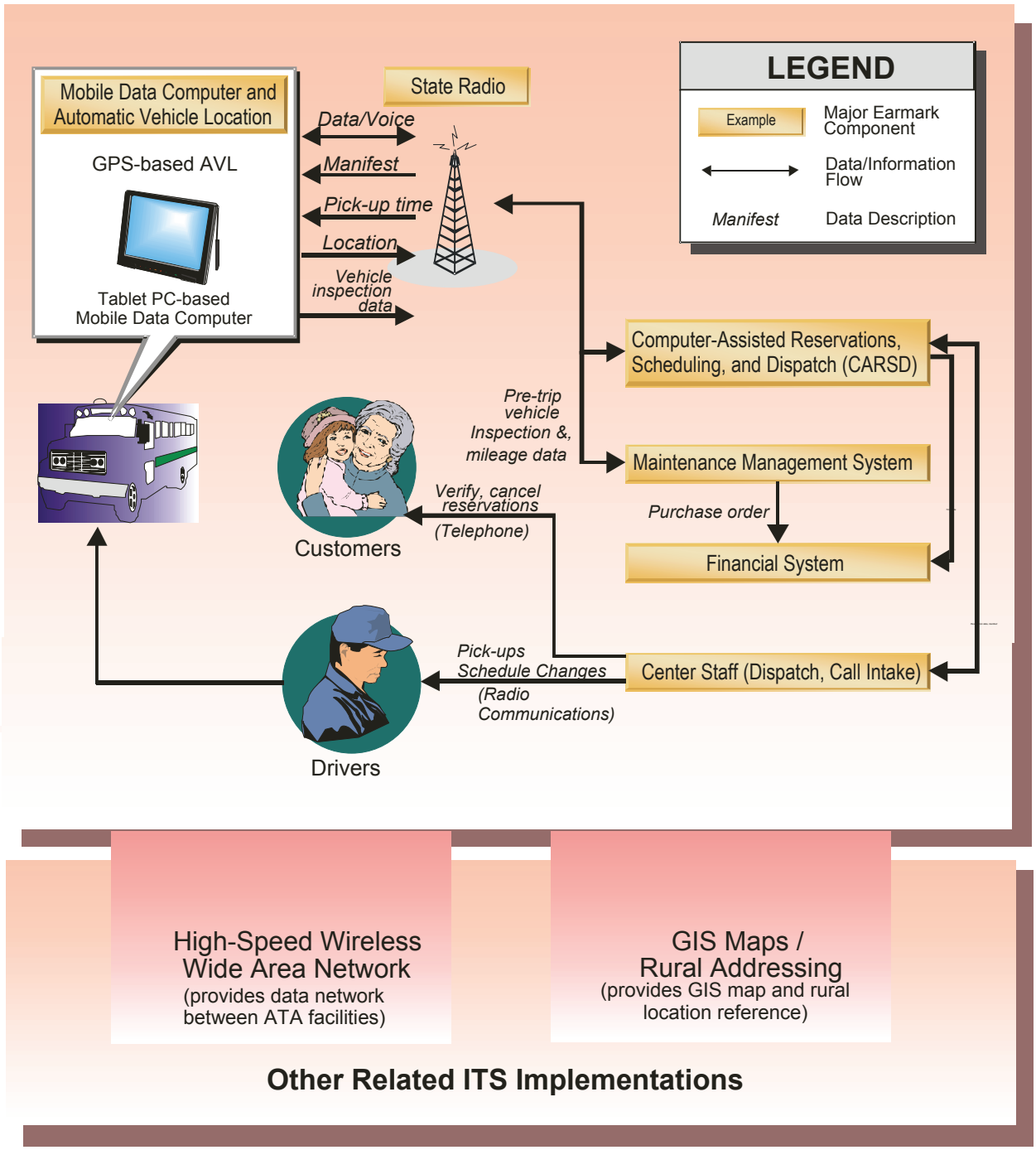

Figure ES-1. High-Level System Diagram

Evaluation Approach, Timeline and History

The evaluation included four evaluations organized around major areas of intended impact or data collection sources:

- Productivity
- Safety
- Customer satisfaction; and
- ATA staff perspectives.

A "systems impacts"—that is, "before-after"—evaluation design was utilized in which conditions before the ATA technology deployment were compared to conditions after deployment. Data included both quantitative data, such as "system data" generated automatically by various ATA systems and qualitative data, which consisted of customer surveys, focus groups, and interviews with ATA staff. As shown in Figure ES-2, planning and design of the technology deployments was done in 2002 – 2004, the various technologies were implemented in a phased manner over the next several years and came on-line at various points during 2006 and 2007. Various baseline (before) were collected between late 2003 and 2005 and post-deployment data was collected in 2008.

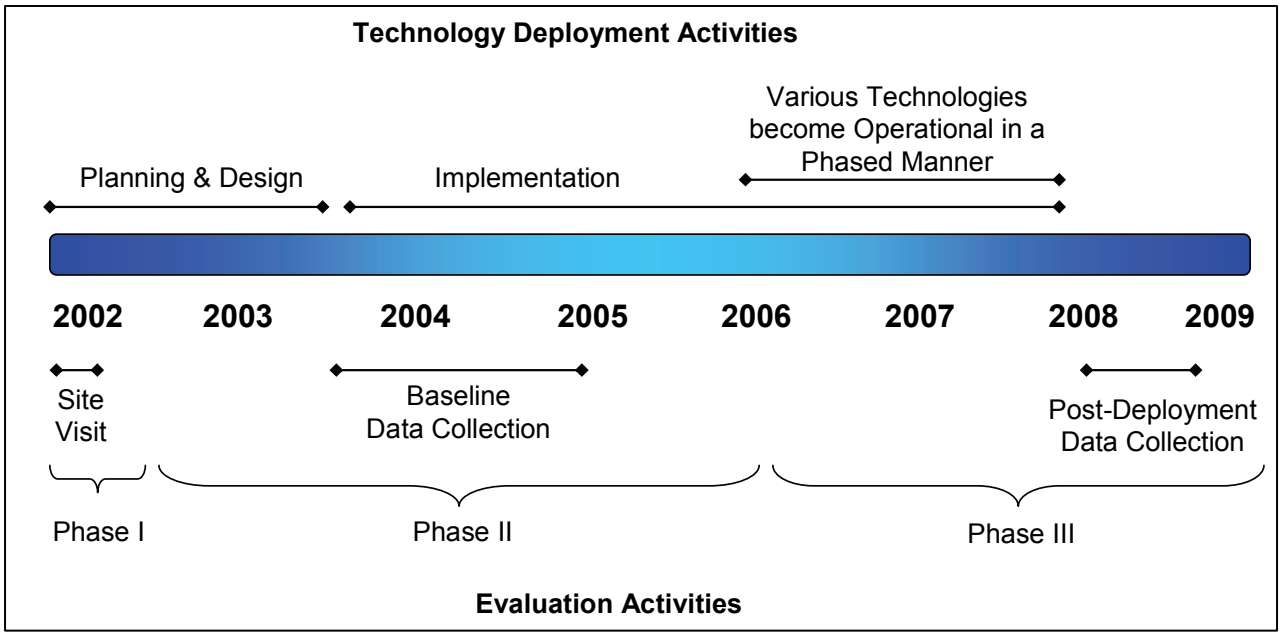

Figure ES-2. Timeline

Evaluation Results

The evaluation produced two primary types of results: (1) Findings related to the intended (hypothesized) benefits of the technology deployment and (2) conclusions, including keys to success and other lessons learned. Results in each area are summarized below.

When interpreting the results presented here, it is important to keep in mind the potential influence of changes not directly related to the technology deployment, including factors such as ridership trends as well as changes in agency processes and procedures. Based on ATA input, and also after analyzing changes in exogenous factors such as ridership and vehicle fleet, it does not appear that exogenous factors significantly influenced evaluation measures; however the actual contribution of these outside influences is uncertain. ATA implemented two major organizational changes in parallel with the technology deployment: consolidation of maintenance and dispatch functions to a central location in Johnsonburg and reorganization of dispatch office staffing assignments. In both cases, ATA believes that the technology played a vital enabling role in the organizational changes. However, because the independent influence of the simultaneous changes (implementing the technology and agency reorganization) is uncertain, the benefit of implementing only one or the other cannot be determined.

Summary of Findings Related to Intended Benefits

Overall, the technology deployment was successful in that most of the intended benefits have been realized, including substantial improvements in maintenance and accounting efficiency. Of the 18 specific benefit hypotheses that were tested, ten were fully supported (intended benefits fully realized), six were partially supported and two were not supported. Where benefits have not been achieved it is mostly the case that ATA believes the benefits will be realized over time (e.g., when they adjust their scheduling methods to take greater advantage of the capabilities of the technology and if and when they implement an interactive voice response system) or that there was never much room for improvement (e.g., customer satisfaction levels were very high before the deployment).

ATA staff feels that the technology deployment has been very challenging but also believes that it has been a clear-cut success. They acknowledge that there is a couple of areas where benefits have not been fully realized—most notably in the area of improved schedule efficiency—but they believe that those benefits will be achieved over time as they take greater advantage of all of the capabilities. ATA staff cites two fundamental types of benefits. The first are broad, agency-wide benefits such as the way in which the technology was instrumental in facilitating the consolidation of major vehicle maintenance and dispatch office functions to a single location (Johnsonburg). This consolidation, in synergy with the capabilities of the technology have resulted in many broad benefits such as the elimination of much paper, improved accuracy and audit capabilities, improved consistency, and a much clearer and effective division of labor in the dispatch office.

Many of the intended productivity-related benefits have been realized, with improved dispatch office staff utilization and reduced invoicing times among the most dramatic. The technologies, coupled with a significant reorganization of dispatch office work assignments, have led to a much calmer, more efficient work environment, including more efficient demand response trip

reservation call taking and less radio chatter. Various technology-related capabilities, including automated collection of detailed proof-of-service data have dramatically reduced the time required to prepare invoices, from an average of 21 days to 12 days.

Other intended productivity benefits show mixed results. On-time performance has improved from 72 to 81 percent although that improvement is somewhat moderated by the fact that there are now more significantly early arrivals. There have been some modest gains in schedule efficiency manifested as a 5.6 percent reduction in demand response non-revenue vehicle miles. However, the role of the technologies in those reductions is unclear and ATA believes that significant reductions directly related to the technologies will not be achieved until they finish adjusting their scheduling methods to take full advantage of the software's "batch scheduling" capability. The unavailability of baseline data on schedule flexibility (e.g., number of same day trip requests accommodated and trip request denials) prevents conclusive determinations. However, the seven months' worth of post-deployment data does show promising trends.

Major benefits have been realized in the area of safety. The deployment of the maintenance management system, aided by the MDCs, has drastically reduced the number of in-service breakdowns, which were a significant concern to ATA in prior years. The number of in-service breakdowns in December-March, usually the worst months due to severe winter conditions in the region, was down from an average of 21 breakdowns a month to about 9 breakdowns a month, a reduction of 57 percent. The worst month for in-service breakdowns went down from 35 breakdowns to 14. Overall, the average in-service breakdowns have been reduced by 69 percent. While some of the improvements can be attributed to an improved fleet, since there have not been significant changes in the fleet, much of the improvement is related to the technology deployment. Although there are far fewer in-service breakdowns now, the average repair time has not been significantly reduced.

Driver pre-trip inspections using MDC's have dramatically decreased the time it takes to get the inspection information to maintenance personnel (from two weeks to same day). Unique defects (typically an average of 49 defects are identified a month) are fed into the maintenance system and are repaired when the vehicle is in the shop for preventative maintenance.

The ATA technology deployment has not significantly impacted customer satisfaction; customers were very satisfied and, for the most part, very grateful for ATA before the technology deployment and they remain that way. Although many customers are aware of the new technologies that they actually interact with or observe (the MDCs and trip reservation phone calls), the vast majority of customers do not feel any differently, fundamentally, about ATA or the ATA service.

Finally, as described above, the absence of good quality baseline quantitative data in a couple of areas limits the ability to draw strong conclusions regarding certain intended benefits. However, it should also be recognized that the ability to easily generate rich, reliable post-deployment data represents an important benefit of the deployment. That is, aside from any improvements realized or not realized in certain metrics, the ability to effectively monitor performance in those areas is itself an important accomplishment.

Conclusions

The ATA technology deployment has been successful based on the many benefits that have been realized, especially so given benefits have been realized over a period when the number of passenger trips served by ATA grew by 10 percent. Further experimentation with their scheduling methods to take greater advantage of the scheduling software and implementation of the postponed interactive voice response system would likely provide greater benefits.

Although the project took a great deal of time to implement—about 7 years from planning to operation—long implementation time frames for these technologies are not uncommon. One of the reasons these projects take a long time is that it is challenging and time-consuming to adapt the technologies to meet the unique needs of a given transit agency, including the process of developing, inputting, and error-checking the origins, destinations, client and other agency specific information required by the technology systems. It is also the case that the implementation of specific technologies must be phased in because the agency and its customers cannot adjust to too many changes too quickly.

The success of this deployment is explained by a number of factors, including utilization of many of the best practices that have been documented in the transit technology literature, including the compilation in the recent Transportation Research Board Report "Improving Public Transportation Technology Implementations and Anticipating Future Technologies."[1] Keys to success for ATA included strong and sustained ATA management and Board of Directors support; a structured, careful, systems engineering-like approach; highly knowledgeable information technologies staff in house; a high degree of staff continuity over the life of the project; and intensive involvement of key staff from throughout the organization from concept through operation.

In summary, the ATA experience provides further evidence that well-established technologies like computer-assisted scheduling and dispatch and maintenance management systems can provide significant benefits but success is dependent on a fairly high degree of competency, care and perseverance on the part of the transit agency.

[1] Matthew Burt and Chris Cluett, Battelle; Carol Schweiger, TranSystems Corp.; Matthew Coogan; Richard and Sharon Easley, E-Squared Engineering. "Transit Cooperative Research Program Report 84: Improving Public Transportation Technology Implementations and Anticipating Future Technologies." Transportation Research Board, 2008.

1.0 Introduction and Background

This report presents the findings of the United States Department of Transportation (U.S. DOT) evaluation of the federally earmarked project "Regional Geographical Information System (GIS)/Intelligent Transportation System (ITS) Initiative by the Area Transportation Authority of North Central Pennsylvania (ATA)". The earmark project was intended to integrate a number of transit ITS technologies to improve the rural fixed-route and demand-response services provided by the ATA in their six-county service area in North Central Pennsylvania. The problems addressed by this earmark include the typical challenges of rural transit operations, including reservation, scheduling, fleet management, maintenance, and invoicing.

The scope of this earmark is closely in line with the "Mobility Services for All Americans (MSAA)" federal ITS initiative which intends:

> "*...to improve transportation services and simplify access to employment, healthcare, education, and other community activities by means of the advanced technologies of Intelligent Transportation Systems (ITS) and through extending transportation service partnerships with consumers and human service providers at the federal, state, and local levels.*"

The lessons learned from this project are expected to benefit other agencies that are considering similar technologies and to inform U.S. DOT policies and programs in this area.

This independent evaluation was conducted in three phases:

- Phase I – An initial site visit in February 2002 culminating in the decision to evaluate this project and to use a systems impact ("before-after") evaluation design.
- Phase II – Authorized in August 2002 and completed in August 2006. This phase involved the development of an evaluation plan, a detailed test plan, collection and analysis of baseline (before) data.
- Phase III – This phase, initiated in April 2007, consists of the collection and analysis of post-deployment data and development of this final evaluation report.

The remainder of this chapter provides an overview of the ATA, describes the technology deployment that was evaluated, and describes the organization of the remainder of this report.

1.1 Overview of the ATA

The Area Transportation Authority of North Central Pennsylvania (ATA) provides fixed-route and demand-response service to a mostly rural six-county area covering 5,000 square miles with a population of about 290,000 people. The agency was incorporated as a six-county Municipal Public Transportation Authority in 1976 and was the first regional rural public transportation system in Pennsylvania. The ATA provides both fixed-route and demand-responsive service to both the general public and social service agency clients (e.g., senior citizens and the disabled). Table 1-1 summarizes the number and type of services offered by the ATA.

Table 1-1. ATA Services

Service	Payment	Number of Routes or Service Zones											
		Total			Inter-Community			Intra-Community			No Fixed Pattern (Demand-Responsive)		
		Route	Vehicle Miles	Passenger Trips	Route	Vehicle Miles	Passenger Trips	Route	Vehicle Miles	Passenger Trips	Routes	Vehicle Mile	Passenger Trips
Fixed-Route	Fare	22	357,211	137,117	12	165,884	70,785	10	191,327	66,332	0	0	0
Fixed-Route Deviation	Fare	33	164,033	31,998	26	115,715	18,109	7	48,318	13,889	0	0	0
Demand Response	Fare	51	660,130	178,212	0	0	0	45	449,263	164,966	6	210,866	13,246
Non-Scheduled (e.g., charter)	Per Mile	27	593,671	24,659	0	0	0	0	0	0	27	593,671	24,659
Total		**133**	**1,775,045**	**371,986**	**38**	**492,465**	**102,140**	**62**	**688,908**	**245,187**	**33**	**804,537**	**37,905**

The ATA offers a variety of services to the region including, Call a Bus (CAB) demand-response service, deviated fixed-route service, fixed-route service, Medical Assistance Transportation Program (MATP) service, and special request service. When a client calls to schedule a ride, customer service must determine the proper service to schedule for this client. If the client lives close enough to a fixed-route (and the client is able to get to the bus stop), the client's destination and time constraints can be met by that fixed-route and the client will be scheduled onto a fixed-route vehicle. The ATA also operates some fixed-routes, from which they will deviate, to pick up a client at their door if the client is unable to get to the bus stop.

Due to the large service area, the demand-response services are organized into "routes" that serve different geographic parcels (i.e., zones). While some demand-response routes are designated for travel within larger townships (e.g., Bradford, Johnsonburg, St. Marys, DuBois), others are designed to provide transportation between townships.

As of 2009, ATA owns and operates 87 revenue and back-up vehicles: 15 coaches in the 20-29 passenger size category; 68 10-16 passenger coaches; and four public and 10 MATP 3-7 passenger mini-vans. They also operate three maintenance vehicles. The ATA employs a total of 148 staff consisting of 100 drivers, 16 administrative/clerical personnel, 16 maintenance personnel, and 16 operations/dispatch personnel.

Over the years, ATA has roughly provided gradually increasing volumes of service. Annual passenger trips have ranged from 339,096 in FY 2002 to 371,986 in 2008, a 10 percent increase. Demand Response service during the same time frame has increased by 13 percent and Fixed Route Service by 15 percent.

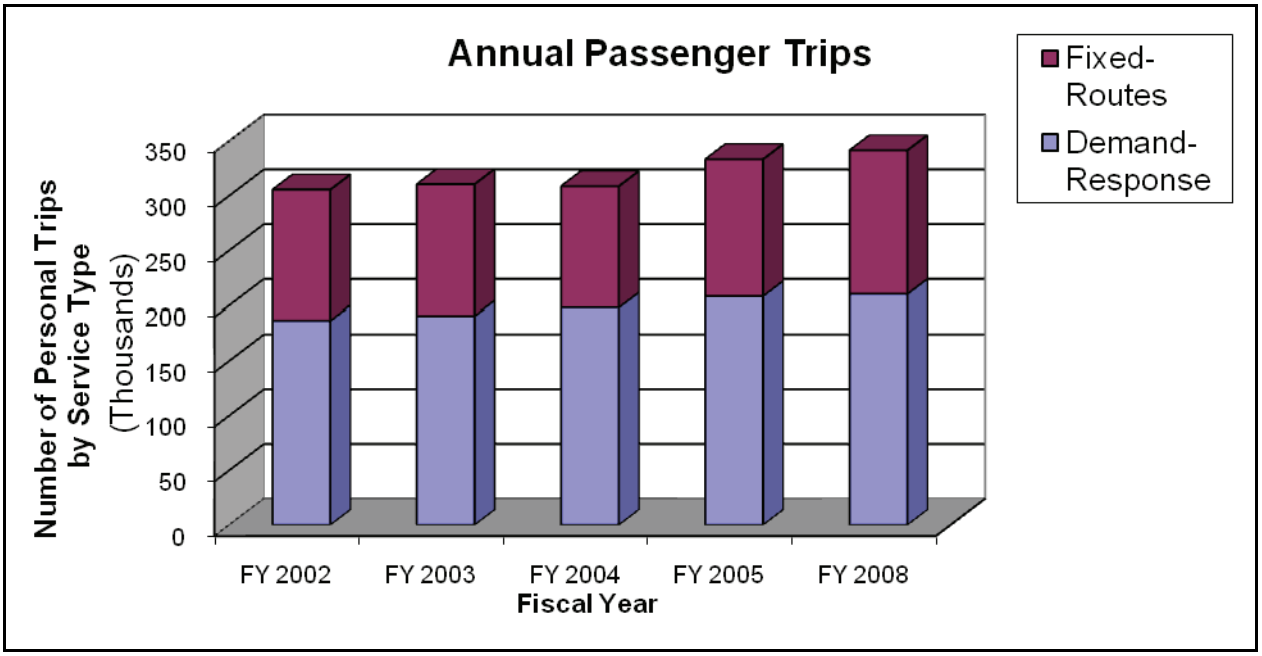

Figure 1-1. ATA Annual Passenger Trips

Figure 1-2 shows the service area of the ATA. Primarily three distinct operating zones exist within ATA with bus operations in Bradford (covering McKean and Potter counties), Johnsonburg (covering Elk and Cameron) and Dubois (covering Jefferson and Clearfield). Prior to 2000, each 2-county region had their own scheduling and dispatch operations with invoicing and maintenance being centralized at the ATA headquarters in Johnsonburg. Since 2000, ATA has consolidated scheduling and dispatch operations for the three centers, and all the scheduling and dispatch operations are carried out at Johnsonburg. Figure 1-3 shows the picture of ATA's new headquarters (HQ) at Johnsonburg, Pennsylvania.

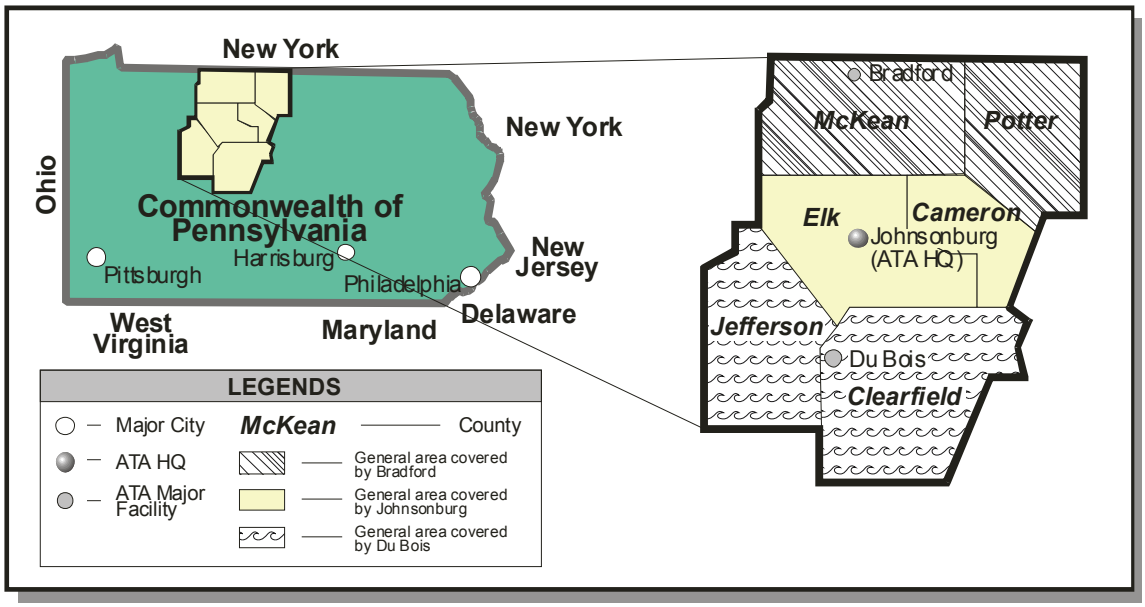

Figure 1-2. ATA Service Area

Figure 1-3. ATA Johnsonburg (HQ) Facility Since 2000

1.2 Earmark Project Description

The ATA implemented an Intelligent Transportation Systems technology project funded in part with federal FY2001 earmark ITS funding. A description of the major components of the earmark project is provided in the following sections. In addition, other institutional entities, such as the State of Pennsylvania and the Metropolitan Planning Organization, are involved to varying degrees in support of the project and services being evaluated.

Supported by the earmark, especially the scheduling system and the improved radio network, ATA decided to consolidate their center activities in Johnsonburg, bringing the scheduling and dispatch functions from DuBois and Bradford into a larger center at the ATA headquarters. The new technologies facilitated this major organizational change. The impacts of the centralization and other organizational changes are discussed in Chapter 3.

Table 1-2 summarizes the implementations by major transit function or service provided by ATA. This table shows in detail how each of the earmark project components support ATA's various transit functions. Figure 1-4 presents a high-level diagram of technology system deployed through the earmark project and Figure 1-5 shows the timeline of deployment. As shown in Figure 1-5, planning and design of the technology deployments was done in 2002 – 2004, the various technologies were implemented in a phased manner over the next several years and came on-line at various points during 2006 and 2007. Various baseline (before) were collected between late 2003 and 2005 and post-deployment data was collected in 2008. The individual technology components deployed through the ATA earmark project are described in sections that follow.

Table 1-2. Mapping of Project Components with Transit Functions

Earmark Project Elements	ATA Functions							
	Demand-Response	Fixed-Route	Fixed-Route w/ Deviation	Medical Assisted	Maintenance Operations	Dispatch	Call Taking	Invoicing
Data/Voice Radio	Communi-cation with vehicles	Communi-cation with vehicles	Communi-cation with vehicles	Communi-cation with vehicles	Communi-cation with service vehicles	Communi-cation with vehicles	N/A	N/A
Mobile Data Computer/ Automatic Vehicle Location	Provide data messaging and vehicle location	Provide data messaging and vehicle location	Provide data messaging and vehicle location	Provide data messaging and vehicle location	MDC facilitates pre-trip inspection	Vehicle locate and data messaging; provide manifest on MDC	N/A	MDC collects service performed data
Computer-Assisted Reservation, Scheduling, Dispatch (CARSD)	Computer assisted reservation; Facilitate scheduling of vehicles and drivers	Facilitate scheduling of vehicles and drivers	Computer assisted reservation; Facilitate scheduling of vehicles and drivers	Computer assisted reservation; Facilitate scheduling of vehicles and drivers	Facilitate scheduling of vehicles	Facilitate scheduling of drivers	Auto-mate call taking	Data input to financial system for invoicing and account payable
Maintenance Management	Receive pre-trip inspection data from instrumented vehicles	Receive pre-trip inspection data from instrumented vehicles	Receive pre-trip inspection data from instrumented vehicles	Receive pre-trip inspection data from instrumented vehicles	Inventory control; maintenance scheduling; pre-trip inspection data	N/A	N/A	Electronic filing of purchase orders
Financial System	N/A	N/A	N/A	N/A	Automate purchase orders	N/A	Receive data from CARSD	Automate invoicing to third party agencies

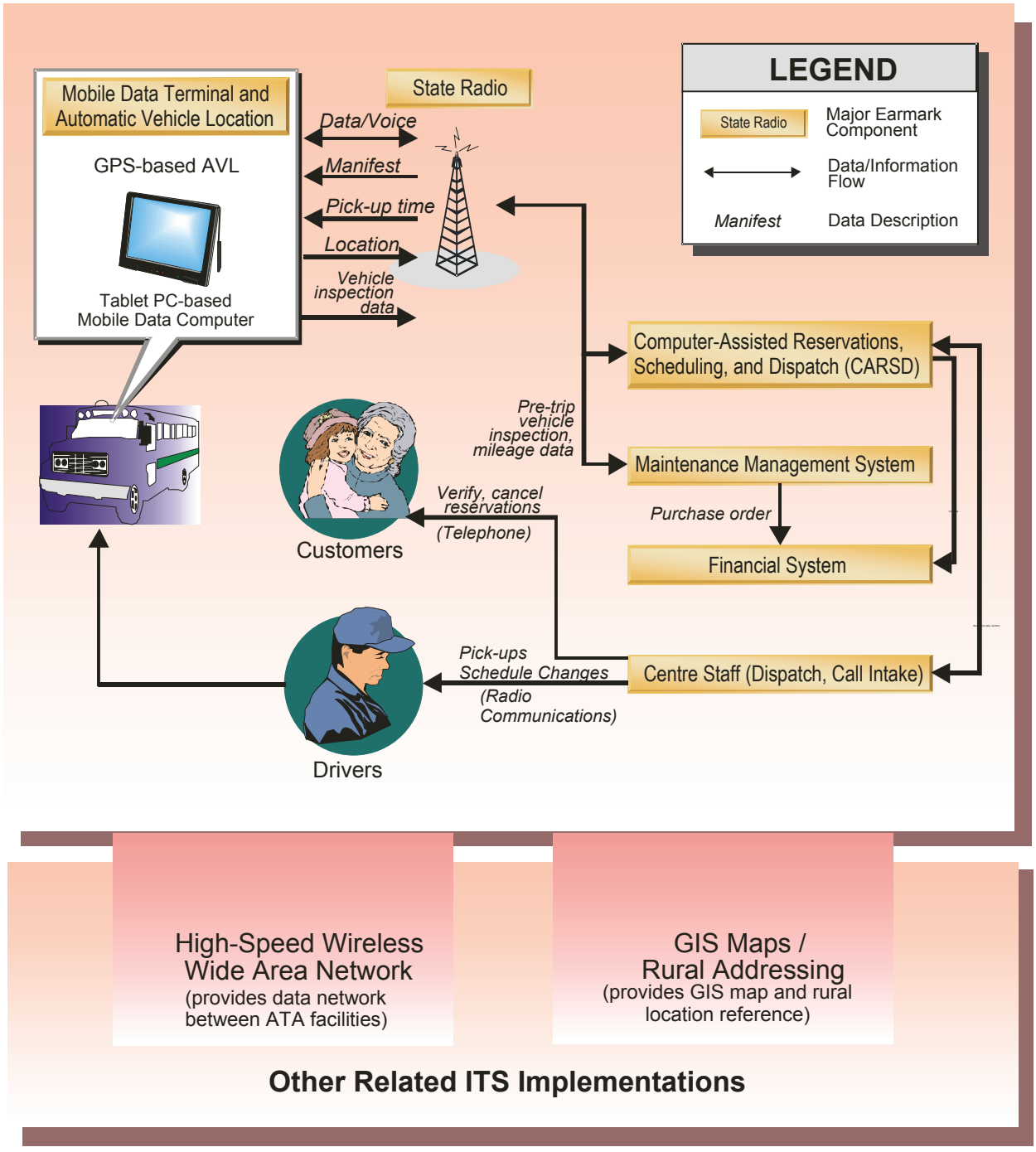

Figure 1-4. High-Level System Diagram

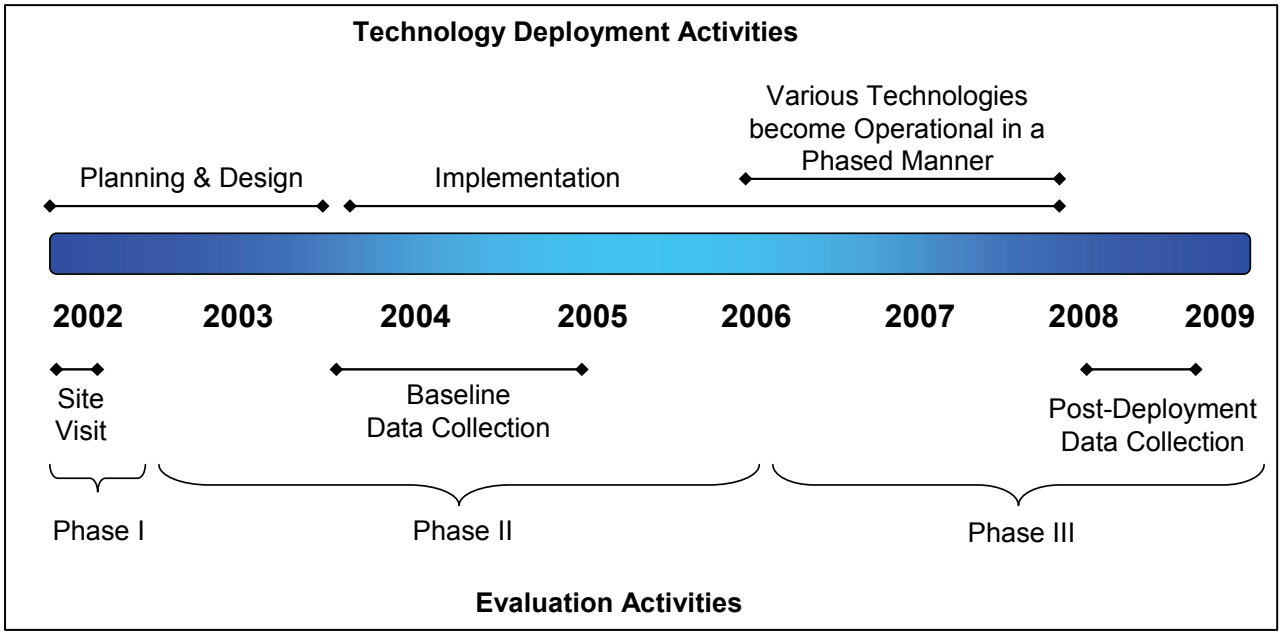

Figure 1-5. Timeline

1.2.1 Digital Voice and Data Radio Communication System

The ATA fleet was equipped with a vintage voice radio system with less than 60 percent coverage of the region. The old radio system was outdated, making it difficult to locate spare parts because the needed parts were no longer being manufactured. The new ATA's system is piggybacking on the Commonwealth of Pennsylvania's Statewide Voice/Data Radio Project that is being implemented to improve public safety. The state is building several hundred towers and employing M/A-Com Opensky technology, a fully digital radio system simultaneously supporting both voice and data transmissions. As a tenant of the state radio system, the ATA fleet will be equipped with voice and data messaging capabilities that provide 95 percent[2] of communication coverage. The new radio provides the digital voice communication that will allow individual units to be organized into talk groups (e.g., buses, supervisors, maintenance; as opposed to a shared channel by all buses). The sound quality and reliability will be significantly improved over the old analog radio system.

The data communication feature provides always-connected Internet Protocol IP-like point-to-point data communication. The data communications support text messaging using a Mobile Data Computer (MDC) and reporting of the vehicle location information using an onboard Global Positioning System (GPS) receiver.

[2] The goal of the Pennsylvania state radio system is to ultimately achieve 95% of communication coverage. This applies to the six-county area because ATA shares the same communications infrastructure.

1.2.2 Mobile Data Computer and Automatic Vehicle Location

The earmark project installed mobile data computer automatic vehicle location (AVL) systems on all ATA passenger vehicles. Those systems provide data communication and vehicle location reporting capabilities.

An industrial version of the Tablet PC computer has been chosen as the MDC. Figure 1-6 shows the MDC and Global Positioning System. The Tablet PC was chosen for its large screen size (i.e., legible to drivers), touch-screen feature, portability, and non-proprietary feature.[3] The MDC will be mounted at the driver's console to provide text messaging, download and display manifests, provide drop-off and pick-up records, and it can be detached from the mounting post to facilitate daily pre-trip walk-through vehicle inspection.

Past research has indicated that the use of text messaging could effectively reduce the amount of voice communication. Routine inquiries between the dispatchers and drivers can be pre-programmed as standard messages on the dispatcher's computer and on the MDCs. Upon receipt of a message, the bus driver can confirm or reply to it by selecting from a drop-down menu one of the pre-programmed response buttons provided using a graphical interface on the MDC. In addition, free-form text messages can be composed on the dispatcher's computer or from the MDC via a virtual keyboard.

Another important function of the MDC is to download and display the manifest. A manifest is provided to each driver by the end of the day (e.g., 4:00 PM) in which the assignment for the next day is prescribed including a list of passengers (name, ID), origins and destinations, pick-up times, etc.[4] The ability to download manifests wirelessly via radio will eliminate the burden of daily distribution of manifests to bus drivers scattered across the service area.[5] Once downloaded, the manifest can be used to record when a pick-up or a drop-off of a passenger occurs. The electronic recording of pick-ups and drop-offs is a highly desirable feature for rural demand-response operations. Such proof of service data can prevent fraudulent reports by the drivers and may be used to assist in dispute resolution with customers and invoicing of other agencies.[6]

A unique requirement of the ATA is to use the MDC for daily pre-trip vehicle inspection as part of their preventive maintenance program. The current procedure requires all drivers to record the inspection results on a paper form. Due to the geographical dispersion, those forms are collected once every week, thereby reducing the effectiveness of preventive maintenance. With the new system, drivers will bring along the MDC when they conduct their daily walk-through.

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[3] Tablet PC is endorsed by multiple vendors, and it operates on a special, "touch-screen" version of Microsoft Windows©.

[4] ATA's manifests include time, name, origin, destination, provider code (subsidizing agency), ID, category, number of zones traveled, fare type, and instructions.

[5] Due to the large service area, approximately 50% of vehicles are parked at bus drivers' residence at the end of the day. The distribution of the manifest occurs daily after 4:00 PM and is achieved using a combination of paper, phone, and fax.

[6] A significant portion of ATA riders are subsidized by social or human service agencies. The invoicing to third party agencies requires accurate proof of service information. ATA is currently requiring drivers to record such information on a "trip sheet" on a daily basis. The trip sheets are then entered into the computer for processing.

The inspection results will be recorded using a stylus (i.e., pen for touch-screen device) into an electronic form on the MDC mounted in the bus. Upon completion, the inspection data will be transmitted automatically over the radio network. Critical problems will be brought to the ATA maintenance department's attention for immediate action. This feature is important because a large portion of ATA's fleet is made up of retrofitted vehicles that require a high level of maintenance. The improved preventive maintenance is expected to minimize unexpected in-service breakdowns while the ATA gradually replaces its fleet with new vehicles.

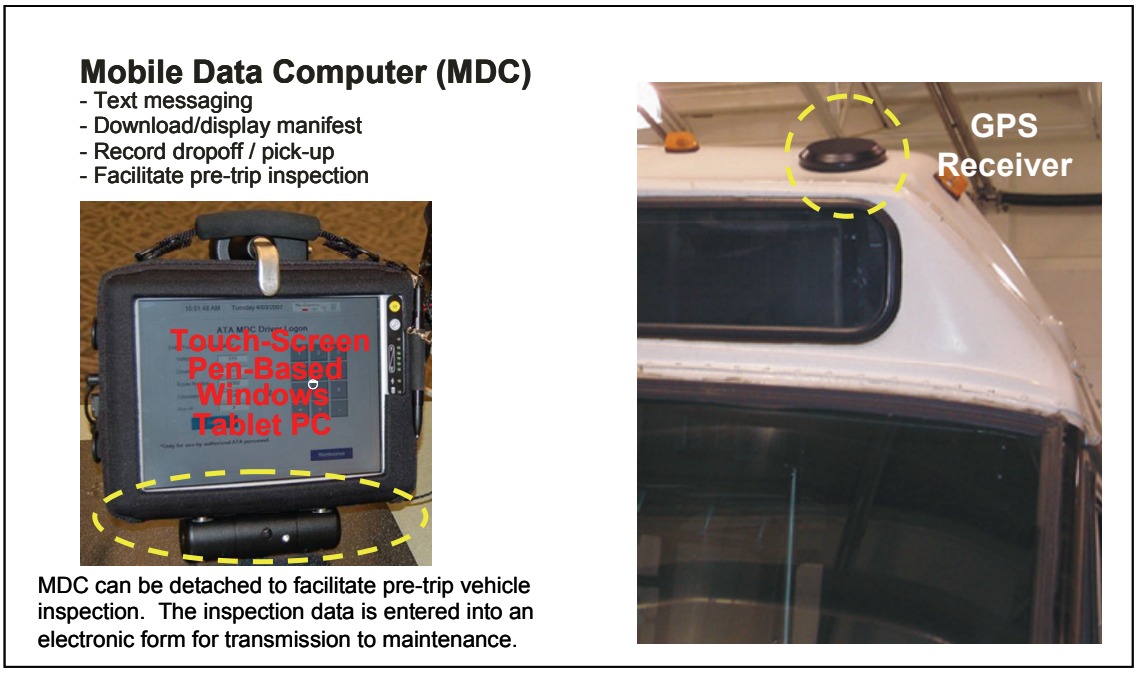

Figure 1-6. Mobile Data Computer and Global Positioning System

The AVL is achieved by integrating a GPS receiver with the onboard radio unit.[7] The AVL can be configured to report vehicle location (in latitude and longitude) at pre-determined intervals (e.g., 1 hour), when a voice or a data message is sent from the vehicle, or it can be "polled" by the dispatcher. The vehicle location data are sent wirelessly over the radio network and can be overlaid on a GIS map on the dispatcher's computer. The AVL is expected to improve fleet management and response to incidents. The AVL information also provides operation supervisors a tool to monitor on-time performance, which is typically randomly conducted by a supervisor waiting at a scheduled stop. The AVL, with recorded pick-up and drop-off times, provides complete records for assessing on-time performance.

AVL and MDC deployment was completed by June 2007. The original schedule called for the completion of vehicle implementation in December 2006. The delay was caused by the slippage

[7] The new state radio system is AVL ready. AVL also is used by other tenants of the state radio system such as law enforcement.

in the deployment of a state radio tower (by the Commonwealth of Pennsylvania) that would provide the wireless communications for the AVL.

1.2.3 Computer-Assisted Reservations, Scheduling, and Dispatch System

The computer-assisted reservations, scheduling and dispatch (CARSD) system is an integrated transit management system that supports ATA's call-intake, scheduling and dispatch activities. The CARSD system is also integrated with the AVL/MDC system, the financial (invoicing) systems, and the maintenance management system. The following sections describe the CARSD functionality for ATA's main activities.

1.2.3.1 Call-Taking

ATA processes two different types of demand response trip request telephone calls: regular call-a-bus demand response (seniors over 65, and non-seniors) and Medical Assistance Transportation Program (MATP). For call-a-bus reservations, CARSD provides an interface to a customer database that contains name, eligibility,[8] residence, previous origins and destinations, special requests (e.g., wheel chair), etc. The built-in error checking feature provides assistance in operations such as selecting the correct eligibility code for the requested trip type. Initially, ATA expected that the CARSD system could also be used to determine the eligibility of Medical Assistance trip requests and an associated evaluation hypothesis was developed. Ultimately, however, this capability was never implemented or utilized because ATA is required to determine Medical Assistance trip eligibility using a separate, state system—the web-based PAPromise system.

Based on the origin, destination, and time of travel input to CARSD by the call-taker, the system can automatically fit the requested trip into a service route with an estimated pick-up time. At the end of each day,[9] the CARSD system will produce the electronic manifests for wireless transmission to the MDCs over the radio.

1.2.3.2 Scheduling for Drivers and Vehicles

The CARSD system provides the interface for scheduling drivers and vehicles for all services. Different from paper-based operations, the system can facilitate the scheduling process by interfacing with the driver database and the vehicle inventory database. This reduces opportunities for human errors and provides a more effective way to fulfill service demands. The full benefits of the CARSD scheduling capabilities are realized through the use of "batch scheduling" in which trip requests and driver and vehicle information is input and the software exercises discretion (within the parameters of various user-specified limits) to create the most efficient schedule.

1.2.3.3 Dispatch

The CARSD system will be integrated with AVL to include real-time vehicle location information for all service types. The dispatchers get an update on vehicle location each time a

[8] An individual may be eligible for different programs depending on the type of trip.

[9] ATA stops taking new reservations for the next day after 3:30 PM. The manifests are distributed to drivers at 4:00 PM.

message or a voice call is made from the vehicle, or at pre-determined intervals. In the case of an emergency, dispatchers can poll the location of any vehicle in the fleet.

Vehicle locations will be graphically represented as overlay icons on the electronic GIS map of the service area. Other geographic information of interest such as customer residence, origin, and destination also can be displayed to enable better decisions by the dispatchers. The interface will provide standard features such as zoom-in, zoom-out, and querying/locating items of interest.

1.2.4 Maintenance Management System

The ATA installed a maintenance management system to address the challenges in vehicle parts inventory and to facilitate better scheduling for vehicle maintenance based on vehicle mileage[10] and service history.

The vehicle parts inventory system features standardized coding of vehicle parts, use of bar codes and scanners for inventory control, and the ability to specify re-ordering points. With accurate inventory information, one could look up part availability at other ATA facilities, thus reducing redundancy. The automatic re-ordering point feature alerts the staff when the inventory level falls below a pre-determined threshold.

Another important objective of this system is to simplify the process of ordering parts by reducing paper work and the associated human errors.[11] With the new system, purchase orders are filed electronically. Eventually, purchase orders will be electronically fed into the financial system to expedite the payment process.

Along with the preventive maintenance using MDCs, the earmark project is expected to improve the overall efficiency of vehicle maintenance and service reliability in terms of reduced maintenance-related breakdowns.

1.2.5 Financial (Invoicing) System

One of the challenges in rural transit operations is invoicing for service. Because the majority of trips are subsidized by health and human service programs, the service providers (e.g., ATA) must provide proof of service information as part of the invoice. Each agency has different requirements in the format and level of details in terms of invoicing. As a result, the ATA typically spends up to a month after the end of the previous month to process and submit all the invoices. Due to the lack of automated data collection, trip information must be entered from individual drivers' trip sheets and other paper sources, which is prone to errors. Tedious manual corrections and reconciliation must be performed before invoices are ready for submittal.

The financial system is integrated with CARSD and MDC/AVL for accurate trip information (including passenger, eligibility and funding agency). While some level of data reconciliation is still expected, the integrated system is expected to significantly expedite invoice preparation and

[10] Collected by drivers using the MDC during pre-trip vehicle inspection.

[11] Common errors include duplicated or incorrect part numbers.

the level of effort by eliminating manual data input. In addition, the quality of the proof of service data will be improved with the use of the MDCs for recording service performance data.

In addition, the financial system will provide general accounting functions, including payroll, account receivable, and account payable.

1.2.6 Interactive Voice Response System (not implemented)

As an optional system in the earmark, ATA had initially planned to implement an Interactive Voice Response (IVR) system. The IVR was planned as an automated interactive telephone system that would allow customers to verify or cancel a reservation 24 hours a day without interacting with a human operator. ATA ultimately decided not to implement the IVR and therefore it is not included in this evaluation. ATA decided to postpone the IVR due to challenges that they encountered with the design of the system and because, with the other technologies being implemented, they felt they had reached the limit of their ability to successfully introduce new technologies to staff and new procedures to customers.

1.2.7 Other ITS Projects and Institutional Roles

The ATA technology project builds upon the implementation of other concurrent enabling technologies. These projects include:

- Comprehensive GIS mapping of the entire six-county region that features rural addressing.[12] This effort intends to establish accurate geographic and demographic information support systems for the public safety, transportation management, transit management and economic development needs of the region. The resulting GIS map will be used by the regional agencies, including ATA in support of the Computer-Assisted Dispatch (CAD)[13]/AVL operations. The Regional Planning Organization (MPO equivalent), the North Central Pennsylvania Regional Planning and Development Commission, will centrally maintain the GIS map.
- Implementation of a point-to-point, high-speed, wireless, wide-area communications network for use by regional agencies, including the ATA. The wireless network provides data networking capability between ATA's main facilities (e.g., Johnsonburg, Bradford, and DuBois) in support of maintenance and operation functions. The same network will also provide inter-agency data networking for updating GIS maps and other regional resources. The ATA is responsible for the maintenance and operations of this data network.

[12] Refers to the lack of cross streets and landmarks in rural environments where the urban house numbering scheme may not be viable.

[13] The GIS data provide a base map for the computer-assisted dispatch on which the vehicle and customer locations are overlaid.

1.3 Organization of this Document

This report on the Phase III evaluation findings includes the following chapters:

- Chapter 2 describes the evaluation approach, including the four evaluation analyses that were performed.
- Chapter 3 presents the evaluation findings.
- Chapter 4 summarizes major findings and presents conclusions.

2.0 Evaluation Approach

This chapter summarizes the approach used to evaluate the ATA technology deployment, including the evaluation objectives, the development and execution of several evaluation analyses, and the potential influence of and approach taken to exogenous factors,

2.1 Evaluation Objectives

The overall objectives of this evaluation are to:

- Assess the performance of the ITS deployment in terms of system impacts, including productivity, safety, and customer satisfaction.
- Document the implementation, including system costs, and identify technical and institutional issues and how they are addressed and resolved.
- Identify lessons learned that may be useful to other developers and implementers of similar projects.

This evaluation is organized as a before and after study, following a protocol set forth by the ITS Joint Program Office (JPO). The evaluation activities are identified based on a list of hypotheses that focus on three national ITS evaluation goal areas, namely, productivity, safety, and customer satisfaction.

2.2 Hypotheses and Analyses

In close cooperation with the ATA, an extensive set of specific hypotheses were developed that flow from the evaluation objectives, relate directly to the individual technologies, and which articulate the intended benefits of the ITS deployment. The intended impacts reflected in the hypothesis statements focus on improving ATA productivity and efficiency, such as by reducing the time required to prepare invoices; improving safety, such as by reducing the number of in-service breakdowns; and maintaining or enhancing customer satisfaction, such as by improving on-time performance. Evaluation hypotheses are presented in Chapter 4 along with a summary of the findings related to each hypothesis. Some changes were made in the hypotheses as the project developed, most significantly the elimination of several hypotheses related to the Interactive Voice Response telephone customer information system that was not deployed.

Four evaluation analyses ("tests") were developed and executed to investigate the hypotheses and to collect lessons learned and other information with regard to the goal areas of productivity, safety, customer satisfaction, and ATA staff perspectives. A "systems impacts"—that is, "before-after"—evaluation approach was utilized in which conditions before the ATA technology deployment were compared to conditions after deployment. Data included both quantitative data, such as "system data" generated automatically by various ATA systems and qualitative data, which consisted of customer surveys, focus groups, and interviews with ATA staff. As discussed in Chapter 1, baseline data was collected in 2003 – 2005 and post-deployment data was collected in 2008.

Table 2-1 summarizes the types of data used in each of the four evaluation analyses. System data were automatically generated and typically provide continuous data over a period of many months. Staff recorded data were manually recorded through a special data collection effort and reflect conditions over a relatively short, illustrative period of time. The productivity and safety analyses relied as much as possible on quantitative data but also utilize ATA staff input to collaborate and/or aid in the interpretation of findings. Most analyses directly compared baseline and post-deployment data. The exceptions are:

- **Service Flexibility** – There were no baseline data for the number of same day trips or trip denials; the analysis considers only the trend in post-deployment data and input from ATA staff.
- **Customer Satisfaction** – No post-deployment survey was conducted because the baseline findings showed very high satisfaction levels and it was considered unlikely that subtle changes could be detected through a survey. As a result, increased emphasis was given the post-deployment focus groups.

Table 2-1. Data Types Used in the Evaluation Analyses

Evaluation Analysis	Data Types Utilized in Analysis			
	System Data	Staff Recorded Data	Staff Interviews	Customer Survey and Focus Groups
Productivity				
Invoice Processing Times		■	□	
Staff Utilization		■	□	
Service Flexibility	■		□	
Schedule Efficiency				
On-Time Performance	■		□	□
Revenue/Non-revenue Vehicle Miles	■			
Safety				
Preventative Maintenance	■	□	□	
In-Service Breakdowns	■	□	□	
Customer Satisfaction				■
ATA Staff Perspective			■	

■ = Primary data source

□ = Supporting data source

The specific approach to each of the four evaluation analyses is described in the sections that follow.

2.2.1 Productivity Analysis

The productivity analysis examined six different parameters ranging from the time required to prepare invoices to the efficiency of the schedules produced using the new software. The approach to each of these investigations is summarized below.

- **Invoice preparation.** An analysis of invoice processing time was conducted by comparing the dates of invoice submission pre-deployment and post-deployment. By reducing the number of days between the end of the month and the invoice submittal, ATA can get reimbursed quicker for the trips provided.
- **Schedule and dispatch staff utilization.** An analysis of dispatcher operations was performed using time-logs kept by the office staff at ATA. This concerns the many critical operational functions being performed by the dispatchers. As part of the earmark deployment, such functions were re-distributed among dedicated staff members through the facilitation of computers and a central database. Time logs were maintained by ATA staff for a 2-week period during the baseline as well as post-deployment and staff utilization was compared.
- **Service flexibility.** Service flexibility was analyzed by looking at system data for indicators such as the number of demand response trip requests denied by ATA and the number of same-day trip requests accommodated. Baseline data for these indicators were not available and so the analysis considers only trends over the 7-month post-deployment period. The evaluation of service flexibility also considered the improvements in radio coverage associated with the technology deployment because ATA believed that improved communications with drivers could facilitate service flexibility.
- **Schedule efficiency.** "Schedule efficiency" describes the efficiency of the schedules produced using the new computer-assisted scheduling system. In theory, the software can generate tighter, more efficient routings (schedules) which would result in improved on-time performance and a higher proportion of revenue miles (vehicle miles driven with at least one paying customer on board) versus "deadhead" miles (vehicle miles driven with no paying customers on board). These metrics were investigated as follows:
    - On-time performance – The baseline evaluation utilized paper records from multiple sources. Driver manifests contained the sequence of customer pick-ups and provided the scheduled time information. Actual pick-up times were obtained from a trip sheet filled out by the drivers as the service is performed. The ATA provided the hardcopy manifests and trip sheets from the last week of August 2005. All relevant records were entered into an Excel spreadsheet for analysis. This resulted in 1,219 trips in support of the on-time performance analysis. The baseline analysis focuses on insuring the data availability and integrity, and provides a discussion of the data distribution patterns relevant to the intended analysis. In this phase, with the deployment and use of the CARSD system, a trip database was available and used for on-time calculations.
    - Revenue miles and non-revenue vehicle miles – Baseline and post-deployment system data were compared to assess changes.

- No-shows – No-shows—when a demand response customer fails to show up for a trip but does not cancel in advance—play a significant role in schedule efficiency. ATA intended to reduce no-shows via the IVR but after deciding to postpone the IVR deployment indefinitely have attempted to reduce no-shows through increased customer education. Because no-shows can have such a significant influence on schedule efficiency, the analysis of revenue and non-revenue miles included an examination of no-show trends.

2.2.2 Safety Analysis

The safety analysis assessed preventative maintenance and in-service vehicle breakdowns. The approach to each of these investigations is summarized below.

- **Preventative Maintenance.** While there is a preventive maintenance procedure in place pre-deployment to require drivers to conduct a daily pre-trip vehicle inspection, those data were not used by the ATA maintenance department due to logistical challenges in collecting the inspection forms – about one to two weeks to arrive at Johnsonburg. With the advent of the AVL/MDCs, pre-trip inspections were integrated with the maintenance management system. The analysis looked at the number of unique defects identified by the pre-trip inspection for preventative maintenance.
- **In-Service Breakdowns.** The key measure for assessing the improvement in maintenance practice is the number of in-service breakdowns. Data for in-service breakdowns and the duration of the breakdowns was collected during the baseline and post-deployment periods.

2.2.3 Customer Satisfaction Analysis

Customer satisfaction was an important but, ultimately, not a driving motivation for the ATA technology deployment. When the evaluation team asked ATA to reassess and prioritize the evaluation hypotheses at the beginning of the post-deployment phase of the evaluation, two of the customer satisfaction hypotheses were eliminated completely because, given the ATA decision to postpone IVR implementation, they were no longer relevant. None of the remaining three customer satisfaction hypotheses were rated by ATA as highly important. This is not to suggest that improved customer satisfaction was not a goal. Rather, it was not as critical a goal as improving ATA productivity—stretching their limited resources—and enhancing safety.

Although elimination of the IVR certainly explains much of the modest expectations for customer satisfaction benefits, it is not the only factor. It is also likely related to the fact that ATA has traditionally enjoyed very high levels of customer satisfaction and, therefore, it would be difficult to realize any improvement in satisfaction.

Baseline Activities. Baseline evaluation activities to gather and analyze customer satisfaction related data consisted of an on-board survey and focus groups with ATA customers. The evaluation team, in consultation with ATA, developed a 10-question survey (a 14-question version was used for demand response riders) focusing on trip making habits (frequency, trip purposes), satisfaction with various aspects of ATA service, and perceptions of safety. The survey was administered on-board by ATA personnel. A total of 390 survey responses were

obtained. The baseline survey instruments (the fixed route and demand response versions) are included in Appendices A and B.

Customer focus groups were conducted to probe more deeply into the opinions of ATA riders and to provide a context for the findings of the on-board survey. Two focus groups were conducted at local restaurants, each lasting about 90 minutes and included a total of 17 customers. The focus groups were held in two different parts of the ATA service area—one in Johnsonburg and one in DuBois. ATA recruited the focus group participants with the objective of obtaining a representative sample of ATA customers. Focus group questions related to on-time performance, scheduling, and safety. The baseline focus group discussion guide is included in Appendix C.

Reflecting the overall ATA customer demographic, survey respondents and focus group participants were overwhelmingly female and elderly.

Post-Deployment Activities. In consultation with ATA and U.S. DOT, the planned post-deployment on-board survey was eliminated. Baseline customer satisfaction results were very high, leaving very little room for improvement. Given the advanced age of most ATA customers and the limited probing and explanation possible with an on-board survey, (especially one not administered directly by the evaluation team) it was believed that any likely changes in customer satisfaction would be too subtle for detection through a survey.

With the elimination of the post-deployment survey, greater emphasis was placed on the focus groups. The number of groups was expanded to four—two in Johnsonburg and two in DuBois—and total participants were expanded to 30 ATA customers. As in the baseline, ATA recruited the focus group participants. However, given the increased reliance on focus group input for the post-deployment evaluation, the evaluation team worked very closely with ATA to attempt to obtain participants representative of the customer base overall. As in the baseline and consistent with ATA ridership in general, participants were overwhelmingly female (27 of the 30) and elderly. A copy of the post-deployment focus group discussion guide is included in Appendix C.

2.2.4 ATA Staff Perspectives

Input from ATA staff played an important role in the evaluation. It was the primary source of lessons learned information (including both institutional and technical issues) and for a few hypotheses where quantitative data were lacking. Staff input also played a very important role in providing a context for interpreting quantitative data findings.

ATA staff input was collected in both the baseline and post-deployment periods through a series of in-person interviews, each conducted by two national evaluation team members. In both cases, interviews were conducted over two-day site visits and included interviews with both ATA DuBois and Johnsonburg personnel. The duration of interviews varied from approximately 30 to 60 minutes depending on the type of personnel interviewed. Individual interview sessions included two to six ATA personnel and were organized around the following staff functions:

- ATA management
- Drivers
- Maintenance personnel
- Schedulers and dispatchers
- Medical assistance
- Accounting

An interview discussion guide focusing on technology project benefits, challenges, and lessons learned was developed for use in all of the interview sessions. The questions pertaining to benefits included a common set of questions asked of all interviewees as well as customized questions focusing on the specific benefits most likely to be observed by specific types of personnel. The interview questions used for ATA management, which included a broad range of benefits topics, are included in Appendix D as an example of the interview discussion guides.

2.3 Exogenous Factors

Exogenous factors are influences that are unrelated to the deployment (or whatever is being evaluated) that may impact the same measures that are being used to evaluate the deployment. In the case of a before-after evaluation like this one, changes in exogenous factors like the size of the ATA fleet and ridership (number and types of trips requested and served) occurring between the baseline and the post-deployment evaluation data collection periods can threaten the ability to differentiate the independent impacts of the technology deployment. For projects like this one where several years elapsed between the baseline and post-deployment data collection (because it took that long to deploy the technologies), the threat of exogenous factors is heightened.

The general approach taken in this evaluation has been to track key exogenous factors like fleet size and composition, ridership, and ATA staffing levels and to interpret evaluation findings in light of any observed changes in those factors. Generally, there were few significant changes in these variables over the course of this evaluation and therefore most of the measured impacts likely stem primarily from the technology deployment. However, as is often the case, it was not possible to fully and explicitly control for exogenous factors and so the possible influence of these factors on the evaluation findings should be kept in mind.

3.0 Evaluation Results

This chapter presents the results of the evaluation of the ATA technology deployment. Results are presented for each of the four main evaluation analyses: productivity, safety, customer satisfaction, and ATA staff perspectives.

3.1 Productivity

The sections that follow present the results of the productivity analysis, including those related to invoice processing time, dispatch office staff utilization, service flexibility, and schedule efficiency.

3.1.1 Invoice Processing Time

Subsidy from third-party health and human services agencies is one of ATA's primary sources of revenue. At the end of each month, ATA needs to prepare invoices for various agencies containing auditable detailed proof of service. Based on interviews with the finance department staff, the invoice preparation process involves many staff members in support of data entry, data reconciliation (e.g., verifying with dispatchers and drivers), auditing and preparation of proof of service data (in various formats required by different agencies), and finally the preparation of the invoice. After the submission of the invoices, additional inquiries can be expected from subsidizing agencies regarding certain service records or charges. The additional inquiries and subsequent reconciliation actions could further delay the time for the agency to get paid. The financial officer cited that electronic data collection of all service data will considerably reduce the invoice processing time, although some degree of human auditing and reconciliation might still be needed with the earmark financial system.

Figure 3-1 shows the distribution of the invoice processing times before and after the earmark. The processing time is derived from the time stamps on the invoices that were submitted to the third-party agencies. With the paper-based system (2003-2004) prior to the earmark, ATA spent an average of 21 days to complete the invoices from the previous month. This has been sharply reduced to an average of 12 days with the electronic system. The substantial savings of 9 days has been realized due to the system's ability to enable quicker data reconciliation, customized reports and more accurate record-keeping of ridership and customer information. Post-deployment, ATA experienced a few delays in November-January due to scheduled system updates to their CARSD system.

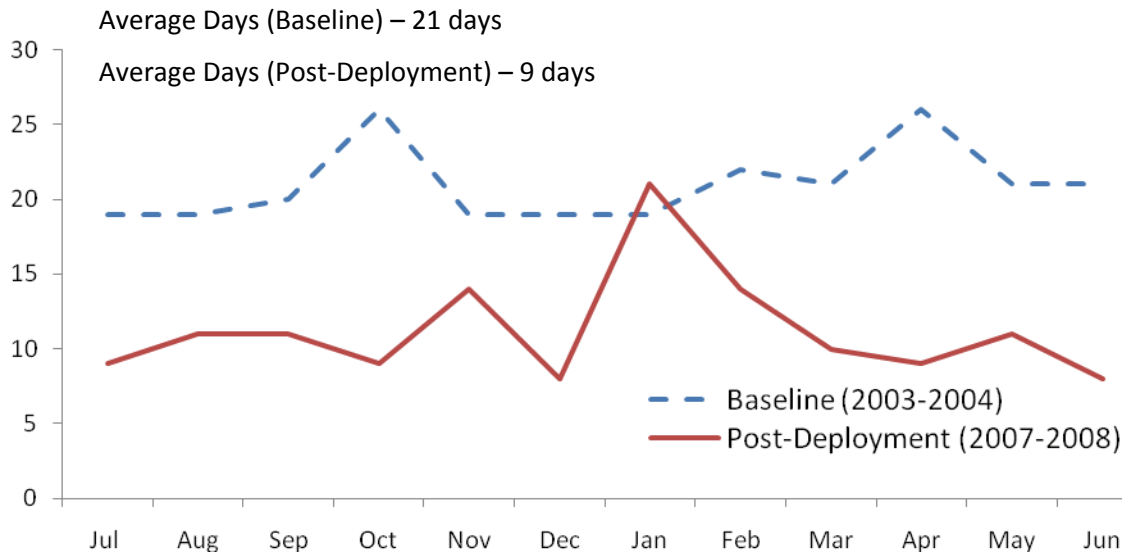

Figure 3-1. Baseline versus Post-Deployment Invoicing Times

3.1.2 Dispatch Office Staff Utilization

The responsibilities of dispatch office staff of primary interest for this evaluation consist of the following three activities:

- Scheduling – Develop the individual driver/vehicle schedules—the manifests showing the sequence of individual pick ups and drop offs;
- Call Taking – Take incoming calls from customers to schedule or reschedule trips; and
- Dispatching – Distribute manifests to drivers and communicate with them over the course of the day regarding a wide range of issues, from ascertaining the current status of each driver and trip (e.g., confirming pick ups and drop offs), coordinating breaks, and coordinating same day changes in the manifest, e.g. dropping trips where customers have cancelled, adding trips, and so forth.

ATA had three objectives related to improving utilization of dispatch office staff, the first two of which were broader objectives partially tied to the technology deployment and a third that was intended as a direct impact of the deployment. The first objective was to facilitate consolidation of all major vehicle maintenance and dispatch office functions to a central location at the Johnsonburg ATA headquarters facility. The second objective was to improve the efficiency of the dispatch office by introducing a division of labor whereby specific personnel would focus most of their day on scheduling, dispatching or call taking functions. ATA management recognized that the new technologies would play a supporting rather than a defining role in achieving these two high-level objectives and therefore did not identify a specific hypothesis for testing in the evaluation. The final objective, for which a specific hypothesis was defined, was to reduce the amount of time dispatchers spend on the radio and cell phones communicating with drivers by shifting much of that communication to the mobile data computers.

The results of the evaluation indicate that all three objectives have been fully realized. ATA has been successful in consolidating maintenance and dispatch activities to Johnsonburg; they have instituted a division of labor in the dispatch office; and dispatch staff now spends substantially less time on the radio or cell phones communicating with drivers. The implications of changes related to the first two objectives are discussed primarily in the ATA Staff Perspectives portion of this chapter.

The amount of time that dispatchers spend on driver communication was ascertained through baseline and post-deployment data collection in which staff maintained detailed logs of the time spent on specific activities every day over the course of between one and two weeks. Those results indicate that the amount of time spent with drivers via radio and cell phone decreased approximately 28 percent, from about 8.7 hours to 6.3 hours per day. Interviews with dispatch office staff corroborate the value of the technology in reducing radio traffic. They say that clear messaging made possible with the MDCs has reduced much of the radio chatter formerly associated with repeating information to drivers who were struggling to understand the dispatchers.

The time logs completed by the dispatch personnel also provide quantitative evidence of the benefits of the introduction of a division of labor in the office, i.e., dividing the work into scheduling, dispatch and call taking functions. After the reorganization, the schedulers spend 75 percent of their time on scheduling activities, dispatchers spend 90 percent of their time on dispatching, and call takers spend 91 percent of their time on the phone with customers. This division is in contrast to the previous organization in which every dispatch staff member's daily activities were fractured across these three functions.

It should be noted that it is not clear how much of the observed benefits stem directly from the technologies, how much from the indirect impact of the technologies in enabling the consolidation of the dispatch function to Johnsonburg, and how much from the reorganization of dispatch office functions. As noted above, ATA believes that the technology played an integral role in both the consolidation and the reorganization, but the relative contributions of these various factors is uncertain and therefore it is unclear what benefits other agencies may obtain who implement only one or two of these changes.

3.1.3 Service Flexibility

ATA viewed the earmark deployment as an opportunity to increase the flexibility of the service and enable the transit system to be more adaptive to changes in schedule and demand. Key indicators for service flexibility included the number of same-day trip requests and the number of trip denials. ATA expected to meet more same-day trip requests and refuse fewer trip requests due to the AVL/MDC system which would allow them to monitor vehicle locations and status (i.e., individual trip pick ups and drop offs) in real-time and communicate schedule changes to drivers quickly and effectively.

Baseline data for same-day trips and trip denials were not available and therefore the analysis is limited to an examination of trends over the 7-month post-deployment period. As shown in Figures 3-2 and 3-3, there is some evidence of positive trends although the limited data (e.g., inability to rule out typical seasonal variation) prohibit drawing conclusions based on the

quantitative data. However, ATA dispatch staff does report that the technology systems have improved their ability to respond to same day trip requests, fill slots made available due to cancelations, etc.

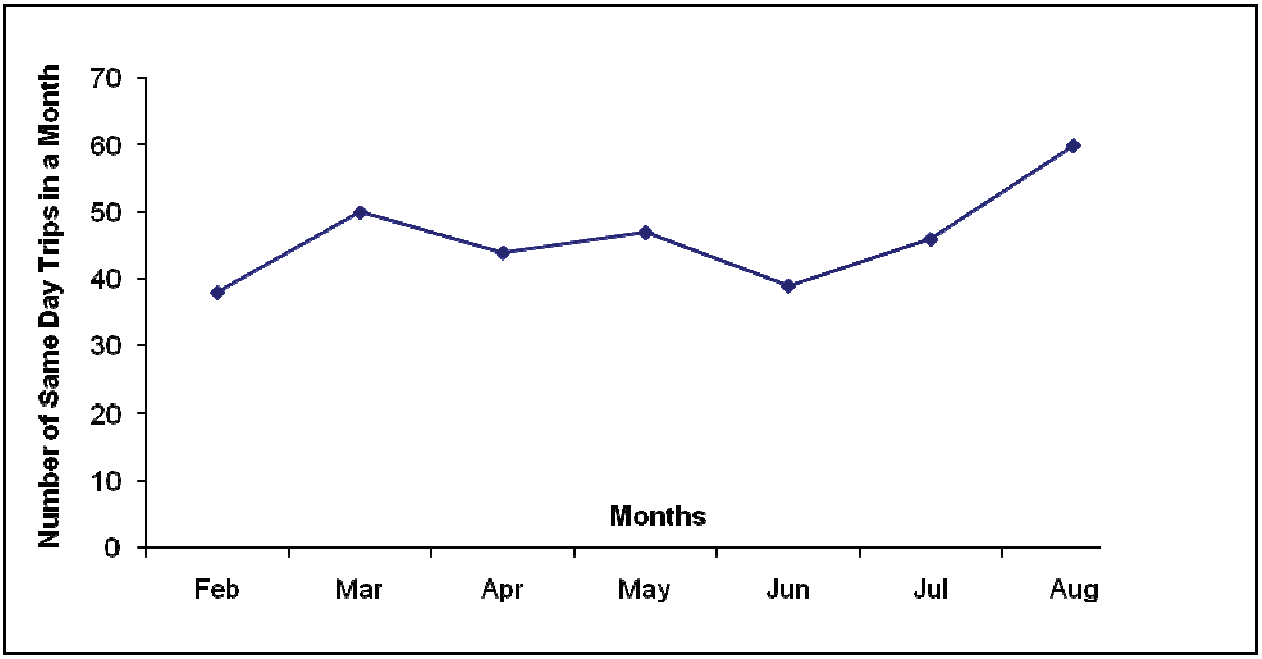

Figure 3-2. Same Day Trips (Post-Deployment)

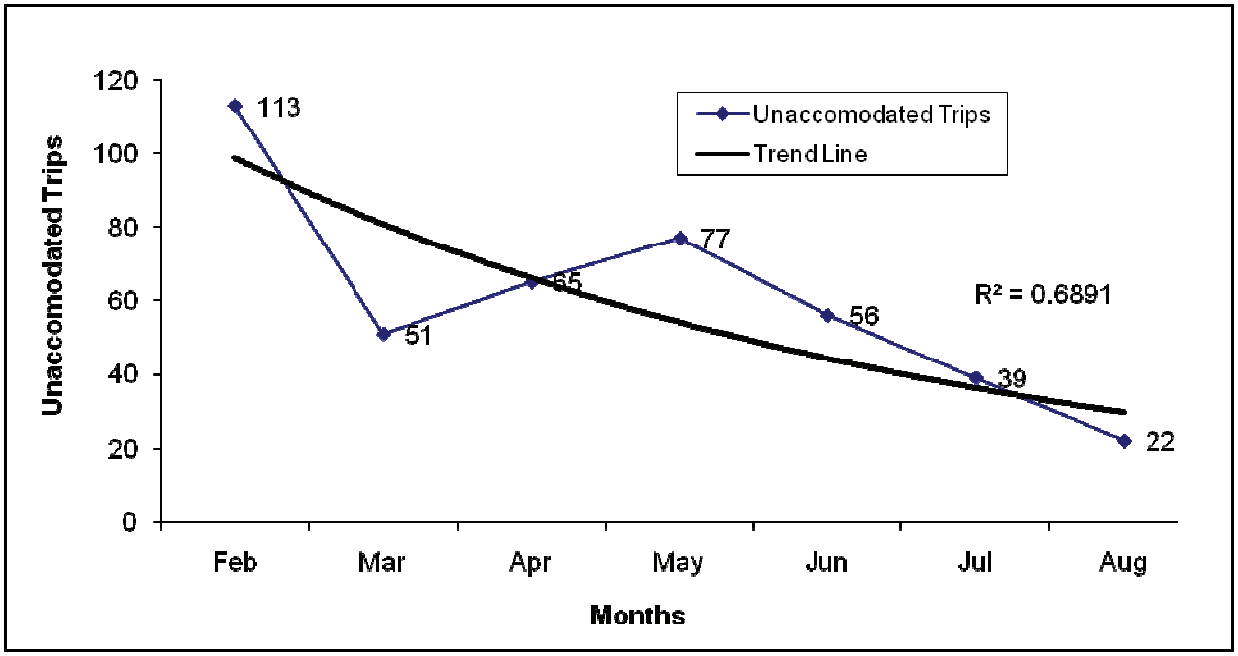

Figure 3-3. Trip Denials per Month (Post-Deployment)

As part of the examination of trip denials, denials by trip type were investigated. As shown in Table 3-1, most of the trip denials in the post-deployment period have been "Medical Assistance-related" trips to medical offices. The relatively high incidence of denials for these trip types is related to the unique nature of these trips and the special procedures that ATA utilizes for them. On-going ATA efforts to reduce trip denials include a focus on Medical Assistance trips.

Table 3-1. Trip Denials by Trip Type, Post-Deployment

Trip Types	Number of Trips Denied	Percentage of Trips Denied
Medical Assistance-related (doctors/offices/dialysis/therapy/hospitalization)	262	62%
Other doctor/office visit	87	21%
Other (groceries, senior center, shopping, etc.)	47	11%
Purpose Unknown	27	6%
Total	**423**	**100%**

A final factor related to improved schedule flexibility is the improved radio coverage realized through the technology deployment. As shown in Table 3-2, the baseline, pre-enhanced coverage was less than 60 percent in several of the counties in which ATA operates. Post-deployment, radio coverage has been greatly enhanced with all counties except Potter, which has the least coverage due to difficulty in getting agreements in place to use that county's towers. This improvement has greatly facilitated the use of AVL/MDCs and has been a vital component in the successful deployment of these technologies. As part of the technology deployment, ATA has become an official statewide backup center for communications. This provides ATA ample communication bandwidth and network redundancy and has been a major factor in the success of all of the communications related aspects of the deployment. By having consistent and reliable radio coverage, ATA hopes to continue improving service flexibility and communications with the drivers in the coming years.

Table 3-2. Radio Coverage

County	Percentage of County Covered by ATA Radio System		Percentage Increase in Coverage
	Post-Deployment (June 2009)	Baseline (September 2005)	
Cameron	88.4%	84.6%	3.8%
Clearfield	96.1%	76.4%	19.7%
Elk	91.6%	59.5%	32.1%
Jefferson	96.1%	54.4%	41.7%
McKean	83.5%	54.7%	28.8%
Potter	79%	77.9%	1.1%

3.1.4 Schedule Efficiency

The deployment of the CARSD system and the AVL/MDC was expected to improve demand response schedule efficiency. Two measures of performance were of interest to ATA and the evaluation: improved on-time performance and reduction of non-revenue (dead head) miles. Statistics on no-shows were also examined because of the major impact they have on schedule efficiency.

3.1.4.1 On-Time Performance

The ability to pick-up a customer at the scheduled time is a key measure of performance for a demand response transit service that makes up the majority of ATA's operations. On time performance is especially important in the six-county area, because of the inclement winter weather and the senior citizens and mental health patients that make up a large portion of the demand response customers. This section presents an analysis of the on time performance of the ATA demand response service before the earmark implementation.

Collecting on-time performance data prior to the deployment of the AVL/MDC was a continuing challenge for ATA and quality statistics were mostly unavailable. For the baseline evaluation, driver manifests and trip sheets from the month of August 2005 were analyzed and compared. The data entry of the large number of paper logs was laborious and challenging due to the handwritten records. In addition, manual data collection is susceptible to human errors in data recording, as well as variations in time keeping and recording (due to a lack of a centralized time keeping). The baseline results reported here are based on 1,219 services rendered.

In the post-deployment evaluation, a richer dataset was available from the CARSD system based on the times recorded by the drivers on the MDCs. Trip data for the month of September 2008 were analyzed for timeliness of operations. Over 16,000 records of trips for the entire month were analyzed with the scheduled pick-up and actual pick-up times compared against each other.

ATA defines "on time" as between 15 minutes before and 15 minutes after the scheduled pick up time. Figure 3-4 compares the baseline and post-deployment distribution of pick up times. The percentage of on-time pick ups (those between 15 minutes early and 15 minutes late) increased 9 percent after deploying the technologies, from 72 percent to 81 percent. The improvement in on-time performance appears to have been realized through a reduction in late pick ups (pick ups made more than 15 minutes after scheduled time). Although the overall improvement in on-time performance is beneficial, it is somewhat moderated by the shift toward early pick ups—within the 30 minute on-time window the number of pick ups that were early has increased from 33 to 54 percent and the number of truly early pick ups (more than 15 minutes early) increased from 10 to 14 percent. These increases moderate the overall on-time improvement somewhat because being significantly early may be more inconvenient to customers than being slightly late.

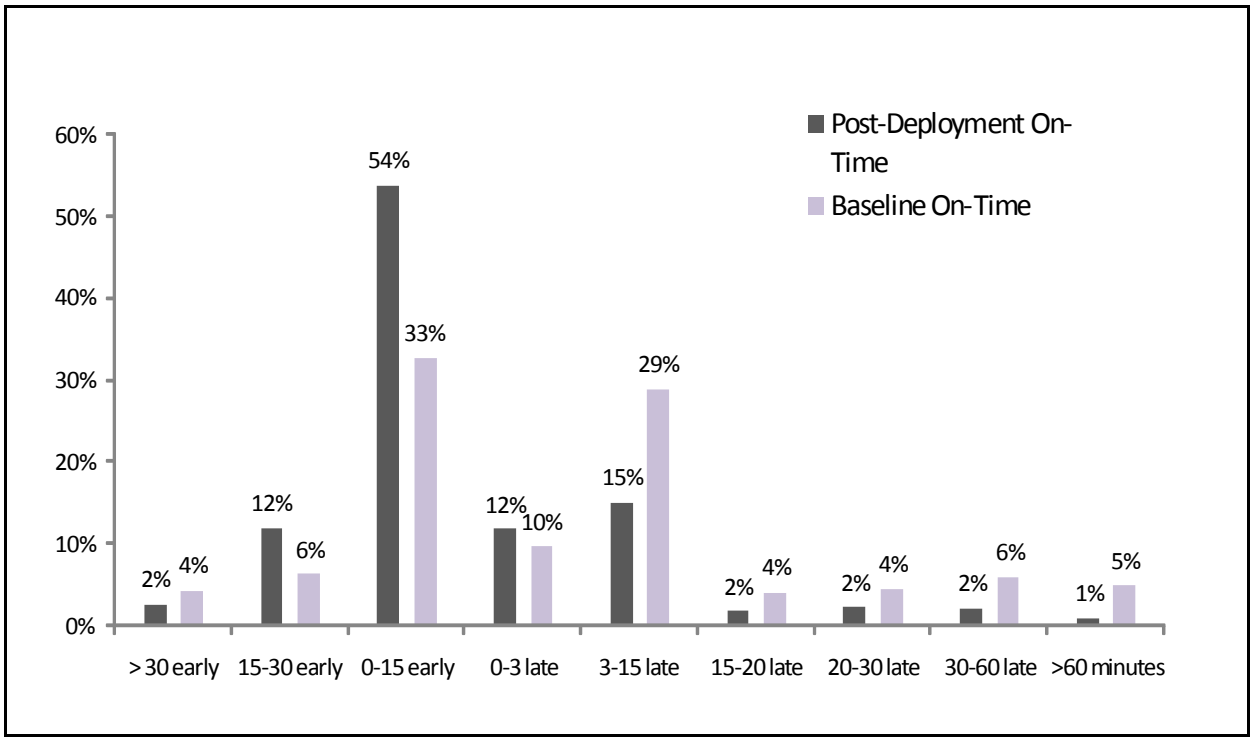

Figure 3-4. Distribution of Pick-up Times

3.1.4.2 Non-Revenue Vehicle Miles

Among the five types of services provided by ATA, the technology deployment was expected to reduce non-revenue miles primarily for the demand response service. Improvements were expected to accrue as a result of the better vehicle routing and improved responsiveness to same day schedule changes (added trips, responding to cancellations and no-shows), made possible with the new technologies.

Detailed statistics by month and by county were obtained for the fiscal years 2002-2005 for the baseline and the post-deployment period (February to August 2008). As shown in Table 3-3, the percentage of non-revenue miles ranges from 21 percent to 26 percent, which is slightly higher than the national average of 24 percent for similar rural environment in the baseline. Table 3-3 also shows that the percentage of non-revenue miles has decreased post deployment by about 6 percent in comparison to the average baseline statistics. The influence of the technology on non-revenue miles is uncertain, however.

Anecdotal information from dispatchers and schedules suggest that it is unlikely that significant improvements in schedule efficiency have yet been realized. Also, ATA has not yet finished adjusting their scheduling processes to take advantage of the batch scheduling capability in the software system, a capability that is expected to be a main driver of schedule efficiency improvements. Batch scheduling is the process by which trip requests are fed into the software and the scheduling software is allowed full discretion in matching trips with drivers/routes so as to produce the most efficient schedule possible. To date, the scheduling software is used only to

tighten up schedules that are fundamentally set manually. ATA intends to move to batch scheduling in late 2009 or 2010. Deferral of the move to batch scheduling is part of ATA's general strategy of introducing technology-related changes gradually over time, limiting the introduction of changes to the rate at which staff can adjust to them. ATA reports that another motivation in deferring the introduction of batch scheduling was to wait until 2009 route modifications were completed.

Table 3-3. Revenue vs. Non-Revenue Vehicle Miles

Year	Demand Response Revenue and Non-Revenue Miles		
	Revenue Miles	Non-Revenue Miles	Percent Non-Revenue Miles
Baseline			
FY 02	556,797	153,439	21.6%
FY 03	558,724	186,963	25.1%
FY 04	574,453	199,879	25.8%
FY 05	624,612	184,114	22.8%
Post-Deployment	22, 064	4,907	18.2%

One of the main constraints on ATA schedule efficiency, including reducing non-revenue vehicle miles, is rider no-shows. Although the one technology component specifically intended to help reduce no-shows—the IVR—was not deployed, an examination of no-show statistics is useful in understanding schedule efficiency challenges.

Baseline and post-deployment no-show data was reviewed for the months where post-deployment data has been collected. Statistics were examined separately for regular demand response trips ("public" trips) and for "subscription" (also known as standing order) demand response trips. Public demand response trips are those where a customer requests a specific, one-time-only trip. Subscription demand response trips are those where a customer places a standing order for a recurring trip, e.g., to be taken to the doctor every Monday at 9 a.m.

As shown in Figures 3-5 and 3-6, not surprisingly, the data show that most no-shows are for subscription trips. For such trips it seems plausible that, on the periodic occasions when the regular trip is not desired, the customer may forget to call in to explicitly cancel that instance of the standing order. Less logical, however are the findings comparing post-deployment with baseline no-shows. As shown in Figure 3-5, inexplicably, the number of subscription no-shows increased dramatically after the technology deployment, although there is evidence that ATA no show rider education efforts are helping bring the number down closer to baseline levels. Also inexplicably (as shown in Figure 3-6) the situation is reversed for non-subscription (that is, public) no-shows, which for several months appear to have decreased significantly since the technology deployment. The explanations may lie in changes in how ATA classifies no-shows or preserves no-show data pre- and post-technology deployment.

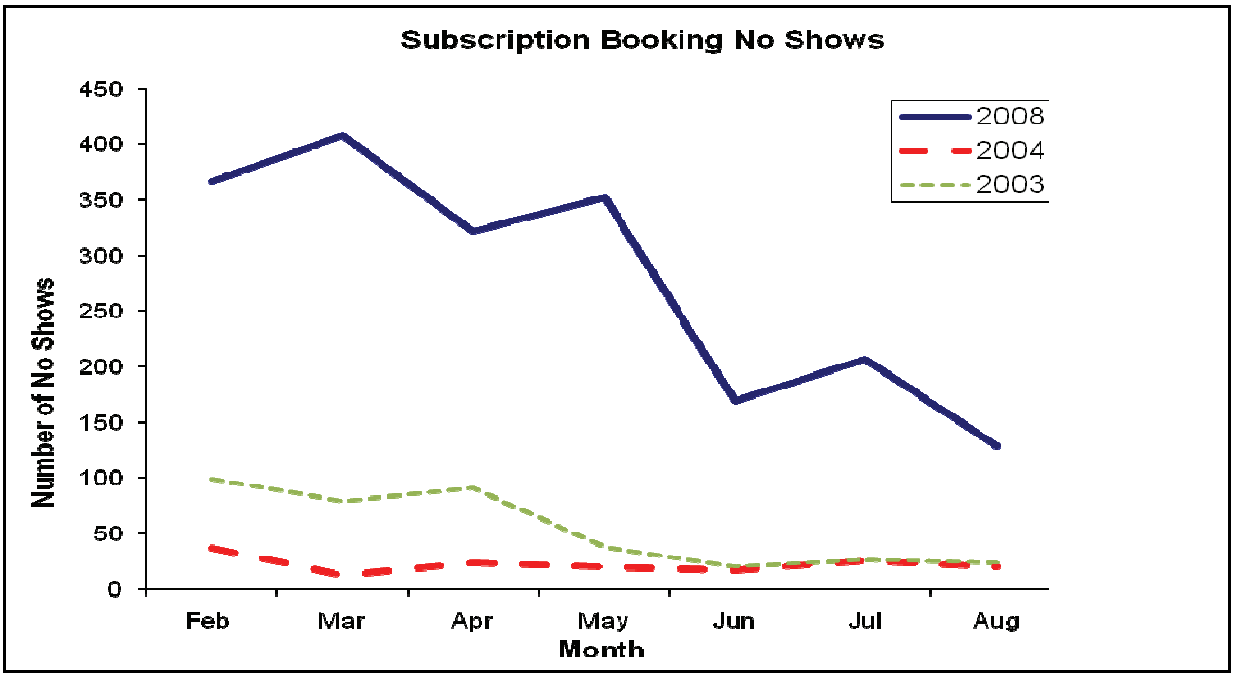

Figure 3-5. Number of Monthly No-Shows for Subscription Bookings

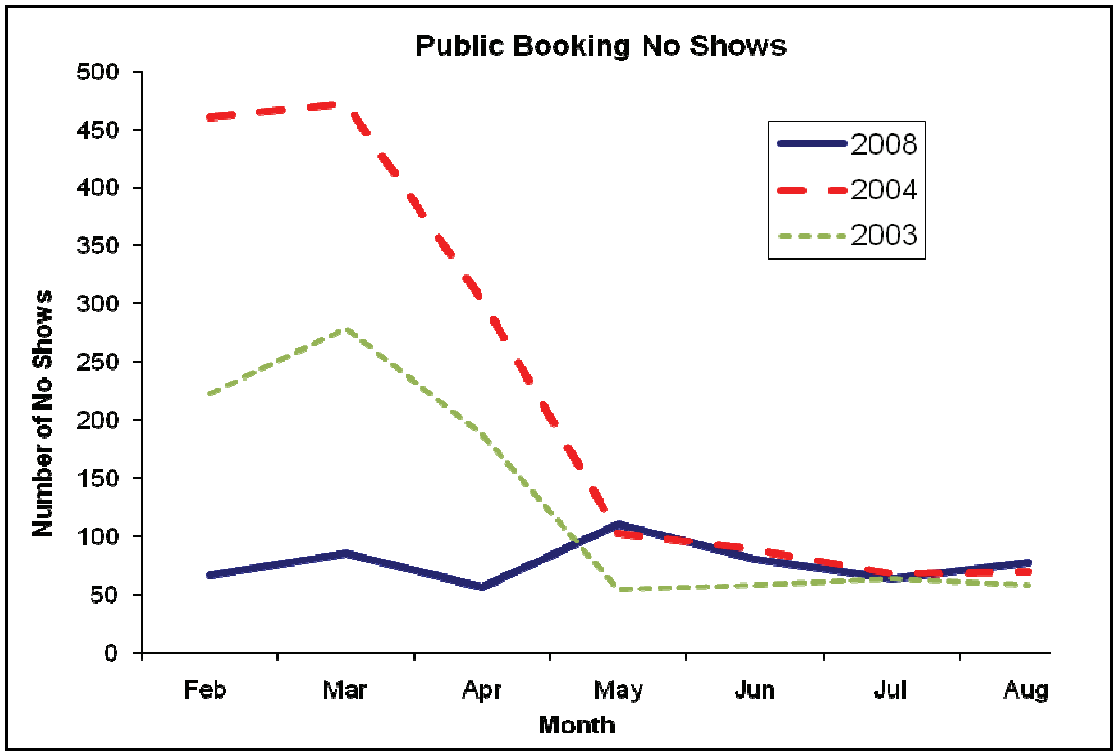

Figure 3-6. Number of Monthly No-Shows for Public Bookings

3.2 Safety

Earmark-related safety improvements are expected from the improved maintenance practices and better radio communications in support of incident reporting and response. Evaluation findings in these areas are presented in the sections that follow.

The potential impact of exogenous factors was discussed generally in Section 2.3 and there are indeed specific exogenous factors that could have influenced findings in the area of safety. The first concerns changes in the size and/or composition of the ATA vehicle fleet. Although there were some changes in the fleet between the baseline and post-deployment data collection periods, based on input from ATA personnel it appears that these changes are probably not responsible for much of the observed safety impacts. The second potentially significant exogenous factor is that between the baseline and post-deployment periods ATA consolidated major maintenance activities to a single location at the Johnsonburg headquarters. Again, ATA staff did not identify this change as having a major influence; that is, they attributed the vast majority of observed benefits directly to the technology rather than to the consolidation, per se. However, it was not possible to formally isolate or control for the influence of these exogenous factors and the results presented here should be interpreted with the understanding that some of the observed benefits may have been at least partially the result of these outside influences.

3.2.1 Vehicle Problems Alerted Through Preventive Maintenance

The baseline evaluation found that there was a preventive maintenance process in place. The process required drivers to conduct a daily pre-trip vehicle inspection and fill out a form. However, the collection of those forms presented a major challenge due to the dispersion of drivers across the six-county area and that many vehicles retuned with drivers to their residence at the end of the day. The pre-trip vehicle inspection forms took almost two weeks to arrive at Johnsonburg headquarters. The maintenance director indicated that the logistical issues and the challenge associated with scanning large volumes of paper forms have prevented those data from being used in the maintenance process. The baseline of the level of utilization of the pre-trip maintenance data were therefore zero.

After the earmark, the pre-trip inspection is done through the MDC and transmitted in near real time[14] over the radio network. The maintenance manager gets the daily MDC pre-trip inspection report and feeds the flagged items into the earmark maintenance management system and associates it with other maintenance records of the vehicle. High-priority maintenance items reported through the MDCs are immediately identified, and the maintenance manager works with the dispatcher to bring the vehicle out of service as soon as possible. For minor issues, flagged items for the vehicle are reviewed and addressed appropriately when they are brought in for scheduled maintenance. Post-deployment, preventative maintenance has gone from a desired feature to daily practice. Utilization of MDC vehicle inspection data are high and on a daily basis. The preventative maintenance cycle has gone from at least a 2-week lag to a daily review.

[14] That is, as soon as the MDC is mounted on the bus upon completion of the inspection.

Figure 3-7 shows in the post deployment period the unique vehicle defects[15] identified by the pre-inspection report on the MDCs.

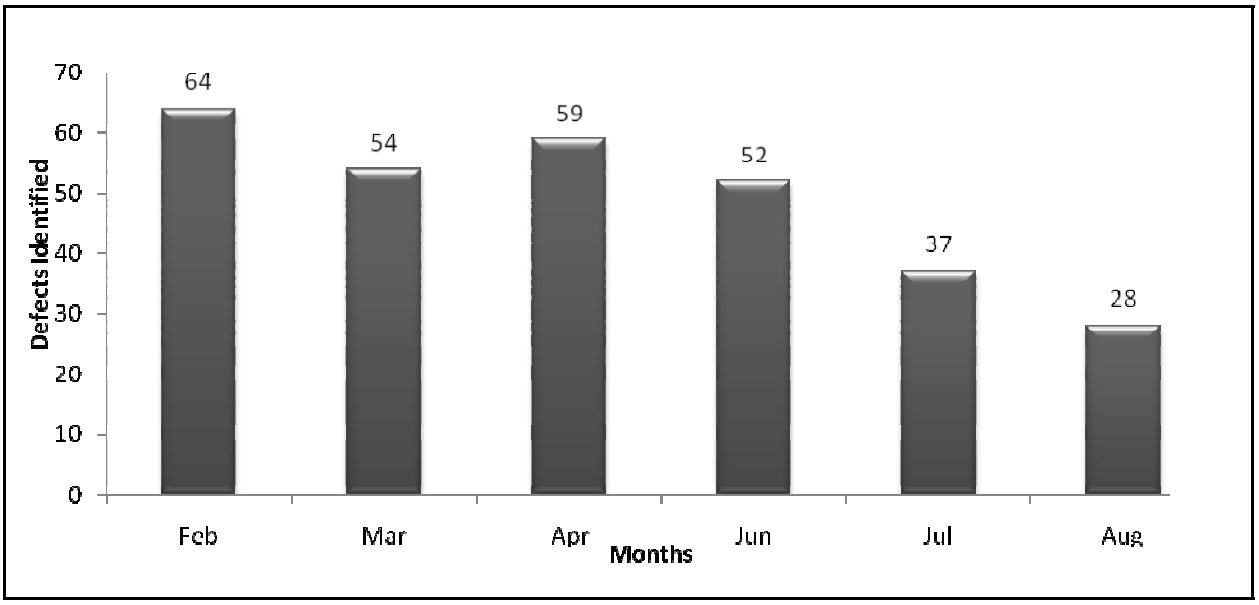

Figure 3-7. Number of Vehicle Defects Detected, Post-Deployment

Defects range from operational and safety problems (gears, engine, alarms) to minor defects like non-working interior lights, minor body damage, windshield wipers replacement requests, display of warning lights (check engine, oil), fluid levels, etc. Drivers at ATA have been proficient at using the pre-inspection module of MDCs and creating these reports at the beginning of each shift.

3.2.2 In-service Breakdowns

Number of in-service breakdowns has been used by ATA management in assessing operational performance for several years. Figure 3-8 presents the monthly statistics of in-service breakdowns from July 2002 to April 2005 compared to the post deployment phase (August 2007 to August 2008).

[15] Defects are identified daily through the pre-inspection routine until they are fixed by maintenance. Minor or cosmetic defects, which would not necessitate a bus removed by daily service, thus will be entered once into the maintenance management system and fixed when the bus is brought in for the maintenance schedule.

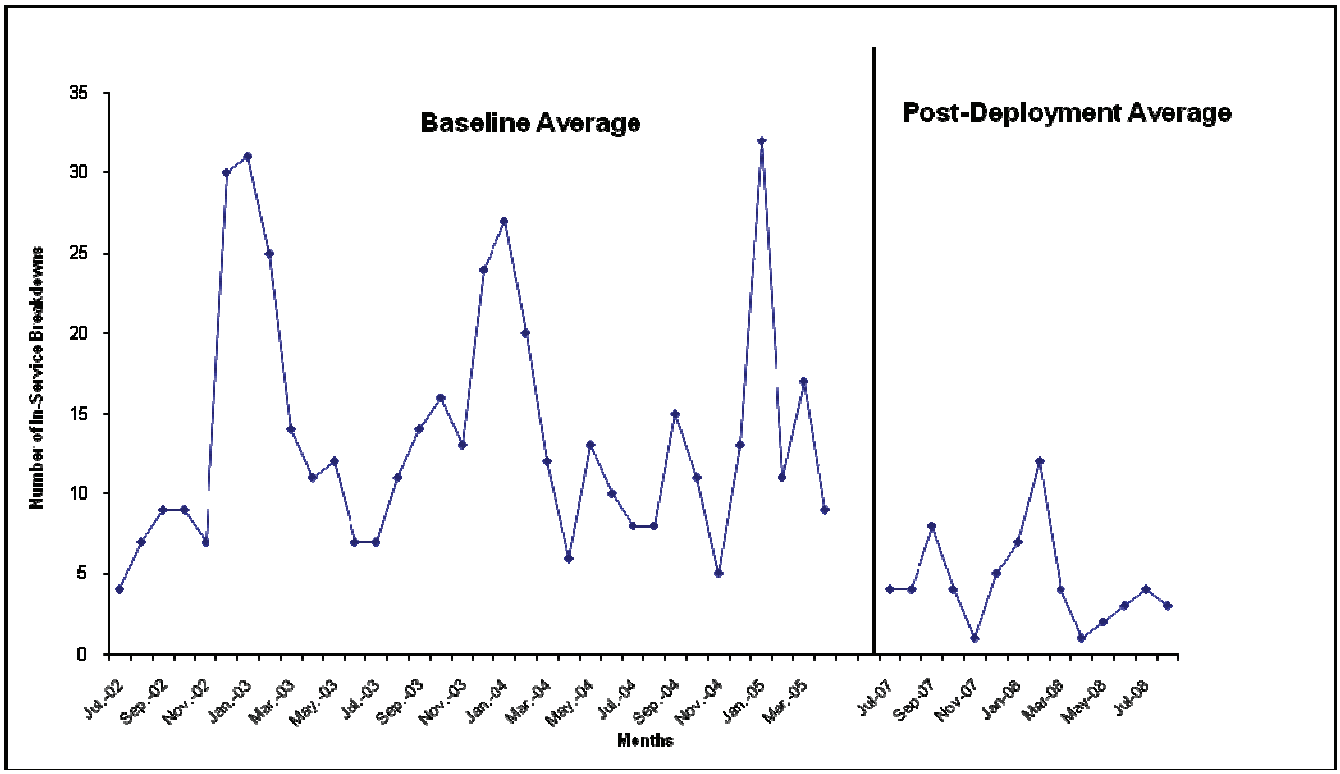

Figure 3-8. In-Service Breakdowns

The number of in-service breakdowns in December-March, usually the worst months due to severe winter conditions in the region, was down from an average of 21 breakdowns a month to about 9 breakdowns a month, a reduction of 57 percent. The worst month for in-service breakdowns went down from 35 breakdowns to 14. Overall, the average in-service breakdowns have been reduced by 69 percent.

This has been one of ATA's major successes in the project. In-service breakdowns were a major concern for ATA given their aging fleet and the severe winter conditions in the region. These breakdowns were also troubling for the customers who had to wait for a replacement bus or maintenance crew in inhospitable terrain and conditions.

By reducing the number of in-service breakdowns so dramatically, ATA has reduced the number of minutes per month that are spent in response, as shown in Figure 3-9. "Minutes in response" is the metric used by ATA to represent the time from notification to getting the schedule back on track. In the pre-deployment baseline period, ATA spent 386 minutes a month on an average responding to breakdowns with a maximum of 936 minutes. In the post-deployment phase, the average minutes per month was reduced to 124 minutes with a maximum of 482 minutes.

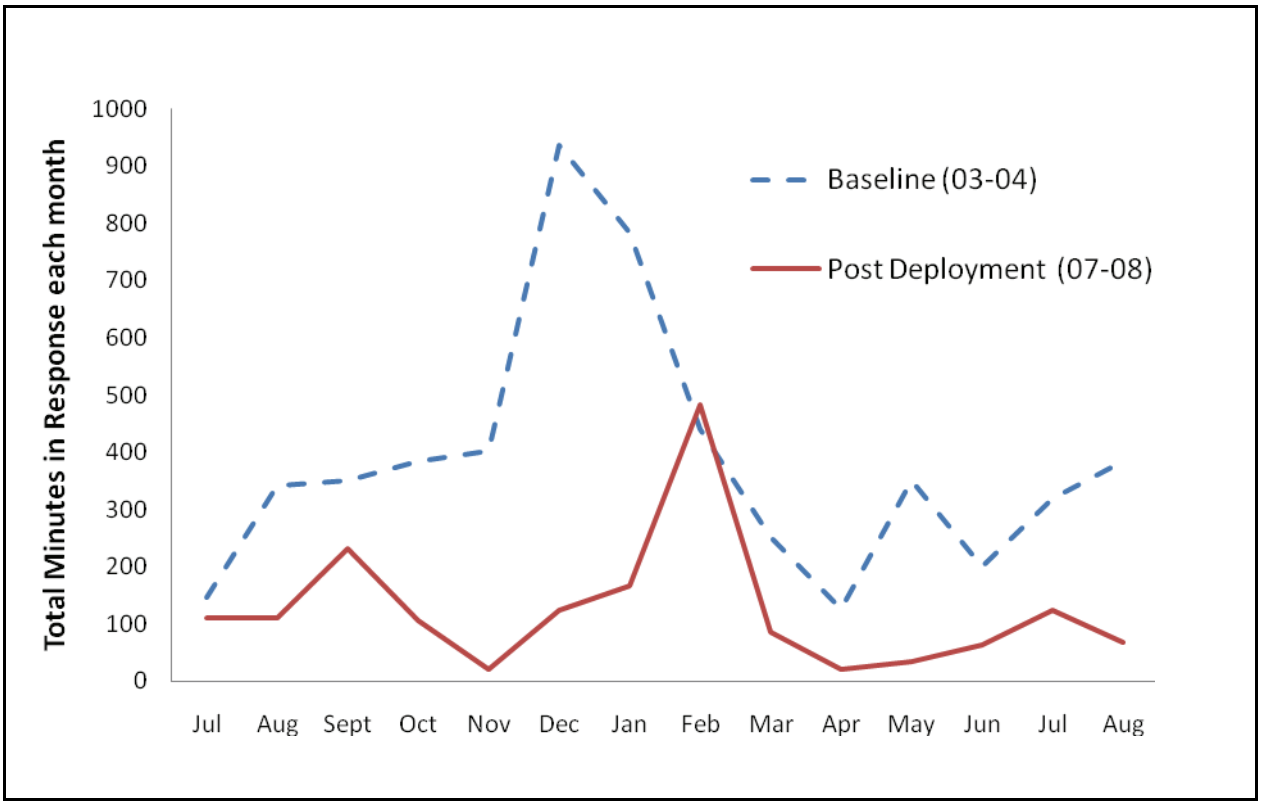

Figure 3-9. Total Monthly Minutes in Response to In-Service Breakdowns

Duration of in-service breakdowns is a particular concern for ATA given their geography, (large rural counties with difficult topography) and severe winter conditions (which would place undue burden on the driver and the riders). Lack of radio coverage was often a primary reason for delayed notification and response. With the earmark project, along with the AVL/MDC deployment, improved radio coverage has raised the expectation of ATA in improving their response times. The ability of drivers to reach the dispatch center reliably and the ability of the dispatcher to locate the bus to determine the appropriate response have been anecdotally noted during interviews.

However, data for duration per in-service breakdowns reveal that the durations have not statistically changed before or after the deployment. The difference in *average minutes in response per breakdown pre-deployment and post-deployment is not statistically significant.* The duration split by time pre and post-deployment (Table 3-4) are statistically similar indicating that the ability of ATA to reduce the durations of breakdowns might have a natural limit, based on distance and resources available to ATA.

Table 3-4. In-Service Breakdown Durations

Breakdown Duration	Baseline	Post-Deployment	Change
Less than 15 minutes	24%	13%	- 11%
15 – 30 minutes	44%	48%	+ 4%
30 – 60 minutes	25%	32%	+ 7 %
More than 60 minutes	7%	7%	--

It may also be possible that with better preventative maintenance, which would conceivably catch and fix the minor problems, the in-service breakdowns that do occur are of a complex nature requiring time-consuming repairs.

Overall, the deployment of the maintenance management system, aided by the MDCs, has substantially reduced the number of in-service breakdowns, which were a huge concern to ATA in prior years. While some of the improvements can be attributed to an improved fleet, the fleet had not been updated or replaced in a significant manner during the post-deployment data collection period. Most of the benefits that have been realized are due to improved maintenance practices supported by the new maintenance management system. Driver pre-trip inspections using MDC's mean maintenance has resulted in vehicle defects communicated to the maintenance group much faster (daily vs. 2 weeks lag prior to deployment). The system has enabled the maintenance crew to be more organized with pulling buses out of service for maintenance, including a better adherence to flowing maintenance requests through dispatch. However, the durations of in-service breakdowns have not been reduced statistically.

3.3 Customer Satisfaction

Overall, ATA customer satisfaction was very high both before and after the technology deployment. As noted in Chapter 2, significant improvements in customer satisfaction were not a driving motivation for the ATA deployment and became less important when implementation of the IVR—the technology most likely to directly impact customers—was postponed. Nevertheless, ATA was interested in monitoring for any changes in customer satisfaction.

The baseline survey results showed consistently high levels of customer satisfaction. Riders' rated their satisfaction on between five (fixed route riders) and eight (demand response riders) parameters ranging from on-time performance to the ease of rescheduling trip reservations. Ratings utilized a scale of 1 to 5, with 5 being "very satisfied" and 1 being "very unsatisfied." Average ratings across both fixed route and demand response rider questions ranged from 3.9 to 4.7 with only one question earning a rating of less than 4.2, thus indicating uniformly high levels of satisfaction. Baseline survey results also indicated that most riders were relatively unconcerned about the amount of time it would take to summon help in the case of a vehicle breakdown. The average rating (with 1 = "not concerned" and 5 = "very concerned") was 2.3.

The results of the baseline focus groups reinforced the survey finding of high levels of customer satisfaction. Most ATA customers are totally dependent on ATA for their mobility and, despite the occasional minor criticism or misunderstanding, they emphatically expressed great appreciation for ATA—especially the personal treatment and evident concern they received from drivers and trip reservation operators. The ATA customers indicated that making and changing reservations was easy to do; that buses were usually on-time and if late it was due to weather; and that they felt very safe on the ATA buses.

The post-deployment focus group findings were generally consistent with those of the baseline sessions. Most customers are, overall, satisfied with ATA and expressed appreciation for the ATA service and for the efforts of ATA drivers and call takers. Most customers were aware of the recent technology deployment, mostly by first-hand observation of the slightly altered trip reservation process and observation of driver interactions with the mobile data computers. Specific post-deployment focus group findings are summarized by topic in the sections that follow.

3.3.1 Perception of Changes

At the beginning of each focus group session, before any references to the technology deployment, ATA customers were asked whether they perceived any recent changes in ATA or the ATA service. Most focus group participants cited no significant changes, including in the areas of safety, on-time performance and trip reservation and rescheduling. The following changes were noted by a few customers:

- Somewhat fewer vehicle breakdowns;
- Radio coverage has improved (e.g., there are fewer "dead spots" where the customers observed drivers unable to use their radio);
- ATA is more consistent/strict in requiring demand response riders to specify their return trip pick up time in advance, when they schedule their trip;
- There are some different trip reservation/trip change telephone procedures in place, e.g., riders have been told by ATA that they should always ask the name of the call taker (a new ATA quality control measure).

3.3.2 Concerns and Suggestions

Most focus group participants had no significant concerns or criticisms regarding ATA or the ATA service. However, there were two concerns that were mentioned by a couple of customers. First, several of the participants in the DuBois focus groups felt that ATA call takers (for trip reservations or changes) do not know them (the riders) personally and are not as familiar with the DuBois area. The riders did not indicate that these concerns significantly impaired the trip reservation process; rather, it appeared that the customers were simply somewhat chagrined that the process seemed less personal. These customer observations are not unexpected given that, in conjunction with the technology deployment, ATA consolidated all trip reservation functions to Johnsonburg. Post-consolidation and post-technology deployment, incoming calls are now automatically routed to the next available call taker, who may be someone who had previously taken calls from only Johnsonburg area customers.

The second concern that was noted by several customers is that it can be difficult to predict the return trip pick up time for doctor visits, beauty parlor visits and other outings where the duration is uncertain and where the customer cannot control the duration. Customers noted that ATA had become stricter in requiring riders to identify their return pick up time when they make their trip reservation. Customers suggest that a "will call" option would be desirable, that is, an open-ended return trip reservation.

The only other technology deployment-related concern noted by a few customers was that the on-board "computer" (the mobile data computers) seemed to cause the drivers a lot of problems. This observation is not surprising given that customers have the opportunity to closely observe drivers and, in the first few "shake down" months of operation, some drivers did experience a combination of technical and user error-related challenges with the MDCs.

Other, non-technology deployment related customer suggestions consisted of: low-floor buses, newer buses, and transfers or a shuttle-type service.

3.3.3 Other Observations

The primary other observation is one that was not voiced specifically by the customers but was apparent from a number of their comments. That observation is that drivers are, in many respects, the "face" of the ATA and by virtue of their recurrent, personal interaction with customers, can both help educate customers as well as color customers' perceptions of service overall, and of the impact of the deployed technologies. It was clear from all of the focus groups that customers come to know drivers well and that drivers are a primary source of information for customers and are shapers of customer perceptions, both by what drivers actually say and do with customers and what the drivers are observed doing. As such, drivers can play a key role in educating and informing customers, including helping them understand changes like the technology deployment, but they can also inadvertently undermine customer acceptance and confidence when they demonstrate frustration with the new technologies. In addition to the aforementioned customers' observations of early post-deployment driver frustration with the MDCs, at least one customer observed that some drivers do not always follow the dispatch instructions from the MDC but rather "ad lib" as they formerly did when they were working from a printed schedule.

3.4 ATA Staff Perspectives

The overall conclusions of the baseline ATA staff interviews were that staff generally believed that the low-technology processes used at that time were time consuming and could cause errors. Staff expected the new technologies to increase the efficiency and accuracy of tasks such as trip reservation taking, preparing schedules, and logging passenger trips. Dispatchers looked forward to better radio coverage and clarity of communications with drivers. Maintenance personnel hoped that the MDCs would improve pre-inspection maintenance leading to more effective preventative maintenance. Managers hoped the new system would help with resource deployment, including facilitating the centralization of trip reservation functions to the Johnsonburg facility, route planning, and access to more accurate, detailed and timely system information.

The post-deployment interviews revealed that:

- ATA management consider the technology deployment to be, overall, very successful and expect greater successes as all personnel became more familiar with the systems;
- ATA management and senior technical personnel believe that they have learned some lessons that will improve their and other transit agencies' future technology implementations;
- ATA personnel who use the technologies on a day-to-day basis feel that most of the expected benefits have been realized; and
- Not all benefits have been realized and/or not all personnel agree that some important benefits, including the improved efficiency of schedules, have yet been realized.

The sections that follow summarize ATA staff perspectives regarding the benefits of the technology deployment, the challenges that were faced and how they were overcome, and the lessons that they take away from this project and that they encourage other transit agencies to consider. Staff perspectives related to benefits are also noted in the productivity and safety analysis results presented in Sections 3.1 and 3.2.

3.4.1 Benefits

Summary observations regarding ATA staff perceptions of benefits are as follows:

- **Technologies enabled major, beneficial organizational changes.** ATA management believe that the technology deployment played a vital role in allowing them to make fundamental changes in how work is done and to thereby enhance efficiency. Namely, the maintenance and scheduling/dispatch systems have been crucial in eliminating the major vehicle maintenance and scheduling/dispatch functions at the DuBois and Bradford facilities, allowing these functions to be consolidated to the Johnsonburg facility where they can be done more efficiently and in a more uniform manner. Dispatch staff reports that it is challenging to cover the entire service area now, but it is possible with the technologies; they further state that centralized dispatching would not have been possible without the technologies. As described below, the technologies have also facilitated a major reorganization of dispatch office work processes that has produced a number of benefits.
- **Accounting and maintenance benefits are major successes.** ATA personnel believe that the intended accounting and maintenance-related benefits have been realized in full and these benefits constitute some of the most important successes of the deployment. These benefits include:
    - A dramatic reduction (a full week) in the time required to prepare invoices, thus improving cash flow.
    - Fewer errors in invoices.
    - Sooner and faster reconciliation of invoices due to the electronic proof of service data generated through the MDCs.
    - Much faster and more effective responses to vehicle maintenance needs, including a reduction in the time to collect pre-trip inspection data from two weeks to less

than a day. This has led to a significant reduction in vehicle in-service breakdowns.

  - More timely notification of vehicle breakdowns from dispatch staff resulting from consolidation of dispatch operations.
  - Dramatic reductions in the amount of paper utilized throughout the vehicle maintenance process.
  - Better control of vehicle parts inventories by virtue of the maintenance management system, including the ability to better limit parts inventories for vehicles soon to be decommissioned, easier look-ups of non-routine parts, faster repairs by virtue of automated parts reordering and elimination of wait times for parts, and reductions in inventory through the elimination of redundant spares.

- **Scheduling and dispatch office staff utilization and satisfaction have been dramatically improved.** ATA management believe that the intended benefits of the technologies for simplifying work processes and maximizing staff utilization in the scheduling and dispatch office have been fully realized. Before the technology deployment, there was no differentiation of labor—everyone did a little of everything throughout a given day. That made for a hectic and inefficient environment. ATA management took advantage of the major changes in work methods associated with the new technologies as an opportunity to introduce a relatively strict division of labor in which personnel focus on one activity all day, e.g., taking trip reservations or dispatching. Cross training has allowed staff assignments to be rotated periodically, thus reducing employee burnout. Scheduling and dispatch personnel feel that these changes have created a much calmer, quieter, less distracting work environment and they like the variety of the six-week work rotation (two on dispatching, then three on call taking and then one on scheduling). Dispatch office personnel say that with the new scheduling system, anyone can schedule for any portion of the ATA service area—the need for specialized knowledge of ATA service subareas has been eliminated because this knowledge now resides in the software.

- **Dispatch office staff cites major efficiency gains in trip reservation and dispatch.** Dispatch office staff, which includes trip reservation call takers, believe that the technology systems have made their work more efficient, citing the following specific benefits:
  - Less time on the phone taking reservations, partly because destinations are already coded into the system and can be easily selected from a menu.
  - Faster and easier determinations of pick ups and drop offs without having to radio drivers (this information is now input by the driver via the MDC).
  - Higher quality work by individual personnel because there is continuity—a person now works on one activity all day rather than having everyone work on bits and pieces of all types of work throughout the day.
  - Improved ability to respond to customers' same-day trip requests and changes, including improved filling of cancellations, because they can quickly and confidently, based on real-time data, identify open slots in the vehicle schedules.
  - Much reduced radio chatter through utilization of MDC messaging capabilities.

- Improved ability to quickly locate and assist drivers in emergencies by virtue of the real-time vehicle location information, MDC communication capabilities, and improved communications system coverage.

- **Benefits of more efficient schedules have not been fully realized.** ATA management and dispatch office staff identify schedule efficiency—that is, the ability of the software to produce "tighter" schedules than was previously done manually—as the one main area where benefits have not been realized. Dispatch staff report that the schedules produced "automatically" still require manual massaging but feel that, through gradual dialing-in of user controlled variables in the software, the schedules are getting better. ATA management believes that the real improvement in schedules (manifested in reductions in non-revenue vehicle miles) will be realized in late 2009 or 2010 when they transition to full "batch scheduling." Batch scheduling is the process by which trip requests are fed into the software and the scheduling software is allowed full discretion in matching trips with drivers/routes so as to produce the most efficient schedule possible. To date, the scheduling software is used only to tighten up schedules that are fundamentally set manually.

- **Schedulers and drivers have different perspectives on schedule quality.** Drivers and dispatch office staff perspectives differ on the extent to which schedules have improved or the rate at which they are improving. Drivers feel that the schedules are, overall, only marginally better, site frequent examples of illogical sequencing of pick ups and drop offs, and do not feel that the schedules are getting better very quickly. Dispatch staff view the schedules less critically and they feel that they are fairly quickly dialing-in the software and improving the quality of schedules.

- **Drivers cite benefits of the new MDCs but also considerable growing pains and some continued "glitches."** Most drivers found the transition to MDCs challenging because they had to learn how to use the new technology. They feel more training would have been helpful. Frequent malfunctions during the "shake down" period also made the transition away from paper manifests trying. Drivers also cite some continuing glitches, such as MDCs being slow to turn on and refresh and inadequate travel times in some schedules. They also feel that there are errors in the manifests resulting from initial coding errors. However, drivers do cite a number of important benefits associated with the MDCs and agree that they would not want to go back to the paper manifests and voice radio-only communications. They appreciate being able to use the MDCs to record pick ups and drops, less time on the radio, the safety and security benefits associated with the automatic vehicle location and improved radio coverage.

- **Additional benefits are expected in several areas.** As noted above in the discussion of schedule efficiencies, ATA expects that the late 2009 – 2010 conversion to full batch scheduling will result in significant improvements in schedule efficiency manifested primarily as reduced non-revenue vehicle miles. Maintenance personnel believe that the value of the maintenance management system will be further enhanced when warranties are included in the system. ATA management believes that the value of the data collected through the system will be realized once they have hired a transit analyst.

3.4.2 Challenges

ATA staff reported that they faced many challenges in implementing the technology systems. They characterize nearly all of the challenges as being the sorts of technical hurdles that are typically encountered in implementing a complex, multi-faceted technology system. Examples of these sorts of typical challenges included difficulties in mounting the MDCs in some vehicles and contending with new versions of software, specifically the maintenance management system, while ATA staff was still becoming familiar with the previous version. There were no "special" solutions to these types of problems. Rather, they were resolved through sustained, thoughtful application of time and attention either directly by ATA staff or by the technology system vendor team in close coordination with ATA.

Many of these typical technical challenges are a result of applying what is in theory commercial-off-the-shelf (COTS) products to the unique environment of a specific transit agency, in this case ATA. Although there are a number of commercial products available, in reality, there are no truly COTS products in the public transportation environment because so many agencies are unique in how they approach the myriad details associated with scheduling, accounting and other core functions.

One technical challenge in particular was identified by many of the ATA interviewees as more daunting, requiring much more effort and having a far greater impact on performance of the technologies than expected. That challenge was preparing accurate, comprehensive ATA data for input into the technology systems, primarily geo-coded addresses and client information (e.g., mobility status) in the scheduling/dispatch/vehicle location system. Unlike ATA schedulers and dispatchers, the technology system cannot utilize personal knowledge of riders and destinations but must rely solely on the data provided. When that information is inaccurate or incomplete the technology either does not function at all or, often worse, fails in ways that are not always immediately apparent, such as generating schedules that do not include enough travel time between pick ups. In some cases, required information was simply missing. For example, many of the rural origins and destinations served by ATA did not have formal addresses. In other cases, minor inconsistencies in the spelling of a street name in different databases would trip up the system.

Training, and specifically the desire for more of it than was available, was another technical challenge that was noted by technical personnel in several departments. Several different drivers at both the Johnsonburg and DuBois facilities said that it was hard learning to use the MDCs and that more training would have been helpful. One group of drivers felt that insufficient training contributed to the habit of some drivers of asking other drivers questions over the radio about the MDCs. In the customer focus groups it was clear that customers pay close attention and that such behaviors probably contributed to customers' perceptions that the MDCs caused the drivers a lot of problems.

One institutional issue noted by ATA interviewees was given greater emphasis by DuBois staff. That issue was the challenge of managing customers' reactions to what some of them perceived as a loss of the "personal touch" as a result of the centralization of scheduling and dispatch functions to Johnsonburg. This issue also surfaced in the customer focus groups. Customers, especially in the DuBois area, were used to dealing with specific call takers and drivers who focused on subareas within the ATA service area. Consolidating call taking and dispatch to

Johnsonburg has meant that customers may get a call taker or driver who does not know them personally.

3.4.3 Lessons Learned

ATA staff identified a number of lessons learned. These lessons are summarized below arranged in the following categories: institutional, planning and development, and implementation.

Institutional:

- Recognition of the importance of attending to normal operational needs while intensively focused on development of the new systems.
- Be patient and persevere. Even with the best planning unexpected challenges will be encountered and it will take time and a sustained, concerted effort to overcome them.
- Utilize partners where possible. Partnering with the state radio system on the communications aspects of the project was instrumental to the ATA project.
- If at all possible, dedicate one or more staff members full time to the technology project for the duration, from planning through implementation.

Planning and Development:

- At the early planning stages, understand and articulate in as much detail as possible how you plan to utilize the technology and the ultimate goals of the implementation.
- Talking to other transit agencies using the technologies is sometimes helpful but sometimes, if the agencies do things very differently, it is not very helpful. The only way to know how helpful it will be is to try, such as by attending user conferences.
- Throughout planning and development, in addition to management staff, include on the agency deployment team representatives of the different functional areas through the organization, including drivers, dispatchers, customer service representatives, mechanics, accounting/finance, and so forth. Early and continuing involvement from these personnel is a key factor in the ultimate acceptance and success of the technology deployment. Input from representatives of each functional area that will use or be significantly impacted by the technology is critical to selecting hardware and software that will work in the "true work environment."

Implementation:

- Do not introduce too many changes at once; phase in the technology at the rate at which the staff and customers can absorb the changes and implement more advanced technology applications (e.g., batch scheduling) after the more fundamental technology applications have been established
- Accurate and complete input data is vitally important, especially geo-coded addresses and client information cannot be over-stated. This should be a very high priority and agencies should plan on spending a lot of time and attention on data checking and

correction. Develop and apply consistent procedures for data checking and cleaning during the initial implementation to be used for maintaining accurate data over time.

- Begin preparing and educating customers for changes early and keep at it through implementation and beyond.
- The value of having an external (consultant) systems integrator to assist with such a complex project.
- Build in a lot of "extra time" in the implementation schedule. As one driver put it: "double everything."
- Encourage regular, structured feedback sessions between drivers and schedulers to identify and resolve problems in the schedules being produced with the technologies. Both parties can learn from one another.
- Provide extensive training to all of the personnel who will interact with the technologies.
- Get as much help from the vendors as you can afford in the initial set up and early operations phase.

4.0 Summary of Findings and Conclusions

This chapter summarizes the findings of the evaluation, including summarizing the test results for each of the evaluation hypotheses and recapping major findings in each of the four major evaluation analyses: productivity, safety, customer satisfaction, and ATA staff perspectives. The summary of findings is followed by a discussion of overall evaluation conclusions.

4.1 Summary of Findings

4.1.1 Hypothesis Testing Results

Table 4-1 summarizes the results of the evaluation hypothesis testing. Each hypothesis is identified as either "not tested" (e.g., those related to the IVR that was not deployed), "supported," "partially supported," or "not supported." A total of 25 evaluation hypotheses were identified for testing. The breakdown of hypothesis testing results is as follows:

- Not Tested = 7 (six related to the IVR system that was not deployed; one related to Medical Assistance eligibility verification, where state requirements to use an external state system have precluded use of the ATA technology system)
- Supported = 10
- Partially Supported = 6
- Not Supported = 2

The results in Table 4-1 indicate that the ATA technology deployment has been successful in many respects. Of the 18 hypotheses that were actually testable, 16 were fully or partially supported. In a number of cases, the reason for "partial" support is that quantitative data limitations prohibit more definitive judgments of success rather than any particular short-coming in the deployment. Even the "not-supported" hypotheses are not all indicative of a significant failure or short-coming, e.g., the move to full batch scheduling planned for late 2009 or 2010 may yet realize the full expected benefits in regard to improved schedule efficiency. Also, the two "not supported" customer satisfaction hypothesis do not indicate that customer satisfaction has suffered, rather that baseline satisfaction levels were high enough that the technology deployment did not improve them further.

Table 4-1. Evaluation Hypothesis Testing Results

Hypothesized Project Impacts	Evaluation Findings
Productivity Impacts	
CARSD will improve the trip reservation for call-a-bus services **[SUPPORTED]**	• Dispatch office staff report that the technologies have improved the efficiency (reduced the duration) of trip reservation phone calls. • Although not definitive, since it was only mentioned once or twice, some customers cited some improvement in this area.
Text messaging using MDC will replace voice communications for repetitive requests by dispatcher **[SUPPORTED]**	• The estimated total amount of time spent each day communicating with drivers by radio or cell phone has been reduced 28 percent, from 8.7 to 6.3 hours. • Dispatch office staff reports that the MDCs have greatly reduced the amount of radio traffic.
Automatic wireless transmission of manifest to MDC over the radio will significantly reduce scheduler's daily tasks. **[SUPPORTED]**	
Use of MDC for pre-trip vehicle inspection (preventive maintenance) improves the timeliness of data collection and transmission. **[SUPPORTED]**	• Maintenance personnel report that dramatic improvements have been realized with the average lag time between the driver conducted pre-inspection and maintenance personnel's awareness of the inspection results decreasing from two or more weeks to less than 24 hours. They feel this has greatly enhanced maintenance effectiveness. • Maintenance personnel also report a dramatic reduction in paper throughout the maintenance process, in part through the MDC-based pre-trip vehicle inspections.
The maintenance management system will improve inventory control by eliminating redundant parts and maintain optimal level of inventory using automatic re-ordering. **[SUPPORTED]**	• Maintenance personnel report that expectations in this area have been fully realized.
With electronic proof of service data and the new financial system, the invoice processing time and level of efforts can be reduced. **[SUPPORTED]**	• The average time required to prepare invoices decreased 43 percent, from 21 days to 12 days. • ATA staff report major efficiency gains and believe that expected benefits have been fully realized.
The electronic collection of proof of service data (i.e., recording pick-up/drop-off) using MDC will result in more efficient execution of timekeeping validation and other payroll tasks. **[SUPPORTED]**	• Accounting staff report that expected benefits in this area have been fully realized. Data are no longer transcribed from the paper driver logs but rather come in digitally from the MDCs.
The electronic filing of vehicle part purchase orders using the maintenance management system and the new financial system will result in faster ordering process. **[SUPPORTED]**	• Maintenance personnel report that expected benefits have been fully realized.

Table 4-1. Evaluation Hypothesis Testing Results (Continued)

Hypothesized Project Impacts	Evaluation Findings
Productivity Impacts (Continued)	
CARSD will improve the ability to fill cancellations and make other dynamic, same-day schedule/ dispatch changes. **[PARTIALLY SUPPORTED]**	• Customers reported no significant improvement (they were and still are satisfied). • ATA staff believes they have realized this benefit. • No quantitative before data are available; post-deployment data show an apparent downward trend but the limited data (7 months) prohibit definitive conclusions.
The system operations data generated by the earmark system will provide more effective planning and analysis. **[PARTIALLY SUPPORTED]**	• ATA management's expectations regarding the availability of data have been met and the data have been of some value. However, full benefits in this area are not expected until ATA hires a full-time transit analyst who can focus on the new data.
CARSD will provide improved quality (routing efficiency) of schedules. **[PARTIALLY SUPPORTED]**	• Dispatch office staff and drivers disagree on the quality of schedules but both generally agree that the system is not yet producing schedules that are significantly better than those produced manually. • Demand-response non-revenue vehicle miles have decreased by about 6 percent but the influence of the technologies on that change is unclear. • Quantitative data show a clear improvement in on-time performance from 72 percent to 81 percent of pick ups. This improvement is somewhat moderated by a small increase in the number of pick ups that are too early.
CARSD will improve Medical Assistance trip reservation by automating eligibility verification. **[NOT TESTED – STATE REQUIRES ELIGIBILITY VERIFICATION VIA STATE SYSTEM]**	
Automatic upcoming trip reminder calls by IVR reduce number of no shows **[NOT TESTED – IVR NOT DEPLOYED]**	
Use of IVR reduces number of calls to ATA customer service line for trip verification or cancellation **[NOT TESTED – IVR NOT DEPLOYED]**	
Early cancellation using IVR improves ability to make dynamic, same-day schedule/dispatch changes **[NOT TESTED – IVR NOT DEPLOYED]**	
Use of IVR for manifest distribution reduces number of calls from drivers to schedulers regarding manifest **[NOT TESTED – IVR NOT DEPLOYED]**	

Table 4-1. Evaluation Hypothesis Testing Results (Continued)

Hypothesized Project Impacts	Evaluation Findings
Customer Satisfaction Impacts	
With CARSD, customers will experience improved reservation **[PARTIALLY SUPPORTED]**	• Customers reported no significant improvement (they were and still are satisfied).
Customers will experience improved on-time performance **[NOT SUPPORTED]**	• Customers reported no significant improvement (they were and still are satisfied).
With CARSD, customers will experience greater flexibility in accommodating same-day reservations and schedule changes. **[NOT SUPPORTED]**	• Customers reported no significant improvement (they were and still are satisfied).
Customer will experience improved service with the automatic trip reminder calls by the IVR. **[NOT TESTED – IVR NOT DEPLOYED]**	
Customers will experience improved satisfaction with the use of IVR for trip verification and cancellation. **[NOT TESTED – IVR NOT DEPLOYED]**	
Safety Impacts	
Improved radio coverage, MDC, and AVL will result in faster and more effective notification of and response to vehicle breakdowns, accidents, and medical or security emergencies. **[SUPPORTED]**	• Maintenance personnel report that, since implementation of the technologies, they learn about vehicle breakdowns from dispatch much more quickly. They generally attribute the improvement to improved communications between dispatch and maintenance resulting from the consolidation of functions that occurred in parallel and are enabled by the technology deployment. • Dispatch staff report benefits in this area, citing several real world examples including locating a driver in a snow storm. • Full benefits related to improved radio coverage have not been realized because gaps are still being filled.
Preventive maintenance using MDC will result in fewer maintenance-related in-service breakdowns. **[SUPPORTED]**	• Dramatic improvements have been realized resulting in a 69 percent reduction in the average monthly number of break-downs, from 13 to 4 per month. • As a result of improved preventative maintenance and fewer breakdowns, ATA has realized a 68 percent reduction in average monthly total “response time,” the total elapsed time between notification of in-service breakdowns to having the vehicles repaired or replaced and back on schedule. • Maintenance personnel corroborate the benefit of the technologies in this area.

Table 4-1. Evaluation Hypothesis Testing Results (Continued)

Hypothesized Project Impacts	Evaluation Findings
Safety Impacts (Continued)	
ATA staff perceives safety improvements with better preventive maintenance, AVL, and better radio coverage. **[PARTIALLY SUPPORTED]**	• Improvements do not appear dramatic but that is only because most maintenance, dispatch and driver personnel did not, despite the radio coverage gaps, perceive safety as a significant concern before the deployment.
Customers' awareness of the improved radio system and ability to track vehicles will enhance the perceived safety of the service and improve customer satisfaction. **[PARTIALLY SUPPORTED]**	• Customers felt safe and secure before and after the deployment so there was not clear improvement (nor opportunity or need for improvement). • When customers were informed of the technology capabilities in this area they were supportive, and there was some indication that their peace of mind was somewhat enhanced.

4.1.2 Summary of Findings

This section summarizes the major findings in each of the four evaluation analyses: productivity, safety, customer satisfaction and ATA staff perspectives. As noted in the sections that follow, the absence of good quality baseline quantitative data in a couple of areas limits the ability to draw strong conclusions regarding certain intended benefits. However, it should also be recognized that the ability to easily generate rich, reliable post-deployment data represents an important benefit of the deployment. That is, aside from any improvements realized or not realized in certain metrics, the ability to effectively monitor performance in those areas represents an important accomplishment.

4.1.2.1 Productivity

Many of the intended productivity-related benefits have been realized, with improved dispatch office staff utilization and reduced invoicing times among the most dramatic. The technologies, coupled with a significant reorganization of dispatch office work assignments, have led to a much calmer, more efficient work environment, including more efficient demand response trip reservation call taking and less radio chatter. Various technology-related capabilities, including automated collection of detailed proof-of-service data have dramatically reduced the time required to prepare invoices, from an average of 21 days to 12 days.

Other intended productivity benefits show mixed results. On-time performance has improved from 72 to 81 percent although that improvement is somewhat moderated by the fact that there are now more significantly early arrivals. There have been some modest gains in schedule efficiency manifested as a 5.6 percent reduction in demand response non-revenue vehicle miles. However, the role of the technologies in those reductions is unclear and ATA believes that significant reductions directly related to the technologies will not be achieved until they finish adjusting their scheduling methods to take full advantage of the software's "batch scheduling" capability. The unavailability of baseline data on schedule flexibility (e.g., number of same day trip requests accommodated and trip request denials) prevents conclusive determinations. However, the seven months' worth of post-deployment data does show promising trends.

4.1.2.2 Safety

Overall, the deployment of the maintenance management system, aided by the MDCs, has dramatically reduced the number of in-service breakdowns, which were a major concern to ATA in prior years. While some of the improvements can be attributed to an improved fleet, since there have not been significant changes in the fleet, much of the improvement is related to the technology deployment. Although there are far fewer in-service breakdowns now, the average repair time has not been significantly reduced.

Most of the benefits that have been realized are due to improved maintenance practices supported by the new maintenance management system. Driver pre-trip inspections using MDC's have dramatically decreased the time it takes to get the inspection information to maintenance personnel (from two weeks to same day). Unique defects (typically an average of 49 defects are identified a month) are fed into the maintenance system and are repaired when the vehicle is in the shop for preventative maintenance. If defects are major, the vehicle is rapidly pulled out of service and the defect addressed. The system has enabled the maintenance crew to be more organized with pulling buses out of service for maintenance including a better adherence to flowing maintenance requests through dispatch.

4.1.2.3 Customer Satisfaction

The ATA technology deployment has not significantly impacted customer satisfaction; customers were very satisfied and, for the most part, very grateful for ATA before the technology deployment and they remain that way. Although many customers are aware of the new technologies with which they actually interact or observe (the MDCs and trip reservation phone calls) the vast majority of customers do not feel any differently, fundamentally, about ATA or the ATA service.

Many customers are elderly and/or disabled and depend entirely on ATA for their mobility. Nearly all of the customers have generally warm and appreciative perspectives on ATA. When quizzed carefully a few customers identify something that may have changed slightly for the better or for the worse but these isolated opinions fall far short of any consensus view. The one issue where there was any pattern was that a number of DuBois area customers felt that the consolidation of call taking and dispatch (and therefore driver assignments) to Johnsonburg has meant that they now deal more often with ATA personnel who do not know them, their issues and preferences, and travel patterns, personally.

4.1.2.4 ATA Staff Perspectives

ATA staff feels that the technology deployment has been very challenging but also believe that it has been a clear-cut success. They acknowledge that there are couple of areas where benefits have not been fully realized—most notably in the area of improved schedule efficiency—but they believe that those benefits will be achieved over time as they take greater advantage of all of the capabilities.

ATA staff cites two fundamental types of benefits. The first are broad, agency-wide benefits such as the way in which the technology was instrumental in facilitating the consolidation of major vehicle maintenance and dispatch office functions to a single location (Johnsonburg). This consolidation, in synergy with the capabilities of the technology, has resulted in many broad

benefits such as the elimination of much paper, improved accuracy and auditability, improved consistency, and a much clearer and effective division of labor in the dispatch office. The second type of benefits emphasized by staff is specific, dramatic improvements in specific activities and their associated metrics. Chief among those benefits, as noted in the discussions of productivity and safety impacts above, are dramatic improvements in preventative vehicle maintenance and the associated reduction in in-service break-downs, and the dramatically reduced time required to prepare invoices.

ATA staff acknowledges that the technology implementation took much more time and effort than anticipated. They do not ascribe this delay and effort to any specific factor but rather to the combined impact of many technical challenges that were greater than expected (having never implemented these specific technologies, they had little upon which to base their expectations). ATA staff generally report that each step in the process was simply more complex, more time-consuming and contained more unexpected issues and challenges with greater implications for the success of the deployment than anticipated. There is one area that several personnel single out as being especially challenging: the process of inputting and extensive checking and correcting of key data inputs such as origin and destination geo-codes and client data.

Although the ATA staff believes their next technology deployment will go smoother by virtue of what they have learned, they would not fundamentally alter their approach nor do they have much in the way of specific advice for other transit agencies. Rather, their general perspective seems to be that to implement these systems successfully, it takes a lot of time, effort and commitment, especially from senior management and the board of directors. Their advice to other transit agencies focuses mostly on general strategies, e.g., be patient, plan on everything taking longer than expected, ensure plenty of training for everyone who will use the technology, begin educating employees and customers early and stay at it, etc.

4.2 Conclusions

Overall, the technology deployment was successful in terms of realizing most of the intended benefits. Where benefits have not been fully achieved it is mostly the case that ATA believes the benefits will be realized over time. ATA anticipates that the full, expected benefit of the technology in improving schedule efficiency (manifested as reduced non-revenue vehicle hours) may yet be realized in late 2009 or 2010 when they begin using the scheduling software batch scheduling capability. ATA also believes that expected benefits related to the IVR can be achieved if and when they implement an IVR. In the case of the hypothesized customer satisfaction benefits that were not achieved, significant improvements were unlikely given the very high levels of pre-deployment satisfaction.

Conclusions regarding the primary reasons that this project was successful are based on: on-site observations, conversations and formal interviews with a wide range of ATA personnel over seven years; before-after analysis of performance metrics; and a familiarity with similar deployments at other agencies. The conclusions related to keys to ATA success are as follows:

- They approached the project in a very structured, thoughtful manner with a great deal of careful planning and preparation. Although not every step of a formal "systems engineering process" was followed, the overall approach included most of the key steps

in the type of systems engineering process that is key to transportation technology success.

- ATA has made both minor and major changes in the way it does their work, e.g., the reorganization of the dispatch office, in order to take fuller advantage of the technologies. In turn, the ATA selected the technologies in part based on their ability to facilitate major changes such as the consolidation of major vehicle maintenance and dispatch office activities to a single location.
- Several key ATA personnel with deep understanding of ATA processes and data, as well as a depth of knowledge in relevant areas such as information technologies, dedicated extensive time and effort over the entire life of the project. There was a high degree of staff continuity; the key personnel that started the project are still there.
- ATA utilized skilled consultants and, although ATA was not particularly experienced with these specific new technologies, ATA staff had sufficient depth of knowledge in information technologies in general to allow them to effectively manage their consultants.
- All of the departmental managers were intimately involved in the project and were tenacious in their efforts to overcome challenges and see the project from the concept phase through to operational reality over a period of almost 10 years.
- ATA senior management was deeply committed and unwavering. They gave senior technical staff the time and support needed to get the job done.
- The ATA Board of Directors was committed to this project over its long lifetime. This speaks both to the Board's understanding and valuation of the technology benefits but also to ATA senior management's successful track record and careful, early, and continuing efforts to educate and build support with the Board.

These findings confirm many of the best practices that have been recognized in the literature, including the recent compilation "Improving Public Transportation Technology Implementations and Anticipating Emerging Technologies."[16]

In summary, the ATA experience provides further evidence that well-established technologies like computer-assisted scheduling and dispatch and maintenance management systems can provide significant benefits but success is dependent on a fairly high degree of competency, care and perseverance on the part of the transit agency.

[16] Matthew Burt and Chris Cluett, Battelle; Carol Schweiger, TranSystems Corp.; Matthew Coogan; Richard and Sharon Easley, E-Squared Engineering. "Transit Cooperative Research Board Report 84: Improving Public Transportation Technology Implementations and Anticipating Emerging Technologies." Transportation Research Board, 2008.

Appendix A

ATA Baseline Customer Satisfaction Survey: Fixed Route

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ATA Customer Satisfaction Survey (Fixed Route)

1. How often do you ride the bus (round-trip)? *(check <u>one</u> box)*

☐ less than 1 time a week ☐ 1-3 times a week ☐ 4-6 times a week ☐ More than 6 times a week

2. How long do you expect to be on the bus ***today*** to reach your destination? *(check <u>one</u> box)*

☐ less than 15 minutes ☐ 15-30 minutes ☐ 31-60 minutes ☐ More than 1 hour

3. Check all the types of bus trips you took ***in the past 30 days,*** and then check the trip type you took most frequently.

	Check **<u>all</u>** trip types that you took	Check the **<u>one</u>** most frequently taken
Work or school	☐	☐
Shopping	☐	☐
Visit friend or relative	☐	☐
Recreation (movie, restaurant, senior/community center, event, etc.)	☐	☐
Medical	☐	☐
Other (specify_____)	☐	☐

In general, how satisfied have you been with each of the following: *(Circle <u>one response</u> for each question)*	**Very Satisfied**				**Very Unsatisfied**
4. The bus picking you up on-time?	1	2	3	4	5
5. The bus getting you to your destination in a timely way?	1	2	3	4	5
6. The bus service provided by ATA, overall?	1	2	3	4	5

7. In general, do you have to call ATA to be picked up by the bus? *(check <u>one</u> box)*

☐ Yes, continue to questions 7a and 7b ☐ No, skip to question 8

When you call ATA to arrange a pickup, how satisfied are you with: *(Circle <u>one response</u> for each question)*:	**Very Satisfied**				**Very Unsatisfied**
7a. The amount of time it takes you to reach a dispatcher?	1	2	3	4	5
7b. The amount of time it takes with the dispatcher to schedule a trip?	1	2	3	4	5

	Very Concerned				*Not Concerned*
8. How concerned are you with the time it would take to summon help in the case of a breakdown or emergency? (*circle one*)	1	2	3	4	5

9. Your characteristics. *(check <u>one</u> box in each column)*

Gender	**Age category**		**Do you have a disability?**
☐Female	☐Under 12	☐21 to 64	☐No
☐Male	☐12 to 20	☐65 or older	☐Yes.

10. Do you have any comments or suggestions for ATA regarding bus service? **(Continue on back if needed)**

Official use: Date_____Time_____Route/Bus#_____Town/County_____ External Factors_____

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Appendix B

ATA Baseline Customer Satisfaction Survey: Demand Responsive

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ATA Customer Satisfaction Survey (Demand Responsive)

1. How often do you ride the bus (round-trip)? *(check <u>one</u> box)*

☐ less than 1 time a week ☐ 1-3 times a week ☐ 4-6 times a week ☐ More than 6 times a week

2. How long do you expect to be on the bus ***today*** to reach your destination? *(check <u>one</u> box)*

☐ less than 15 minutes ☐ 15-30 minutes ☐ 31-60 minutes ☐ More than 1 hour

3. Check all the types of bus trips you took ***in the past 30 days,*** and then check the trip type you took most frequently.

	Check **<u>all</u>** trip types that you took	Check the **<u>one</u>** most frequently taken
Work or school	☐	☐
Shopping	☐	☐
Visit friend or relative	☐	☐
Recreation (movie, restaurant, senior/community center, event, etc.)	☐	☐
Medical	☐	☐
Other (specify_____)	☐	☐

In general, how satisfied have you been with each of the following: *(Circle <u>one response</u> for each question)*	**Very Satisfied**				**Very Unsatisfied**
4. The bus picking you up on-time?	1	2	3	4	5
5. The bus getting you to your destination in a timely way?	1	2	3	4	5
6. Being able to arrange a trip on the ***day*** you want to travel?	1	2	3	4	5
7. Being able to arrange a trip at the ***time of day*** you want to travel?	1	2	3	4	5
8. The amount of time it takes you to reach a dispatcher?	1	2	3	4	5
9. The amount of time it takes with the dispatcher to schedule a trip?	1	2	3	4	5

10. In the past 6 months, has ATA called you to change the time of your pickup? *(check <u>one</u> box)*

☐ Yes, continue to question 10a ☐ No, skip to question 11

10a. How satisfied are you with the way ATA handled rescheduling for you? (*circle one*)	*Very Satisfied* 1	2	3	4	*Very Unsatisfied* 5

11. In the past 6 months, have you called ATA because your bus was late or failed to show up? *(check <u>one</u> box)*

☐ Yes, continue to question 11a ☐ No, skip to question 12

11a. How satisfied were you with the timeliness and accuracy of the information you were told? (*circle one*)	*Very Satisfied* 1	2	3	4	*Very Unsatisfied* 5

12. How concerned are you with the time it would take to summon help in the case of a breakdown or emergency? (*circle one*)	*Very Concerned* 1	2	3	4	*Not Concerned* 5

13. Your characteristics. *(check <u>one</u> box in each category)*

Gender ☐ Female ☐ Male

Age category ☐ Under 12 ☐ 12 to 20 years ☐ 21 to 64 ☐ 65 or older

Do you have a disability? ☐ Yes ☐ No

14. Do you have any comments or suggestions for ATA regarding bus service? **(Write on back)**

Official use: Date_____Time_____Route/Bus#_____Town/County_____ External Factors_____

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Appendix C

Scripts for Customer Focus Groups

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Script for Baseline ATA Customer Focus Groups

Introductions

1. **Ground rules**
   (1) Individual identities are confidential
   (2) No right or wrong answers
   (3) Schedule to keep—limited to about 2 hours
   (4) Audio-taping for notes only; tape will be erased. Use only if everyone consents.
   (5) Purpose of the focus group is to discuss satisfaction with ATA's bus service

2. **Introductions**
   (1) Explain role/function of the evaluation
   (2) This is an informal discussion, part of several different data collection efforts
   (3) First name only
   (4) County of residence
   (5) Bus usage: type of service used, main reasons for use, and frequency of use

3. **On-time performance**
   (1) What is your experience with the bus picking you up on time?
   (2) What is your experience with the bus getting you to your destination on time?
   (3) What is your experience with how long you have to spend on the bus in relation to the distance traveled?
   (4) Have any of you experienced a situation where the bus was very late or did not show up? How satisfied were you with the way that ATA handled that?

4. **Scheduling**
   (1) Are you able to arrange trips for the day and time you want to travel?
   (2) How satisfied are you with the amount of time it takes to reach a dispatcher on the phone?
   (3) How satisfied are you with the amount of time it takes with the dispatcher to schedule a trip?
   (4) Have any of you been called by ATA to reschedule a trip?
   (5) How satisfied were you with the way ATA handled that?

5. **Safety**
   (1) How safe do you feel on the bus?
   (2) Do you have any concerns about how long it would take the bus driver to summon help in the case of a breakdown or other emergency?

6. **Other**
   (1) Do you have any other areas of concern or praise for the bus service provide by ATA?

Script for Post-Deployment ATA Focus Groups

Introductions

1. Purpose of the focus group is to discuss your experiences using ATA's bus service (we're helping ATA assess their customer's satisfaction)
2. Individual identities are confidential – first names only today
3. No right or wrong answers – please speak your mind
4. Schedule to keep—limited to about 1-1/2 hour
5. Audio-taping for notes only; tape will be erased. Use only if everyone consents
6. Go around the table and ask each person a few background questions:
    - First name
    - County of residence
    - How long you've been riding ATA
    - The types of ATA services you use (e.g., demand response or fixed route with deviation)
    - Main reasons for using ATA
    - For what types of trips do you use ATA, like shopping, work, medical, etc.

Discussion Questions

1. **Overall changes**
    a. Comparing this year (2008) to last year (2007), do you sense any changes in the way ATA is running their service?
    b. Overall, has the quality of ATA service changed for you (for better or worse), comparing this year (2008) to last year (2007)? If so, explain how.

2. **On-time performance (over the last six months)**
    a. What is your experience with the bus picking you up on time?
    b. What is your experience with the bus getting you to your destination on time?
    c. What is your experience with how long you have to spend on the bus in relation to the distance traveled? That is, do you feel the buses take a direct route and don't make too many stops along the way?
    d. If you called ATA to check on a bus that was running late and were given an estimate of when the bus would show up, how satisfied were you with accuracy of that estimate?
    e. Comparing this year (2008) to last year (2007), based on your personal experience, has ATA's "on-time performance" changed? If so, how?

3. **Scheduling a trip (over the last six months)**
    a. Is ATA always able to accommodate your trip requests for the day and the time you wish? Under what circumstances have they been unable?
    b. If you've requested a same day trip (a trip for the same day that you called in the reservation), has that request been accommodated? If not, why?
    c. How satisfied are you with the amount of time it takes to reach a dispatcher on the phone?
    d. How satisfied are you with the amount of time it takes with the dispatcher to schedule a trip?
    e. Have any of you been called by ATA to reschedule a trip? If so, how satisfied were you with the way they handled that?
    f. Comparing this year (2008) to last year (2007), has your personal experience scheduling a trip with ATA changed? Has it been any easier or any harder to make a trip reservation for the same day or make same day changes in your reservation?

4. **Safety**
    a. How safe do you feel on the bus? If you don't feel safe, please explain why.
    b. Do you have any concerns about how long it would take the bus driver to summon help in the case of a breakdown or other emergency?
    c. Comparing this year (2008) to last year (2007), do you feel any more or less safe on ATA's buses? If so, why?

5. **Overall satisfaction with service**
    a. Overall, how satisfied are you with ATA's service? If you aren't totally satisfied, why not?

6. **Awareness and perception of technologies**
    a. Are you aware of any new technologies that ATA has begun using in the last year or so?
    b. In 2007, ATA implemented several new technologies. These technologies are intended to:
        - Help them take trip reservations faster
        - Better respond to cancellations, last minute trip requests and other changes
        - Track their vehicles so they can more quickly locate them if they need to make changes in the schedules or if there is an emergency
        - Improve the effectiveness of vehicle maintenance.

        i. How do you feel about ATA spending money on these sorts of technologies?
        ii. Do you have any other questions or comments about these technologies?

7. **Other**
    a. Do you have any other areas of concern or praise for the bus service provide by ATA?

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Appendix D

Discussion Guides for ATA Staff Interviews

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Discussion Guide for Baseline ATA Staff Interviews

I. ATA Managers

1. Ground rules (same for all interview groups)

(1) Individual identities are confidential
(2) No right or wrong answers
(3) Schedule to keep—limited to x hour
(4) Audio-taping for notes only; tape will be erased. Use only if everyone consents.
(5) Purpose of the interview is to discuss the deployment of the new mobile voice/data and CAD/AVL systems

2. Introductions (same for all interview groups)

(1) Explain role/function of the evaluation
(2) This is an informal discussion, part of several different data collections
(3) First name only
(4) How long with Areas Transportation Authority?
(5) How many years doing this job?

3. Implementation

(1) How far along are you with the implementation of the new systems?
(2) What do you think has gone well to date?
(3) What problems have you encountered with the implementation to date?

4. Safety

(1) Describe the current safety procedures in the event of a crash, breakdown, or other emergency.
(2) How well do these procedures work?
(3) What problems are encountered with these procedures?
(4) The new mobile voice/data and CAD/AVL systems are intended to improve safety. How do you expect this to happen?
(5) Are you expecting safety to improve through improved maintenance practices? Describe current practices and how you expect this to change.

5. Mobility

(1) Do you expect the new systems to improve on-time performance? How do you think this will occur?
(2) Do you think the new systems will improve ATA's ability to schedule rides? How will this occur?
(3) How will bus routing improve with the new systems?

6. Productivity

(1) How will the new systems improve your ability to analyze and plan bus service?
(2) How will the new systems improve accounting and invoicing procedures?
(3) How will the new systems improve satisfying the needs of third party agencies?
(4) How will the new systems improve how fares are determined and ATA's financial performance?
(5) How will the new systems improve timekeeping and payroll?

II. Bus drivers

1. Safety

- Describe the current safety procedures in the event of a crash, breakdown, or other emergency.
- How well do these procedures work and what problems have you encountered?
- The new mobile voice/data systems and CAD/AVL are intended to improve safety. Do you think they will and in what ways?

2. Mobility

- Do you ever have a problem finding the proper pick-up or drop-off point? How much of a problem is it?
- How easy is it to accommodate late changes in scheduled pick-ups and/or drop-offs and route changes?
- How often do you get behind in the schedule? What are the main reasons for that? What actions do you take to minimize lateness?

III. Maintenance personnel

1. Safety/Mobility/Productivity

- Describe the current maintenance procedures? How well do these procedures work?
- How are problems with buses reported to you?
- How well does this system work?
- How much do you know about the new mobile voice/data and CAD/AVL systems?
- Do you think these new systems will improve maintenance procedures?
- How do you think improvements will come about?

IV. Dispatchers

1. Safety

a. Describe the current safety procedures in the event of a crash, breakdown, or other emergency.
b. How well do these procedures work and what problems have you encountered?
c. The new mobile voice/data systems and CAD/AVL are intended to improve safety. Do you think they will and in what ways?

2. Mobility

a. Describe the current procedures for scheduling rides.
b. What are the main problems you encounter getting people where they want to go?
c. In your experience, how easy is it for people to travel the day and time they want to?
d. Is it currently possible to fulfill requests for same-day trips? How easy is it to do so? How about canceling trips on the same day?
e. How much of a problem are vehicle breakdowns? How are such problems handled?
f. Do drivers have problems locating riders? What are the procedures when this occurs?

Example Discussion Guide for Post-Deployment ATA Staff Interviews: ATA Managers (Chief Financial Officer, Operations Director, Operations Supervisor, Customer Service Manager)

Ground Rules-Introduction

1. Individual identities are confidential
2. No right or wrong answers
3. Schedule to keep, so may need to follow up
4. Audio taping for notes only; tape will be erased; use only if everyone consents
5. Purpose of the interview is to discuss your perceptions of the benefits, challenges and solutions, and lessons learned associated with your technology investments:
    a. Data/voice radio system
    b. Mobile data terminals
    c. Automatic vehicle location
    d. Computer-assisted reservation, scheduling and dispatch software
    e. Vehicle maintenance management software
    f. Financial software
6. Purpose of the evaluation is not to pass judgment per se, but rather to gather information that will help other transit agencies and help U.S. DOT in future investment decisions

Interview Questions

1. Benefits
    a. What benefits did you expect from the technology, and have you obtained them? Our understanding of your intended, major benefits include:
        i. Improve ability to fill cancellations and make other dynamic, same-day schedule changes
        ii. Make the call-a-bus trip reservation service more efficient
        iii. Simplify schedulers' work by using MDC to replace some voice communication
        iv. Produce better schedules (more efficient routing)
        v. Provide useful data for planning and analysis
        vi. Faster and more effective notification and response to vehicle incidents (breakdowns, emergencies, etc.)
        vii. More effective maintenance (fewer breakdowns, better inventory control)
    b. What did it take in order to realize those benefits—have you changed the way you operate (policies, procedures, etc.)?
    c. Have the benefits you have realized been the ones you expected?
    d. Are there benefits that you have not obtained yet, but still hope to obtain? (how?)

2. Challenges
    a. What, if any, problems are you still working on with the technologies?
    b. What were the most significant challenges faced in implementing and effectively operating the systems?
    c. How did you overcome those challenges?
    d. What other factors, decisions, and actions have been critical to your successes (or failures)?
    e. Was it difficult to learn how to use the new technology and to get the most out of it? How could training and the learning curve be improved?
3. Other Lessons Learned
    a. What advice would you give other transit agencies contemplating similar technologies?
    b. What can be done to make the implementation of these technologies faster and easier for other transit agencies?
    c. Are there any other lessons that you've learned that you would like to have captured in the evaluation?

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