"Lessons Learned" Evaluation of Intelligent Transportation Systems (ITS) Implementation at Santee Weteree Regional Transportation Authority

U.S. Department of Transportation
Federal Transit Administration

OFFICE OF RESEARCH, DEMONSTRATION, AND INNOVATION

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6. AUTHOR(S)
Ted J. Rieck[1] and Mark Carter[2]

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Science Applications International Corporation 10260 Campus Point Drive San Diego, CA 92121 TranSystems Corporation 2400 Pershing Road, Suite 400 Kansas City, MO 64108	8. PERFORMING ORGANIZATION REPORT NUMBER

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13. ABSTRACT (Maximum 200 words)

The purpose of this "lessons learned" is to document the experience with Intelligent Transportation Systems (ITS) implementation at the Santee Wateree Regional Transportation authority (SWRTA). SWRTA is a public transportation provider serving rural central South Carolina as well as the City of Sumter. This "lessons learned" documents the challenges faced by SWRTA in implementing ITS technologies. The case study attempts to provide useful lessons to other transit systems as they consider similar ventures. Among these lessons are: the need for comprehensive technology planning, strong and committed project management, employee "buy-in" and development, and budgeting sufficient implementation time with contingencies.

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Santee Wateree

R **T** **A**

Your Community Transportation Provider

June 2002

Notice

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1 foot (ft) = 30 centimeters (cm)	1 centimeter (cm) = 0.4 inch (in)
1 yard (yd) = 0.9 meter (m)	1 meter (m) = 3.3 feet (ft)
1 mile (mi) = 1.6 kilometers (km)	1 meter (m) = 1.1 yards (yd)
	1 kilometer (km) = 0.6 mile (mi)
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1 square yard (sq yd, yd^2) = 0.8 square meter (m^2)	1 square kilometer (km^2) = 0.4 square mile (sq mi, mi^2)
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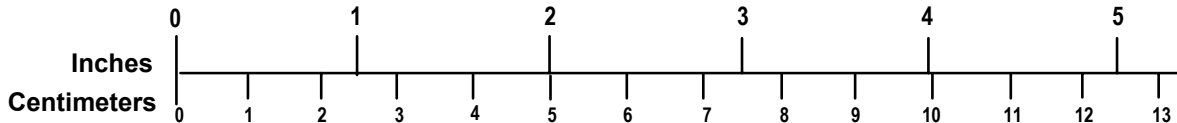
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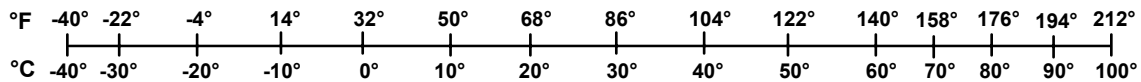
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PREFACE

It is not the critic who counts; not the man who points out how the strong man stumbles, or where the doer of deeds could have done them better. The credit belongs to the man who is actually in the arena, whose face is marred by dust and sweat and blood; who strives valiantly; who errs, who comes short again and again, because there is no effort without error and shortcoming; but who does actually strive to do the deeds; who knows great enthusiasms, the great devotions; who spends himself in a worthy cause; who at the best knows in the end the triumph of high achievement, and who at the worst, if he fails, at least fails while daring greatly, so that his place shall never be with those cold and timid souls who neither know victory nor defeat.

Theodore Roosevelt,
The Man in the Arena: Citizenship in a Republic, address delivered at the Sorbonne, Paris, April 23, 1910.

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1. INTRODUCTION

The purpose of this "lessons learned" report is to document the experience in Intelligent Transportation Systems (ITS) implementation at the Santee Wateree Regional Transportation Authority (SWRTA). This report will document the challenges faced by SWRTA in implementing ITS technologies. The case study attempts to provide useful lessons to other transit systems as they consider similar ventures.

1.1 Background

SWRTA is the public transportation provider for a mostly rural area of central South Carolina. See Figure 1. SWRTA primarily serves a 2,500 square mile area covering four counties. SWRTA also provides contracted Medicaid and work support services in three other counties.[1] It provides traditional paratransit services to persons with disabilities as well as fixed route services in the City of Sumter. In an effort to increase driver accountability and to generally improve the efficiency of its operation, SWRTA sought to implement various ITS technologies. These technologies were to be deployed in conjunction with flexroute service. These included systems for computer-assisted dispatching and scheduling (CADS), automatic vehicle location (AVL), mobile data terminals (MDTs) and geographic information systems (GIS).[2]

The US Department of Transportation engaged the SAIC/TranSystems Team to investigate SWRTA's experience with advanced technology systems. The study addressed the following objectives:

- Improvement in the effectiveness and efficiency of transportation services provided in the SWRTA area

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[1] Clarendon, Sumter, Lee and Kershaw counties comprise SWRTA's primary service area. In addition, SWRTA provides Medicaid and Work Support services in Orangeburg, Calhoun, and Berkeley counties.
[2] In addition, an accounting package was to be implemented as part of this symphony of technology. This report does not substantively discuss the financial package, as it is not, considered part of "advanced technology" as defined by this "lessons learned."

Figure 1: SWRTA Service Area
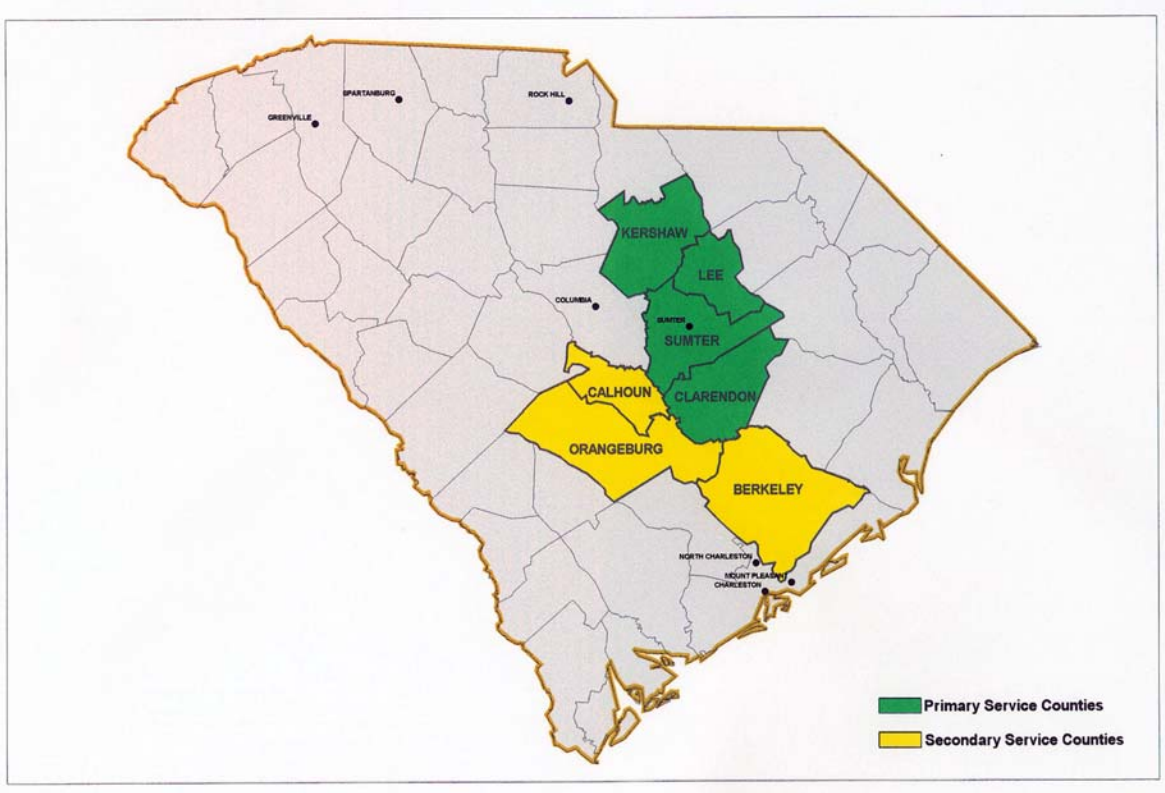
- Improvement in Customer Satisfaction through better service

- Demonstration of the applicability of ITS technologies in the provision of flexroute services to rural areas as well as other environments

- Development of a mechanism for disseminating "lessons learned" in the use of ITS technologies, and

- Development of a mechanism for the industry-wide deployment of ITS technologies in flexroute services.

For reasons to be discussed below, the implementation of these technologies met with significant problems. The goal of this case study is to help other rural transit providers learn from the experiences of SWRTA.

1.2   Overview of Situation

SWRTA is a complex transportation operation. It operates both fixed route and demand-responsive services. Fixed route operations are primarily within the City of Sumter, though long-distance services to the Myrtle Beach tourist area are also provided. Twenty-four vehicles are used to provide peak service on the fixed route system with about 800 daily riders. In addition, demand-responsive services are provided with a peak fleet of 54 vehicles. About 1,000 patrons use this service each day.

A share of SWRTA's funding comes from Medicaid contracts it has with various counties in its service area. According to the 1999 National Transit Database, about 34 percent of its funds come to the agency from State and Federal sources.

1.3   Organization of Paper

This paper presents the SWRTA experience in a case study format. First, basic facts about the implementation of advanced technology are given. Second, issues about that implementation are discussed followed by an analysis. Finally,

conclusions or "lessons learned" are drawn, and policy implications for the Federal Transit Administration (FTA) are suggested.

This paper is based on site visits and interviews with people involved in the implementation, as well as a review of industry practice from both personal interviews and literature review. The information used in this case study is based not only on personal interviews with SWRTA staff, but also on information obtained from people who observed the SWRTA experience from the sidelines. This included Santee-Lynches Regional Council of Governments and State of South Carolina observers. Finally, documentation concerning SWRTA's efforts to implement advanced technology was obtained and reviewed. This included a grant request, internal memorandum, vendor proposals, and similar documents.

2. IMPLEMENTING ADVANCED TECHNOLOGY

This section provides an overview of the process undertaken by SWRTA to bring advanced transit technology to rural, central South Carolina. First, a brief chronology of events is presented. Second, the implementation by technology type is discussed in more detail.

2.1 Chronology of Events

In general, the decision to acquire and implement advanced technology was evolutionary. While a vision to move SWRTA "into the 21st Century" was clearly the agency's intent, the steps to reach that point were based on circumstances and opportunity. In short, the agency acquired technology as the need for that technology became apparent. There is no evidence that a "grand plan" or strategy existed to determine needs and to fit technology to those needs in a systematic way.

The movement toward advanced technology started with the acquisition of geographic information system (GIS) software. The GIS software revealed opportunities for SWRTA to re-deploy its services. To support that re-deployment it was determined that additional advanced technology, in the form of Computer Aided Dispatching and Scheduling (CADS), was needed. This scheduling software was acquired and implemented in a "piecemeal" fashion. The acquisition of automated vehicle location (AVL) and mobile data terminal (MDT) systems were seen as adjuncts to the scheduling system. In addition to this "piecemeal" approach, Y2K and other issues affected SWRTA's ability to successfully implement this system. In the end, for reasons to be discussed, SWRTA was unable to implement the system.

Figure 2 illustrates the basic process in which SWRTA attempted to implement advanced technology. As seen in the illustration, there were nine basic steps. These steps are described below.

Figure 2: Timeline of Advanced Technology Implementation

Basic Flowchart of Events for ITS Implementation at
Santee Wateree Regional Transportation Authority

```
Vision for            Partial              Total CADS
Technology            CADS                 Implementation
   |                    |                      |
   v                    v                      v
  GIS                ITS Grant              CADS
                     (MDT/AVL)              Problems
   |                    |                      |
   v                    v                      v
FlexRoutes  ------> Acquisition ------>     CADS
                                          Disconnection
```

Step	Description
1. Vision for Technology	1994: desire to move SWRTA into 21st Century.
2. GIS Acquisition	1996: grant available from South Carolina Department of Transportation (SCDOT) to acquire GIS. In 1997, SWRTA wins grant and acquires software. Also in 1997, SWRTA hired a GIS coordinator.
3. Flexroutes	1998: based on GIS data and visit to Putnam County, Florida, flexroute system designed and implemented for Kershaw County. System was initially implemented using manual scheduling methods.
4. Partial Computer-assisted dispatching and scheduling (CADS)	SWRTA management believed that the operation of the flexroute system could be enhanced with CADS. Software was acquired to accomplish matching patrons with flexroute services. During system training in the Fall of 1998, it was discovered that the entire CADS package was needed for the flexroute portion of the system to work properly.
5. ITS Grant (MDT/AVL)	Late 1998/ early 1999, discretionary grant funding was made available to SWRTA. SWRTA decided to use those funds to complete the implementation of the CADS system as well as to acquire AVL and MDT systems.
6. Acquisition of CADS System	1999: researched various systems via trade shows. Developed RFP to acquire the services of a systems integrator who would bring together hardware and software. Awarded contract to local firm in June 1999.
7. Total CADS Implementation	August 1999: implementation of the scheduling system began. The system was to be "live" by January 2000. At the same time SWRTA obtains three new service operating agreements while losing two existing agreements. In September a technical project manager was hired to oversee the installation.

8. CADS Problems	October/November 1999, the scheduling software vendor arrives to begin staff training. The hardware portions of the system are unable to handle the software. At same time turnover experienced among scheduling/dispatch staff, and data for scheduling parameters discovered to be incomplete. The system goes "live" in January 2000 despite problems.
9. CADS System Disconnected	After continuing problems (e.g., the system "lost" data), by the Fall of 2000 the scheduling system was disconnected and a less technical application (using Q&A) was implemented.

2.2   Geographic Information System

SWRTA's first significant step toward implementing advanced technology was the acquisition of Geographic Information (GIS) software. With the assistance of the Santee-Lynches Regional Council of Governments (COG), SWRTA applied for and won a grant from the South Carolina Department of Transportation (SCDOT). The purpose of the grant program was to encourage inter-agency coordination.

SWRTA hired a consulting firm to develop hardware and software specifications and help install the GIS software. In addition, SWRTA hired a planner to manage and operate the GIS.

The agency acquired ArcView and ArcInfo brand software. The installation worked well without any significant problems.

An early task assigned to the GIS was to map demand response trips. Figure 3 shows a plot of Medicaid clients in Lee County. Using the analysis created by the GIS, SWRTA was able to develop a flexroute system. (See Figure 4.)

Figure 3: Sample GIS Plot of Demand Response Trips
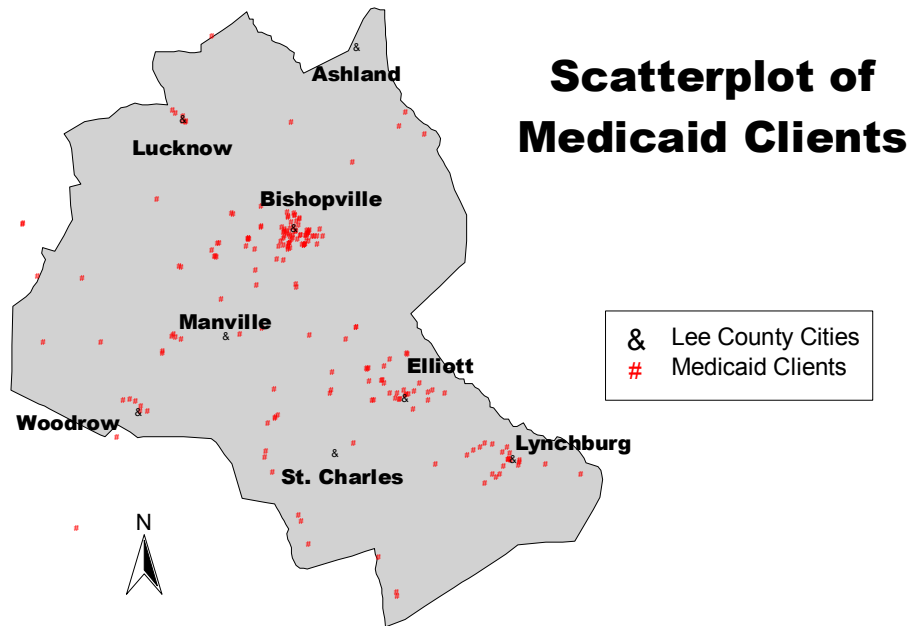
Source: *Presentation by Will Davis, of SWRTA, Rural Advanced Technology and Transportation Systems International Conference, Branson, Missouri, August 2000.*

Figure 4: SWRTA Flexroutes
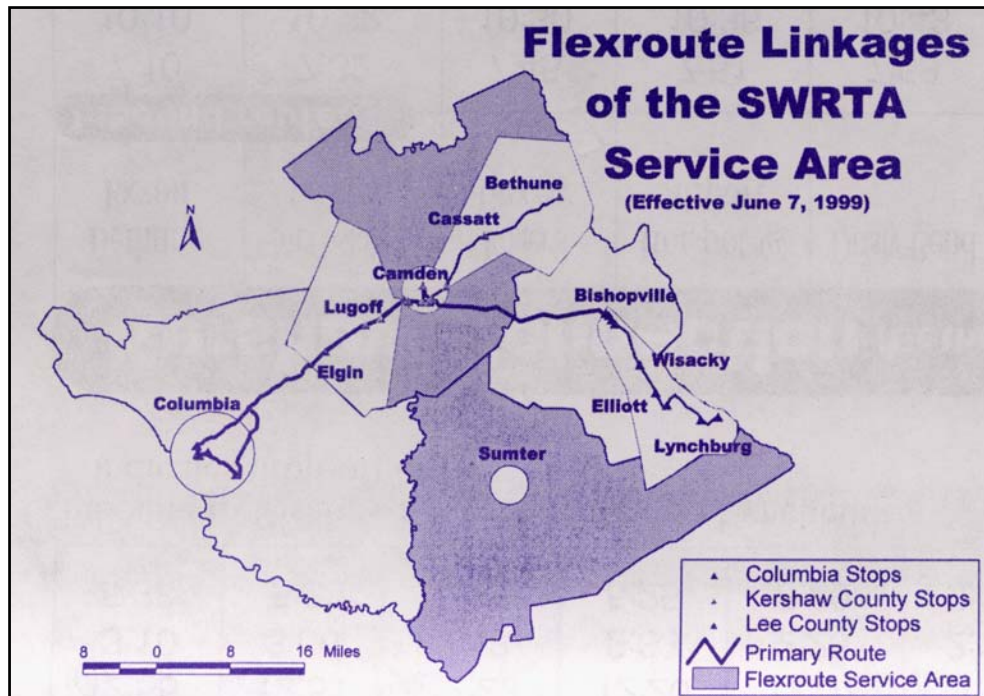
Source: *SWRTA public bus schedule.*

Just prior to implementing a flexroute system, SWRTA staff toured the transit system of Putnam County, Florida. Putnam County had a system of flexroutes that was supported by CADS, Automatic Vehicle Locator (AVL) and Mobile Data Terminal (MDT) systems.

2.3 Computer-Assisted Dispatching and Scheduling

With the implementation of the flexroute system some operational problems arose. While the routes operated at some level of efficiency, SWRTA dispatch staff sometimes had a difficult time in assigning riders to the services. For the flexroutes to reach their full potential, it was important that as many demand response patrons as possible be placed on the flexroutes. For reasons that are somewhat unclear, the operating staff missed opportunities to make such assignments.

One possible reason is that the dispatch staff wanted to make sure the demand response drivers had work. Assigning patrons to flexroutes would reduce the work of demand response drivers. Since dispatchers were former drivers, some sympathy for demand response drivers is one possible motive. Another reason may be that the procedure for assigning to the flexroute was considerably different from that for demand response and, therefore, more burdensome than the more familiar demand response process. (This may indicate either a lack of training or a lack of motivation on the part of dispatchers.) Finally, there was a perception among some of the operating staff that many riders did not like the flexroute service despite its lower fare versus the demand response service. These factors and probably others required too much supervision by SWRTA management.

To encourage greater use of the flexroute system, part of an automated schedule or CADS (computer-assisted dispatching and scheduling) package for such operations was acquired. Initially the package acquired was thought by SWRTA to be applicable for flexroute service on a "stand alone" basis. After the software

was acquired, it was discovered that a full scheduling system for both the demand response and flexroute systems was needed. Shortly after that time, SWRTA was able to secure discretionary grant funds that they elected to use to purchase the balance of the scheduling package as well as to position themselves to acquire AVL and MDTs.

2.3.1 Background Issues

The CADS system was purchased for the following reasons:

- To improve the flexroute operation by making it easier for dispatch/scheduling staff to assign patrons to the routes.
- To reduce paperwork and simplify the reimbursement/billing process as well as to integrate the agency's financial reporting system.
- To prepare for Y2K.
- To increase driver accountability thereby making the overall operation more efficient.

Improve Flexroute Operations

As discussed earlier, it was believed by SWRTA management that the flexroutes were not being used to their potential. A CADS system was seen as a way to facilitate greater use of the flexroute system by making trip assignments administratively easier.

Simplify Billing Process

Much of SWRTA revenue is derived from Medicaid reimbursements. For each rider carried by SWRTA making a Medicaid eligible trip, the host county would reimburse the carrier on a per passenger mile basis. The clerical support necessary to process the trip data for 1,000 daily riders was burdensome. It was hoped that the scheduling system would generate reports to reduce paperwork and simplify the billing process. Those reports were to be integrated with the

new accounting system concurrently implemented concurrent with the other systems.

<div align="center">Prepare for Y2K</div>

SWRTA management was informed that the preexisting computer system, including the financial accounting module and Medicaid billing process, was not Y2K compliant. There was a fear that the system would not function. The CADS is an important source of information for the Medicaid billing process and, therefore, an integral part of the accounting system. Successful implementation of CADS was a vital step in bringing all systems into Y2K compliance.

<div align="center">Increase Driver Accountability</div>

The scheduling system had the potential to create greater accountability by dictating driver route patterns. The scheduling system would delineate routes, indicating the order of passenger pick-ups and drop-offs. The prior system relied on the driver to establish a route pattern. Consequently, management lacked awareness as to the driver's position on his or her route. This situation created a problem in managing "on-street" operations.

2.3.2 Acquisition and Implementation

SWRTA began the procurement process for the remaining elements of the CADS system in 1999. The strategy was to hire a "systems integrator" who would bring the software and hardware elements together. In addition, the integrator would oversee installation. This procurement process was preceded by SWRTA staff researching various software products by visiting trade shows and attending one vendor's user group meeting. This research effort was also supplemented by talks with users of scheduling software.

In June 1999 two firms responded to the Request For Proposal (RFP). Both proposals included the same scheduling system software, and both firms were

local to South Carolina. In that same month, the contract was awarded. The software was to be up and running within six months – by January 1, 2000.

The following events took place during implementation:

- In August 1999, the GIS planner was appointed to oversee some aspects of the software implementation. The planner realizes that a computer "guru" is needed to help manage the project.

- In September 1999, a relatively inexperienced information technology specialist was hired. By November 1999 this individual is given project management responsibility for the implementation. The GIS planner was reassigned to assist in the start-up of new services in another county.

- Initial system training was to take place in August/September. This initial training was to consist of a one-week "product" demonstration. "Real" SWRTA data would not to be used. The training did not take place because the software vendor was not ready.

- From September to October, SWRTA staff began data entry which included client names and addresses. Data could not be readily transferred since there was much duplication of names and addresses. Of the 40,000 clients in the database, half were believed to be repetitive. Other problems with data entry included inadequate mapping information for the portion of the software reliant on geocoded data.

- In October initial vendor training on software. That training provided an overview of the system. In November 1999, the scheduling software vendor arrives to complete the training of personnel. The computer system crashes during training in November 1999. The hardware was not able to handle the software. Its systems integrator had assured SWRTA that the hardware conformed to the specifications set by the software vendor. Later it was determined that the specifications were minimal and did not account for any growth that had taken place since the contract award.

- By early 2000, the software was up and running, albeit roughly. Schedules were not accurate with illogical trip assignments. For example, a manifest for a driver in one county would contain trips from yet another county. In addition, trips booked on the system did not show up on driver manifests. Billing-related data entry of driver manifests into the system did not go well. The software was unable to capture a specific rider's distance traveled (i.e., passenger miles). The distance that passengers travel was a critical element in Medicaid billing for SWRTA. The fact that the system was unable to produce the data in the form needed by SWRTA was a significant failing.

- During the first half of 2000, an in-house programmer wrote a Microsoft Access application to supplement/replace the billing data entry portion of the scheduling software. Later it is discovered that the program was critically flawed.

- Due to numerous problems, the scheduling software was disconnected in the Fall of 2000, and replaced with a program written in an "off the shelf" database management program.

2.4   Automated Vehicle Location/Mobile Data Terminals

- The grant that funded the CADS package was also to fund the acquisition of an automated vehicle location system (AVL) and mobile data terminals (MDTs). Because of the problems associated with the CADS system, the AVL/MDT portions of the grant were put on "hold." In addition to the funding issue, the communication system of SWRTA was also under scrutiny.

- SWRTA uses two-way radios in the rural portions of its service area. SWRTA saw that the weak link in adding AVL/MDT would be the communications. At the time, SWRTA operated at a very low frequency (40 – 70 MHz) over 2,500 square miles in its core four-county area. Some radio vendors told SWRTA that data can be transmitted at these low frequencies (1 voice, 2 data channels), but they had yet to test data

transmission.   Also, since the service area was very rural they had several "blind spots" where radio communications did not exist. The big question for SWRTA was whether their existing radio system supported advanced technologies. One weakness that was identified was the lack of communication with the state DOT. SWRTA believed that mutual benefits could be realized if there were partnering on communication issues such as sharing towers.

Summary of AVL/MDT status:

- Inoperable CADS system with which to tie into the AVL/MDT technology.
- Inadequate funding with which to deploy system
- Questionable adequacy of communication system. SWRTA received conflicting advice as to whether data transmission could work with their low-frequency radio system. There was no independent verification that a low-frequency radio system would serve SWRTA needs.

3. ISSUES IN IMPLEMENTING ADVANCED TECHNOLOGY

From Section 2, several issues emerge regarding the implementation of advanced technology. These issues are the need for technology planning, preparing the staff for advanced technology, and preparing the organization for advanced technology. Section 3 describes the issues in detail, while Section 4 will discuss SWRTA's experience with these issues in light of an "idealized" implementation approach.

3.1 Technology Planning

There are two issues associated with technology planning. The first is assessing the technological needs of the organization. The second is developing an implementation strategy that fulfills the vision produced through the assessment.

3.1.1 Assessing Needs

Before acquiring advanced technology, an agency should perform a needs assessment. Obviously, advanced technology should produce some benefit. Such benefits can be tangible or intangible. Tangible benefits include improving cost efficiency, increasing productivity, or reducing the time to process paperwork. Intangible benefits include improving customer satisfaction, making the transit system more convenient, or improving information available to system management. An accounting of these benefits is crucial in deciding what technology is to be implemented. The key elements in an assessment include:

- What are the key challenges or problems facing the agency?
- Is there a technological answer to help solve or meeting such challenges?
- Which technology is applicable?
- How would that technology be beneficial?
- What has been the experience of other users of that technology in addressing similar challenges?

- If the technology were to be acquired, what staff would be directly and indirectly affected?

- What issues might the affected staff have with respect to the technology?

- What hardware, software, and personnel issues are related to the given technology?

- Is there sufficient support offered by vendors?

3.1.2 Implementation Planning

Before a given technology (or group of technologies) is acquired, the agency should develop a written implementation plan. The plan would include key steps and estimates of time and budget required at each step, as well as other resources required to successfully implement the plan. Possible obstacles should be identified along with solutions. These questions would be included in such a plan:

- Based on the experience of others, how long does it take to implement this technology once acquired?

- What are the steps, in sequence, for bringing this technology on-line?

- What are common problems that are encountered during implementation?

- What are common strategies for implementation? Which is suited for the organization?

- What are the experience and qualifications of the people leading/managing the implementation?

- What are the costs for implementation in terms of staff time and other resources?

- What kind of staff training is required to ensure successful implementation?

- What are the financial aspects of the implementation? Is the implementation cost (including contingencies) in line with available resources?

- What are provisions for testing the new system before the old system is disconnected?

- What are the indicators of a successful implementation?

3.2 Project Management

Of crucial concern is the project manager. This person must be the project champion and should be committed to making the system work. He or she must also possess, at least, a basic understanding of the technical aspects of the project.   More importantly, the project manager must also have good management and political skills to bring all necessary people and resources together.

In addition to the project manager, other key implementation players need to be on board. This includes making sure that the necessary people to be involved are identified and their roles explained. These questions are basic for the project manager and team:

- Who will be the project manager? Is this person technically skilled? If not, what resources will be made available to this person to address technical issues? Does the project manager have good management and political skills to marshal the implementation resources?

- Does the necessary staff have "buy in"? If not, what issues need to be resolved?

- What are the immediate and on-going technical skills needed to accomplish implementation and support this system once on line?

3.3 Employee Development

Employee development generally involves two factors. First, is the necessity to have a degree of employee acceptance or "buy-in" of a given ITS project. Second, the training of employees so they are able to competently utilize the given technology.

Depending on the role of a given employee with the new technology, the degree of "buy-in" or acceptance may be needed to ensure successful implementation and operation. In the case of SWRTA, this includes the dispatchers and schedulers who ultimately must make the CADS work. They need to be given a sense of ownership in the technology and believe that the success of the technology is tied to their success.

Employee training on the new technology is another development factor. Even an enthusiastic employee needs to know how to properly use the new system. One of the issues facing SWRTA was that the system operation occurred with little or no training. Training on the system is essential if the benefits of that system are to be realized.

3.4   Implementation Time

The time it takes to execute a new technology or system is almost invariably longer than expected. Sufficient time plus contingency for problems should be built into project implementation schedules. As part of implementation planning, it should be determined where likely problem areas may exist and, possibly, how much time may be needed to address them.

4. ANALYSIS OF IMPLEMENTATION ISSUES

The following section first presents industry experience in acquiring and implementing new technology, and second an idealized process for implementing advanced technology. This process is derived from industry experience as well as from selected industry literature. It is an attempt to provide a basis upon which to critique the SWRTA experience.

4.1 Generalized Industry Practice

This report is not intended to provide a comprehensive review of the transit industry's practice in implementing advanced technology. Rather, the goal is to find some pattern of practice that can be used as a basis to evaluate the SWRTA experience. This section summarizes various sources of this information.

4.1.1 Technology Plan for North Carolina Transit Systems

In June 1999, the Institute for Transportation Research and Planning (ITRE) at North Carolina State University documented the practices of transit systems in implementing advanced technology. Technology Plan for North Carolina Transit Systems, among other things, surveyed ten rural or small urban area transit systems on the problems and benefits associated with ITS. The result of this survey work was a list of priorities and strategies by which the North Carolina Department of Transportation (NCDOT) would promote and fund the use of such technology for transit systems in the state. Among the lessons learned by these ten systems were:

- Build support internally by justifying reasons for acquiring the technology
- Select a proven product
- Emphasize training (this includes basic computer training as well as training on the given technology itself)
- Anticipate delays by preparing contingency plans
- Seek professional expertise

- Select a systems integrator.[3]

4.1.2 TCRP 18 – A Handbook for Acquiring Demand-Response Transit Software[4]

In 1996, the Transportation Research Board (TRB) published A Handbook for Acquiring Demand-Response Transit Software authored by Roy Lave and others. As the title indicates, the publication is intended to guide transit systems through the purchase and implementation of CADS systems.   While the handbook focused on the "nuts and bolts" aspects of paratransit software, it did offer the following advice for systems seeking to automate:

- Maximize manual systems

- The organization may have to change procedures to accept a new computer system.

- Document in advance needs and expectations.

- Prepare staff for a new system by involving them in the development of system specifications.

- Largely base system decision on analysis.

- Buy a system with greater capacity than what is currently needed; anticipate growth.

- Identify peers who have implemented similar systems and talk to them.

- Don't purchase system until it is seen working elsewhere.

- If full CADS is acquired, evaluate adding complementary systems (e.g,, AVL, MDTs) and make one vendor responsible for the entire system.

- Beware that implementation takes time; be realistic about implementation schedules.

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[3] *Technology Plan for North Carolina Transit Systems* (June 1999), Institute for Transportation Research and Education, North Carolina State University, page 10.
[4] *TCRP 18 – A Handbook for Acquiring Demand-Response Transit Software*, Transportation Research Board, Washington DC, 1996.

4.1.3 How Effective Are Computer-assisted Scheduling and Dispatching Systems in Paratransit? Results from a Sample of Operators[5]

This paper presented the results of a survey of 14 paratransit systems. Many of the systems were classified as small or medium sized agencies with a median fleet size of 30.5 vehicles and 37 paratransit operators.   The purpose of the paper was to report on the experience that these systems had in implementing and using CADS systems.

Key issues raised in the paper that are relevant to SWRTA were:

- Reducing the workload of paratransit staff was the number one reason for acquiring a CADS. Replacing obsolete hardware and improving on-street efficiency were tied as the second-most picked reason for acquiring such a system.
- Over half the agencies took more than 5 months to implement a system.
- In terms of initially setting up a CADS, data entry was one of the top problem areas operators had in implementing a system.
- Most operators believed that a staff person dedicated as a system project manager was key to successful implementation.
- Adequate vendor-supplied training and support was seen as a typical deficiency during the system start-up phase.
- Forty percent of surveyed systems added either full time or part time personnel as a result of implementing a new CADS.

4.1.4 Ottumwa Transit Authority ITS Implementation[6]

As part of this "lessons learned" study, the TranSystems Team made a site visit to the Ottumwa, Iowa transit system. The Ottumwa Transit Authority (OTA) operates in a 10-county area, approximately 5,000 square miles with a

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[5] Anthony Pagano, Paul Metaxatos and Mark King, *How Effective Are Computer-assisted Scheduling and Dispatching Systems in Paratransit? Results from a Sample of Operators*, paper delivered at 80th Annual Meeting of the Transportation Research Board, Washington DC, January 2001.
[6] From site visit by TranSystems to Ottumwa system, June 13, 2001.

population of 140,000. OTA has a mixed fleet of 51 vehicles and only 11 of the vehicles are housed at the Ottumwa facility. The remaining vehicles stay with the drivers throughout the service area. About five years ago, OTA embarked on an ITS implementation. The interest in ITS grew out of a desire to be able to operate transit service more effectively in a very large, and very rural service area. OTA received a $600,000 grant for a demonstration project. According to OTA's manager, the project has been the most difficult endeavor she has ever been involved with.

The ITS implementation consisted of:

- Communications and automated vehicle location (AVL) system
- Computer aided Dispatch (CAD)
- Geographic Information System (GIS)
- Mobile Data Terminals (MDT)

Reasons for moving toward ITS:

- Optimize routes
- Monitor drivers
- Evaluate opportunities for coordination
- Better communicate with vehicles
- Facilitate OTA's billing process

Key experiences:

- Pre-project planning is important
- Many options available for systems; choices complicated to evaluate
- Strong communications background for system.
- Important to have good project manager and access to peers and other knowledgeable sources.

4.1.5 Cape Cod Advanced Public Transportation System[7]

Cape Cod Advanced Public Transportation System (CC—APTS) is an example
of a well thought-out implementation of advanced technology. The CC—APTS
was intended to address several issues facing the Cape Cod Regional Transit
Authority (CCRTA).   These issues included access to jobs, integration of
transportation modes, traffic congestion issues, and air pollution from
surrounding regions. These issues caused CCRTA to seek out ITS as a way to
promote greater efficiency through coordination of services, provide improved
customer information, promote safety and security, and to attain a higher level of
fixed route service.

CCRTA, in pursuing the implementation of its CC—APTS, brought together a
number of organizations through a strategic partnership. These included local,
state and federal entities as well as the Cape Cod Chamber of Commerce and
the Cape Cod Economic Development Council. The agency also sought help
from local colleges.

Phase I implementation (accomplished over a three year period) involved
development of GIS capabilities including hardware acquisition and design and
testing for data communication systems and AVL. Also included in this initial
phase was an upgrade to CCRTA's paratransit scheduling software. Phase II
(planned for 2000-2001) includes, among other things, acquisition of AVL and
MDTs, as well as the completion of the data communication system. Phase III
(planned for 2001-2003) looks at additional advanced systems including
electronic payment systems.

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[7] Based on a presentation made by Dennis Walsh at the 14th National TRB Rural Public &
Intercity Bus Transportation Conference, Lake Tahoe, Nevada, November 13, 2000.

4.1.6 CTAA[8]

At the Community Transportation Association of America's (CTAA) annual meeting, a panel discussion on problems with implementing automated scheduling was held. One presentation was made regarding the experience of Hill Country Transit District (HCTD) in central Texas.

HCTD was asked to take over the operation of a small urban transit system operated by one of the local cities. The City had purchased a CADS system and had already scheduled installation and training. The installation and training was to take place about two weeks following the assumption of the transit system by HCTD.

The following problems were experienced by HCTD:

- Equipment and software installation took longer than expected, shortening the time available for training.
- The Mobile Data Terminals (MDTs) interfered with the communication systems of local radio operators, requiring HCTD to limit the use of the terminals.
- Scheduling system parameters were not realistic; the parameter inputs were made without involvement of the dispatch staff.
- Various software glitches were experienced, including those that caused the system to "go down" as well as inexplicable rescheduling of booked trips.

HCTD had these basic recommendations regarding CADS implementation:

- Establish the need for a CADS. Justify the reasons and research the decision thoroughly.
- Bring in, as necessary, expertise that is not biased to a particular system.

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[8] From presentation made by Glenda Moseley, Hill Country Transit District at the Community Transportation Association of America (CTAA) 2001 Expo in Salt Lake City, Utah, May 2001.

- Make sure the staff is knowledgeable about the system and is prepared to implement it.

- Thoroughly examine the technical requirements of the given system and make sure the system is adaptable to the business needs of the transit organization.

4.1.7 Building Professional Capacity in ITS--An Assessment of ITS Training and Education Needs: The Transit Perspective[9]

This document was produced as part of a larger effort by the US Department of Transportation entitled "Building Professional Capacity in Intelligent Transportation Systems: Documentation and Analysis of Training and Education Needs in Support of ITS Deployment."   This document reported on a survey of ITS training needs of the transit industry. The survey consisted of personal interviews conducted by the Volpe National Transportation Systems Center. The survey reported on needed skills, types of training delivery methods, as well as a policy discussion involving ITS educational needs.

Of note for the "lessons learned" work are the top skills identified as educational needs in the deployment of ITS technologies. In part, they are:

1. *Understanding technology options* – how to make the right choice with a broad basis of organization participation.
2. *Cost/Benefit Analysis* – how to weigh the benefits of a given system versus its costs.
3. *Contract Management skills*— recognizes that most agencies do not have, in-house, the requisite skills to manage highly technical procurements.
4. *Financing* – making sure that all financial pieces are in place. The survey noted that grants drive projects. Typically, operating and maintenance are costs not included in grants. Agencies need to anticipate those excluded costs.

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[9]The Volpe National Transportation Systems Center, US Department of Transportation, April, 1999.

5. *Developing of a business plan* – recognized that ITS deployments were frequently "piecemeal" and that there was a need to develop an overall business plan in such deployments.

4.1.8 FHWA's Final Rule and FTA's Policy for Applying the National ITS Architecture at the Regional Level[10]

This pamphlet was produced to provide an overview of the Final Rule/Policy regarding the National ITS Architecture. On January 8, 2001, the U.S. Department of Transportation published FHWA's Final Rule on the National ITS Architecture. At the same time, the FTA's version of the rule ("policy") was also published. The Rule/Policy generally requires the development of a regional ITS architecture prior to the implementation of ITS projects. It also requires that all ITS projects be developed using systems engineering. A systems engineering approach, as defined by the Rule/Policy thoroughly considers all aspects of a project's life cycle including "…planning, design, procurement, deployment, operations, maintenance, expansion, and retirement of the system and subsystems."[11] The systems engineering requirement is flexible in scope and depth depending upon the complexity of the given project. In summary, a systems engineering analysis needs to include the following elements:

- Indicate the project's relationship to the regional ITS architecture.
- The roles and responsibilities of project stakeholders
- Requirements definition
- Analysis of Alternatives
- Procurement Options
- Identify ITS standards
- Identify needed procedures and resources.

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[10] *FHWA's Final Rule and FTA's Policy for Applying the National ITS Architecture at the Regional Level*, U.S. Department of Transportation, 2001.
[11] *FHWA's Final Rule and FTA's Policy for Applying the National ITS Architecture at the Regional Level*, U.S. Department of Transportation, 2001, page 5.

4.2 Ideal Process

Table 1 describes the ideal process. Figure 5 summarizes this process. How this process ties in with the Final Rule/Policy of the National ITS Architecture (discussed in 4.1.9) is discussed later.

Table 1: Idealized Technology Implementation Process

Step/Item	Description
Identify Current/Near Term Problems	Involves specific issues facing agency such as: • Simplify record keeping • Increase service productivity • "Where's my bus" • Simplify reporting
Identify Future Vision	Future of agency. Such as: • Use flexroutes • Expand services • Internet based services (e.g., reservations, information, fare purchases)
Technological Assessment	Compare needs (current and future) with technological solutions (both in use and potential). Identify gaps in technology. Are any of the technology gaps a project "killer"?
Technology Plan	
Identify Needed Technology	Determine application and hardware needs based on the technological assessment.
Technology Strategy and Goals	Determine approach to acquiring technology. Establish performance goals/expectations. Define "success."
Institutional Issues	Determine how business aspects of the organization may be affected by the new system. Can the technology system adapt to current business practices? Will business practices need to be reconfigured to maximize the benefits of the new technology? Is there Institution-wide "buy-in" with the project? If not, are there budgetary, administrative or maintenance issues?

table continued

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Step/Item	Description
Organizational Players	These questions should be asked of the people directly or indirectly involved in the technology implementation and operation: • To what extent should people in key functional areas of the organization be involved in the design, planning, implementation and operation of the given system? • Do those people have the needed technological background to support the planning, implementation and operation? • Is there someone who has the skills to be the project manager?
Budget and Financing	An accurate budget forecast along with identified funding are crucial elements to make sure the project can be accomplished with the resources needed for a successful outcome.
Timing/Phasing	• How much time is required for each step in the process? • What are the critical elements that must come together for the timeline to work? • What factors could interfere with those critical elements? • What contingencies are available in the event the deadlines for those elements are missed? How would that affect the over all timeline?

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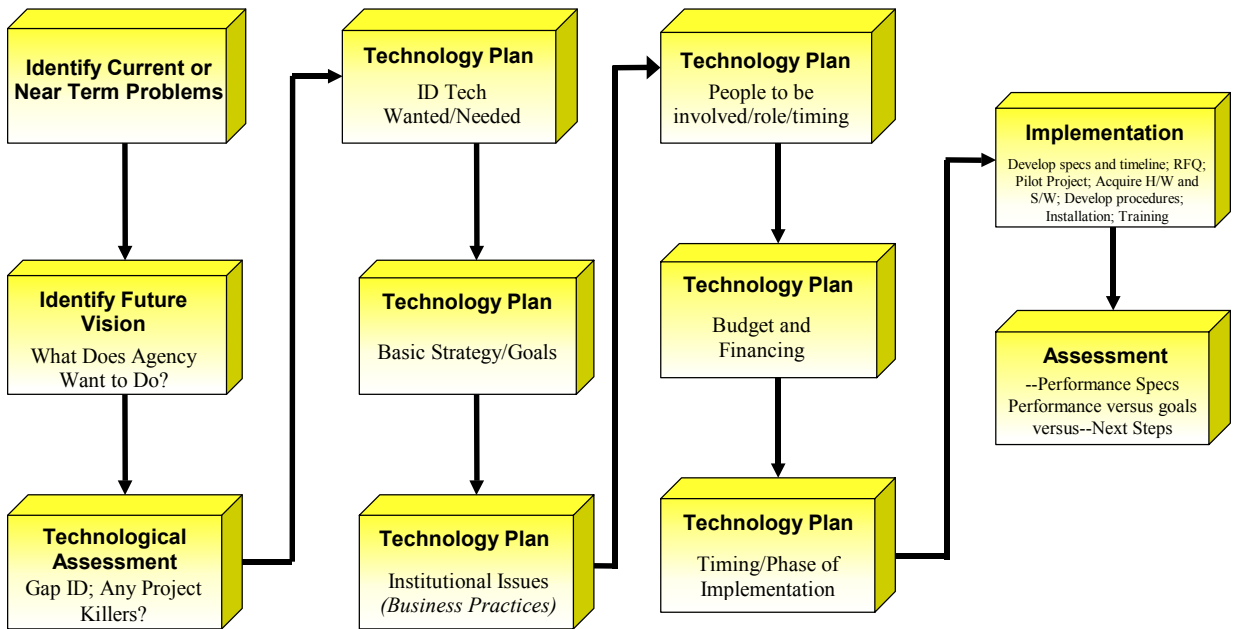
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Step/Item	Description
Implementation	- Develop Detailed System Specifications - Develop Detailed Project Time Line and Milestones - Establish Vendor Selection Committee - Develop Vendor RFQ - Develop Selection Committee Vendor Rating System - Send Out Vendor RFQ and Select Vendor - Select Location for Pilot Project - Acquire Pilot Hardware and Software from Selected Vendor - Develop Pilot Implementation Team - Develop Software/Hardware Upgrade Policy - Develop System Routine Maintenance Program - Review Pilot System Feedback - Review Pilot System's Meeting of Project Objectives, Goals and Budget - Modify Pilot Implementation Plan and Implement Recommendations - Re-evaluate Pilot Project Metrics with Feedback Implemented - Repeat Testing on Pilot Project as Necessary - Modify Project Timeline if Necessary - Lock Down System -- No More Changes - Develop Procedures for System Upgrades and Enhancement - Document System Training Procedures - Train Administrative, Operation, and Maintenance Staffs - Begin Full System Rollout - Monitor Full System Against Baseline Metrics - Implement Incremental Upgrades Consistent with Upgrade Policies - Measure Performance Against Baseline Metrics with Upgrade In Place
Assessment of Results	- Review results for impact on current or near term problems. - Review results versus Technological Assessment

Figure 5: Idealized Implementation Process

Identify Current or Near Term Problems

Technology Plan
ID Tech Wanted/Needed

Technology Plan
People to be involved/role/timing

Implementation
Develop specs and timeline; RFQ;
Pilot Project; Acquire H/W and
S/W; Develop procedures;
Installation; Training

Identify Future Vision
What Does Agency Want to Do?

Technology Plan
Basic Strategy/Goals

Technology Plan
Budget and Financing

Assessment
--Performance Specs
Performance versus goals
versus--Next Steps

Technological Assessment
Gap ID; Any Project Killers?

Technology Plan
Institutional Issues
(Business Practices)

Technology Plan
Timing/Phase of Implementation

4.2.1 Application of the Ideal Process Under the Final Rule/Policy

The ideal process previously illustrated in Figure 5 generally conforms to the systems engineering requirement of the Final Rule/Policy.   While SWRTA implementation efforts predated the Final Rule/Policy, the use of the ideal process is enhanced by its compliance with FTA/FHWA directives.

Table 2, after the next page, compares required systems engineering elements with the ideal process.

As seen in the table, the ideal process ties in well with virtually all of the systems engineering elements. The technology planning step addresses many of these engineering elements.   Addressing the regional ITS architecture relationship, while not contained in the technology planning step, can be satisfied in one or more of the other process steps.   It can be addressed as part of problem identification, future vision, and/or the technological assessment steps of the ideal process.

4.3 Critique

Table 3, at the end of this section, summarizes the critique of SWRTA process for implementing advanced technology.   The table compares the "idealized" process with that followed by SWRTA. Comments are included with some of the comparisons.

4.4 Critique Summary

The critique reveals the following:

- SWRTA took piecemeal approach to implementing advanced technology.
- No detailed needs assessment.
- No assessment of the impacts of implementing advanced technology.
- Lack of experienced project management.

- Not enough time to properly implement the system.

- Lack of financial planning.

- No contingency planning.

- Lack of proper training.

- Not enough staff "buy-in."

Table 2: Comparing the Ideal Process with the National ITS Architecture Final Rule/Policy

Systems Engineering Element	Ideal Implementation Process Step					
	Identify Problems	*Identify Future Vision*	*Technological Assessment*	*Technology Plan*	*Implementation*	*Assess Results*
Regional ITS Architecture Relationship	✓	✓	✓			
Stakeholders Roles and Responsibilities				✓		
Requirements Definitions			✓	✓		
Analysis of Alternatives			✓	✓		
Procurement Options				✓	✓	
Identify ITS Standards				✓	✓	
Identify needed procedures and resources				✓	✓	✓

Table 3: Critique of SWRTA Implementation Process

Ideal Process	SWRTA Process	Comments
Identify Current Problems	• Initially to promote inter-agency coordination. • Later to make operation of flexroutes more efficient as well as improve driver accountability. • Prepare for Y2K • Simplify billing process	• SCDOT made available statewide grant to promote interagency coordination. Produced the decision to acquire the GIS. • The GIS enabled SWRTA to identify opportunities for flexroutes. Later, problems with maximizing use of flexroutes prompts search for CADS.
Identify Future Vision	"Bring SWRTA into 21st Century"	• Vision more philosophical than operational.
Technological Assessment	Decision to acquire scheduling software when dispatchers not assigning people to flexroutes. Current software deemed not Y2K complaint.	• Assessment appears to have been informal and reactionary to immediate issues.

table /continued

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Ideal Process	SWRTA Process	Comments
Development Technology Plan		
Identify Needed Technology	• CADS selected. • MDTs and AVLs seen as successor technologies	Reasons for selecting not entirely clear. Perhaps came about as a result of travel to Putnam County, FL and exposure to different technologies via conferences and trade shows pointed to these solutions. Process did not involve the broad involvement of SWRTA staff.
Technology Strategy and Goals	Incremental approach where problem(s) identified along with a technical solution.	No apparent strategy.
Institutional Issues	No discernible assessment as to how business or procedures will change.	Key assumption or misconception was that the CADS software could produce reports that would support Medicaid billings. They did not.
Organizational Players	Changes in leadership and people participating in project.	Designated project manager was a novice in both technology and transportation.
Budget and Financing	Process for budgeting and financing to the extent required of grants process.	There were no plans for maintenance and operation of the system. Further, there was no anticipation for possible up-grades and continual staff training.
Timing/Phasing	Accelerated by Y2K.	Perhaps gravest oversight in the process was the implementation timeframe.

table/ continued

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Ideal Process	SWRTA Process	Comments
Implementation of Plan		
Develop Specifications	Minimum standards were used for software. Did not allow for system growth.	The computer system crashed about four to eight weeks before it was to go live. This was a serious development that impacted SWRTA implementation efforts.
Acquire hardware/software	Used System Integrator; researched various software at trade shows.	The level of research and experience with this type of technology did not anticipate the problems encountered during implementation.
Install system	Used system integrator.	Some disconnect between CADS vendor, SWRTA, and system integrator. CADS vendor apparently unaware of problems until too late.
Train personnel	Two one-week sessions. The second session canceled because of hardware problems. The second session not held before the system went "live."	Lack of timely training due to system crashing.
Test System	Not really done; actual operation was the test.	
Assessment of Results	The CADS system was never fully operational. Therefore, testing was not done.	

5. LESSONS AND IMPLICATIONS

This section highlights the lessons learned from SWRTA's experience in attempting to implement advanced technology.

5.1   Key Lessons

There are four key lessons from the SWRTA experience. They relate to the value of:

1. Technology Planning
2. Project Management
3. Employee Development
4. Implementation Time

Technology Planning

As discussed in Section 3, technology planning has two parts: assessment of needs and implementation planning.   In this regard SWRTA's experience included:

- There was no detailed assessment as to what the agency needed in the way of advanced technology. The agency believed it would be better off with the GIS, CADS, AVL and MDTs. But it does not seem clear to how or why it would be improved. The implementation of GIS was a positive move that happened to work out for the agency. However, SWRTA might have been better off looking into an improved accounting system to address Y2K and the Medicaid billing issues.

- The level of implementation planning, at best, was minimal. Without a clear picture as to where the agency wanted to go with technology, the ability to execute the implementation of a broad range of technology was lacking. Project level implementation planning with the CADS appears to have been also done at an elementary level. Issues relating to data entry,

hardware specifications, the ability of the software to do what was needed, the availability of training personnel all give the appearance of having been implemented episodically.

Project Management

The key aspect of project management is to insure that the right people are in place to carry out the project. At a minimum, the qualifications of personnel need to be assessed along with their availability to see the project through. While SWRTA attempted to assemble the right team (they used a systems integrator and the hiring of an information technology person, for example), the team failed to produce the desired results. It is not clear why that happened; the reasons may include lack of appropriate qualifications and/or the lack of strong project leadership. Also, the turnover in various staff within the agency may have also contributed to inconsistent project leadership.

Given the turnover in staff and the change in personnel assignments during the latter half of 1999 and 2000, there would seem to have been a lack of ownership and accountability for the project. Thus, the need for dedicated and strong project management would seem to be a clear lesson that was learned at considerable cost.

Employee Development

One of the issues in SWRTA efforts to implement the CADS was employee training and acceptance of the system. While the strong support of employees appears not to have been a major factor in the CADS, problems, the lack of good training was. Training was delayed due to vendor scheduling and system hardware problems. Quality of training, as supplied by the vendor, was seen by SWRTA to be inconsistent. This, together with employee turnover, made the situation with the CADS much more difficult to manage. These difficulties undoubtedly affected the acceptance of the system by the employees.

Implementation Time

Probably the biggest lesson here is the value of time. In virtually all surveyed literature, the implementation of advanced technology always takes more time that one would think. That would clearly be the case with SWRTA. An extra six months (with no Y2K pressure) might have made a difference. In addition, the agency had a fairly full agenda in the Fall and Winter of 1999. SWRTA commitment to taking on additional counties evidently exacerbated an already heavy workload. Despite the diligence of all involved, the staff just was not able to keep up with the number of changes going on at once.

5.2   Implications for the Federal Transit Administration

If ITS is to become a growing part of the rural transit industry, the SWRTA experience points to some possible issues for the Federal Transit Administration. Arguably, some of the barriers to implementing ITS in the industry are related to cost and perceived benefits, as well as the mechanics of making the systems work. While it is not clear how representative the experience of SWRTA is throughout the industry, Santee-Wateree's experience may give pause to agencies wishing to acquire advanced technologies. If the Santee-Wateree experience proves typical of the "horror" stories associated with new technological ventures, the adoption of advanced technology may slow, with the consequence of delaying the accrual of potential benefits to the transit industry.

The advent of the Final Rule/Policy for the National ITS Architecture with the systems engineering requirement may help to avoid future problems experienced by SWRTA.

The following are suggested issues that the Federal Transit Administration (FTA) may wish to consider. They are posed as questions.

- How should the FTA support advanced planning per the Final Rule/Policy? While the experience of SWRTA pre-dates the Final

Rule/Policy, for the Policy to be truly effective it needs to reach the intended audience. Is enough technical and planning support given to rural areas? Are rural areas being adequately included in statewide ITS planning?

- Is the level of industry training focused on technology planning appropriate for rural areas? How well does the current ITS information and training infrastructure, including systems engineering training, reach the rural transit audience?

- Should FTA require that portions of ITS grants include a set-aside for training and other employee development?

5.3   Next Steps

There are several questions that the FTA may wish to address:

- Determine extent of issue with problems with CADS software and other advanced technology. How common are SWRTA's problems? Are they widespread enough to warrant industry-level action?

- Examine role of FTA's Rural Transit Assistance Program (RTAP) and State DOTs in education with respect to technology planning.

- Consider the appropriate role of trade associations in fostering good technology planning. Would there be a conflict of interest associated with their involvement?

- Document best practices associated with technology planning and implementation.

5.4   Epilogue

Since the disconnection of the CADS system, the Federal Transit Administration (FTA) has undertaken an "implementation planning" effort to assist SWRTA. The purpose of the "implementation planning" work is to correct some of the issues addressed in this report.

Among the activities undertaken were:

- A technology assessment was completed in November 2001.
- SWRTA has formed a positive relation with South Carolina Department of Transportation (SCDOT) that is instituting a statewide ITS program.
- SWRTA employees have received basic computer training through a state-sponsored program.
- SWRTA hardware has been up-graded.
- By the summer of 2002, it is hoped that new scheduling software will be implemented.

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