ITS Transit Case Studies: Making a Case for Coordination of Community Transportation Services Using ITS

David Ripplinger
Associate Research Fellow

Del Peterson
Associate Research Fellow

Small Urban & Rural Transit Center
Upper Great Plains Transportation Institute
North Dakota State University

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Executive Summary

Advances in computers, telecommunications, and information system technologies have led to the development of a wide range of applications that can improve the efficiency and quality of service for all forms of transportation, including public transit. These developments provide additional tools to help manage the complexity that often arises when local transportation providers coordinate their services.

This study presents the experiences of three organizations as they planned, implemented, and operated intelligent system (ITS) to meet the mobility needs of the communities they serve through improved coordination. These agencies are the Suburban Mobility Authority for Regional Transportation (SMART) in Michigan; Reach Your Destination Easily (R.Y.D.E.) in Nebraska; and NDinfo.org in North Dakota. The objective is to provide parties considering or currently involved with the planning and operation of intelligent transportation systems with additional insight gained from knowledge of the unique experience of each of the three organizations. For each of these organizations, technical and institutional issues, requirements, benefits and costs, lessons learned and agreements among transportation providers and funding agencies are described fully in the report.

The Three Systems

SMART provides fixed-route and demand-response service to Wayne, Macomb, and Oakland Counties in southeast Michigan. It also works with and administers programs and locally generated funds for community transportation providers which are referred to as community partners. SMART currently employs a broad array of technologies to help it provide transportation to the communities it serves. However, the centerpiece of SMART's current intelligent transportation system related to coordination is its real-time demand-response system. This system allows its community partners, local social service agencies and other entities to schedule rides on either SMART's or its community partners' fleet. The system relies upon an information and computational hub, located at their Oakland Terminal, which may be accessed via the Internet. As the data processing for system occurs at the hub, a low-cost computer can be used by community partners and others to take advantage of the same functionality available to SMART itself.

R.Y.D.E. is a transportation broker located in Kearney, Neb., a city of nearly 30,000, and provides services to a multi-county region. Though only a little over five years old, R.Y.D.E. has seen tremendous growth in ridership, much of which would not have been possible in the absence of technology, primarily scheduling and dispatch software. As part of its adoption of new technology, R.Y.D.E. developed its own ITS architecture, a process that has provided numerous benefits to the agency and the community it serves. R.Y.D.E. has long-term plans for the implementation of additional technology including mobile data terminals

NDinfo.org is a novel statewide approach to address the challenges of mobility in North Dakota. The intent is for NDinfo.org to mature into an online hub of information on various social services, including transportation service, available to individuals throughout the state. One of the program's most promising features will allow for increased coordination of transportation services across North Dakota. Its transportation module currently consists of a searchable online database. It is intended to eventually provide users with the ability to schedule rides and purchase tickets for trips provided by more than one entity.

Measuring the Impacts of ITS on System Performance

The benefits from coordination to southeast Michigan resulting from the organizational structure of SMART have been estimated at approximately $2.7 million in 2002 dollars (1). This is the difference between the funding received by local transportation providers, $7 million, and the estimated cost of SMART delivering those same rides, $9.7 million. The latter value was found by multiplying the number of trips provided by SMART's community partners by the average SMART paratransit trip cost. It should be noted that much of this savings results from SMART's organization structure and not directly from ITS, though it would be difficult for SMART to provide the high quality of service to its clients without the use of advanced technology.

The annual financial benefits arising from R.Y.D.E's coordination efforts in Kearney, Neb., have been estimated to be $400,358 (1). This value was determined by multiplying the difference between pre-coordination and post-coordination per trip costs, $5.08, times the number of trips provided, 78,220. As R.Y.D.E. was quickly approaching the point at which traditional methods of scheduling and dispatch were no longer efficient, most, if not all of the $400,358 can be attributed to the introduction of advanced technologies and the processes used to manage them which allowed for further coordination to occur.

Given the infancy of NDinfo.org, it is difficult to quantify the impacts of the program. Presently, NDinfo.org's transportation component provides little functionality beyond its searchable database. Its proposed content and capabilities show great promise for increased coordination among transportation providers in North Dakota. However, a significant amount of work that will make this possible has yet to be completed. Even when it does provide the planned functionality, measuring its impacts will be difficult.

Recommendations for the Successful Implementation of ITS

Community transportation providers can learn a number of lessons from the experiences of SMART, R.Y.D.E., and NDinfo.org in designing and implementing ITS. While many of these lessons are specifically related to ITS and coordination others are more general in nature. These lessons are classified into three categories: understanding and educating the community; identifying, tailoring, and adopting the proper technology; and making the most of available resources.

With respect to understanding and educating the community, the three agencies learned to appreciate the importance of understanding the community transportation system, identifying actual needs, promoting adoption, and educating employees, riders and the community. To better frame the mobility challenges facing his community and how they could be addressed, the manager at R.Y.D.E took an introductory course in systems engineering. In North Dakota, a series of public forums were held to identify the actual transportation needs of its residents. Despite efforts to make it as beneficial to users as possible, SMART has had difficulty with the adoption of its integrated scheduling and dispatch system. Following the introduction of its scheduling and dispatch software, R.Y.D.E.'s drivers were educated about the software and the benefits it provided the organization, riders, and the community. That education helped the driver more fully appreciate the system.

Lessons related to identifying, tailoring, and adopting technology include the issues of developing an ITS architecture, staying focused on outcomes, user friendliness, centralization, scalability, and redundancy and backup. R.Y.D.E. developed and implemented its own ITS architecture which required it to work with other shareholders in the community, think about long-term functionality and the way information is shared between system parts. R.Y.D.E. also stayed focused on outcomes by thinking about the impacts of technology on riders and the community and not becoming enamored with technology itself. The success of NDinfo.org, the online database, is strongly dependant on its user friendliness. The issues of centralization, scalability, redundancy, and backup were important to SMART and its centralized computer scheduling and dispatch system.

The limited resources available to design, implement, and make use of technology in transportation systems present a challenge for all involved. There are high costs to being the first mover where technologies have not been tested and refined, as experienced by SMART which has been an innovator in ITS for over a decade. Attracting and retaining technologically adept managers who can take full advantage of limited funds and the technologies implemented, as was done by R.Y.D.E., is also important. Consultants are often necessary to ensure the successful design and deployment of technology, but they should not replace on-site understanding of the system. In Michigan, SMART learned first hand that there are financial benefits to adopting generic technology. It is also important to account for long-term viability, as NDinfo.org has done by providing information on a number of services, including those outside of transportation that would provide funding to sustain the service. Finally, agencies should be able to handle the day-to-day operation of the system. Occasional technical assistance will likely be necessary as in the case of NDinfo.org.

1. Improving Community Transportation

Delivering transportation services to a community is a difficult task. In many small urban and rural communities a single individual is responsible for managing all aspects of an agency from operations, human resources, and marketing, to finance. As a result, finding the time and resources to plan for and implement changes to the organization's service policy or to study the adoption of new technologies and management techniques is often quite difficult. The challenge is even more pronounced when the goal is for agencies to coordinate with one another to improve the efficiency of the entire community transportation system. Barriers to coordination may include concerns about regulatory requirements, perceived incompatibility of goals and needs, and uncertainty of the benefits that accrue to each agency are often noted.

Fortunately, a number of contemporaneous developments make the present an opportune time for transportation providers throughout the nation to revisit the issues of coordination, technology, and management techniques. Efforts at coordination among local transportation providers are receiving a greater emphasis and in many parts of the country additional resources have been made available. The price of technology targeted at the issues faced by small urban and rural transportation providers continues to fall. Finally, the management techniques and processes for making the most of available resources continue to be refined and, in their present form, may provide valuable alternatives in addressing the mobility needs of a community's residents.

Designing and implementing an intelligent transportation system at the regional, as opposed to agency, level provides a number of benefits. Many of the benefits and challenges of developing a regional intelligent transportation system are the same as those faced when agencies try to coordinate their services. Identifying these benefits and how the challenges can be addressed are two of the motivations for this report.

In this report, the experiences of three organizations are analyzed. These organizations include the Suburban Mobility Authority for Regional Transportation (SMART), Reach Your Destination Easily (R.Y.D.E.), and NDinfo.org. The analysis focuses on each entity's planning for, implementing, and operating Intelligent Transportation Systems (ITS) to meet the mobility needs of area residents through improved coordination.

The goal of this analysis is to provide transferable insights regarding the design and operation of ITS. First among these is the integral role ITS can play in assisting in coordination efforts. Technical and institutional issues, requirements, benefits and costs, lessons learned, and agreements among transportation providers and funding agencies will be addressed when applicable.

The report is divided into five sections. Section 2 provides an introduction to the issues of coordination, mobility management, and ITS. Case studies are presented in Section 3. Each organization's motivations, barriers to coordination, proposed ITS solutions and their effects are presented. Section 4 is comprised of the lessons learned from each of the three cases. A summary of the findings is presented in Section 5.

2. Coordination, Mobility Management, and ITS

For those unfamiliar with coordination, mobility management, and ITS, a brief review may be beneficial before proceeding to the case studies. Reframing the challenge of providing transportation to managing mobility often improves both the design and delivery of service. ITS provides both the tools and the framework for improving coordination among transportation providers. In addition, the development and deployment of an ITS architecture, a tool described later in the section, requires that everyone in the region impacted by the implementation and operation of an intelligent transportation system be involved to some degree during its design.

2.1 Mobility Management

Each of the three agencies that are the subject of this report have been innovators in mobility management, a management approach that is different than that currently used by most community transportation agencies. The unique aspects of mobility management elaborated on by Birnie are the basis for this section (2). *TCRP Report 21* presents strategies for local agencies that supply transportation to behave as mobility managers (3).

The mobility management approach has impacts on service design and management as well as the relationships and interactions between the many transportation providers in a particular community. Mobility management relies on coordinated service to improve customer service and increase system-wide efficiency.

Mobility management differs from traditional approaches as it focuses on individuals. Transportation solutions are tailored to meet these individual needs. As a result, few, if any, communities will be best served with a single, uniform transportation alternative. Instead, a number of diverse services will likely need to be provided.

Similarly, though the many services needed by a community's residents could be delivered by a single provider that will usually not be the case. In fact, agencies that provide transportation will serve as brokers guiding riders to the most efficient and effective service in the community that meets their needs. This will require that agencies act not only as service providers but as mobility advocates.

The ability to succeed using the mobility management approach is enhanced with ITS. This is because of the increased complexity introduced when managing a system focused on the individual. ITS provides the tools and procedures that allow for the collection, storage, and use of the large amounts of information needed to properly manage a community's mobility.

The degree of mobility management can vary greatly. At a minimum, mobility management involves a change in the approach of designing and delivering service at the agency level. At the other end of the spectrum, mobility management includes becoming involved in the development and management of all aspects of the transportation infrastructure to improve the efficiency of the system.

2.2 Coordination

Providers of community transportation are limited by financial and legal constraints. One of the greatest opportunities for improving the service delivered by any one agency is to work with others in the community. Despite the potential benefits, few efforts at coordination have been successful. However, there are signs that things may be changing.

Coordination has been defined as the sharing of transportation resources, responsibilities, and activities of various agencies with each other for the overall benefit of their community. This coordination can and has taken a number of forms based on the needs of the particular community. The primary idea is that by working together, agencies that provide transportation services in an area can increase system-wide efficiency.

The benefits associated with coordinating transportation in a community have long been acknowledged. However, related costs, financial and otherwise, have often inhibited local coordination efforts. Recent developments have, however, brought coordination to the forefront of important issues facing transportation providers.

Executive Order 13330, signed by President Bush in February 2004, established the Interagency Transportation Coordinating Council on Access and Mobility which is intended to increase coordination among 62 federal programs that provide funding for human service transportation. It complements the United We Ride program, a federal interagency program led by the Federal Transit Administration and aimed at addressing these same coordination issues. United We Ride efforts include providing a framework and technical assistance designed to aid local efforts to address coordination, state grants to fund innovative coordination programs, and awards to recognize leaders in the application of coordination principles.

The benefits to coordinating efforts among agencies that deliver transportation services in a community include increased access to funds, a more cost-effective use of resources, improved efficiency, and centralized management of resources. Barriers to coordination include concerns about remaining in compliance with regulations, perceived incompatibility of goals and needs, and uncertainty of the benefits and costs that accrue to each agency.

2.3 ITS in Public Transportation Systems

Intelligent transportation systems (ITS) refer to the technology, data, people, and processes used to provide mobility, enhance productivity, and increase safety. In the context of public transportation, ITS is synonymous with advanced public transportation systems (APTS), though the acronym ITS is more prevalent and will be used in this report. The term ITS is also used to describe the technologies that are used to improve the delivery and quality of service of transportation. For example, computer-aided dispatch and scheduling software is often referred to as ITS, though according to another definition it would be thought of as being a part of it. In this report, the definitions will be used interchangeably and the precise meaning will be able to be drawn from the context.

A number of ITS technologies may help a community better meet its mobility needs. More advanced ITS technologies in small urban and rural areas include computer-aided dispatch and scheduling software, automated billing and reporting software, smartcard technology, mobile data terminal (MDT) technology, and automatic vehicle location technology. Less advanced ITS technologies include customized spreadsheets, cb radios, and Internet websites. Determining what technologies to use and how to integrate them into a single system is the difficult task addressed by this report.

An important, though technical, concept that aids in the understanding ITS is an ITS architecture. An ITS architecture is a framework that describes agreements among agencies, defines the functions of technologies they use and how the technologies interact, and identifies the data that will be shared between ITS subsystems. R.Y.D.E., one of the agencies that is the subject of the case studies that follow, designed, implemented and maintains a regional ITS architecture.

As of April 2005, a regional architecture is required to be in place whenever funds from the federal Highway Trust Fund or Mass Transit Account are used to fund ITS projects. In the future, most transportation agencies that adopt ITS technologies will not have to go through the process of developing an ITS architecture from scratch, but will instead rely upon the work of their predecessors. However, in some cases, the existing architecture may need to be modified to accommodate the plans of transit agencies, particularly those who plan on more elaborate or cutting-edge ITS projects that were not considered when the architecture was first designed.

3. Case by Case

The mobility needs and the best methods of meeting them vary greatly by community. Given the absence of a uniform technique of delivering community transportation, knowledge of the actions taken by individuals and agencies that have addressed similar challenges may be beneficial. This is especially true when novel techniques or technologies, such as ITS, are deployed or when difficult issues such as coordination of transportation service are being addressed. In this section, the experiences of the Suburban Mobility Authority for Regional Transportation (SMART), Reach Your Destination Easily (R.Y.D.E.), and NDinfo.org in using ITS to address challenges to coordination in the communities they serve are presented.

Each of the three cases that make up this section include general background information on the organization involved, the events that spurred the need for ITS including those related to coordination, the experiences in development and implementation, and the effects that followed. Technical and institutional issues, requirements, benefits and costs, lessons learned and agreements among transportation providers and funding agencies are presented where relevant.

3.1 SMART

SMART does more than simply provide fixed-route and demand-response service to southeast Michigan, it is a mobility manager for the residents of the communities that it serves. This mindset, which permeates all aspects of SMART's planning and operation efforts, is readily evident in the service it provides and the relationship it has with other providers of community transportation in the three-county area that make up the Detroit metropolitan area. To be a successful mobility manager, SMART has had to become innovator in both coordination and ITS.

SMART provides a variety of public transportation services alone and in conjunction with community partners to over seventy communities in Macomb, Oakland, and Wayne Counties in southeast Michigan. These counties as well as the locations of three of SMART's Community Transit Partners, the cities of Livonia and Troy and Shelby Township, whose experiences with SMART are discussed later in this section are presented in Figure 1. The three counties are home to more than 2.3 million people and cover more than 1,585 square miles.

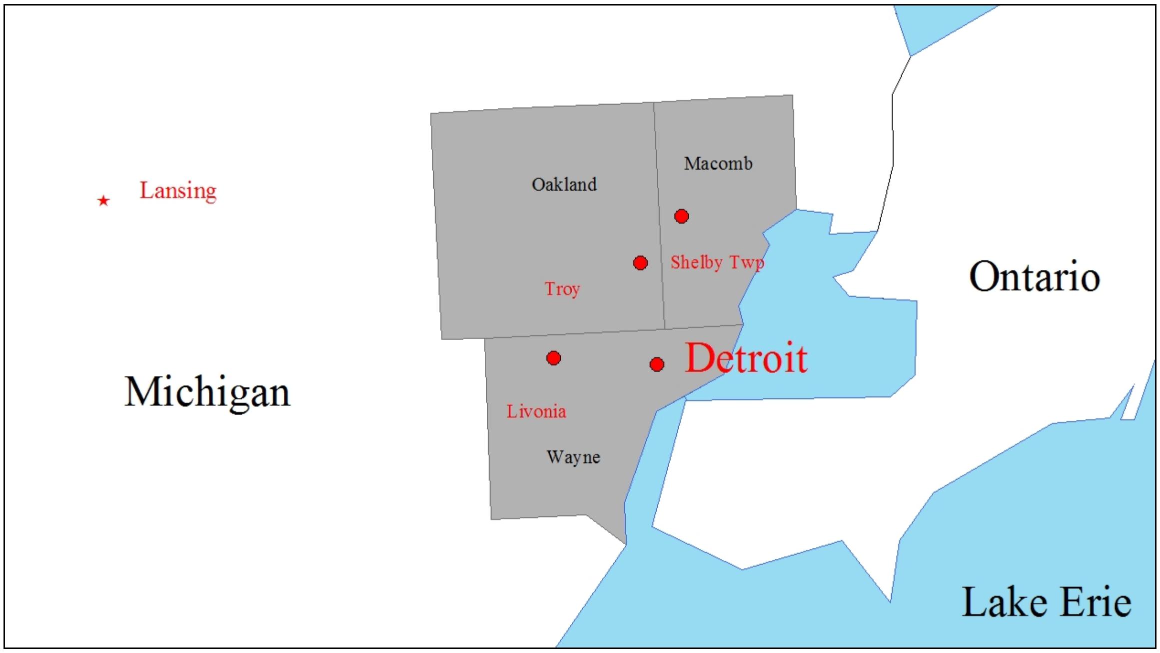

Figure 1. Southeast Michigan

The mobility needs of the more than 70 communities served by SMART are as diverse as the communities themselves. An intimate understanding of the demands for mobility helps SMART and its community partners determine what combinations of services help them to supply the optimal overall service.

There still remain a number of traditional commuters, those who travel from suburban residences to jobs in the city center. Though these rides used to comprise nearly all trips provided by SMART and its predecessor systems, today they make up only a part of SMART's service. Today, reverse access commutes which provide transportation from homes in Detroit to jobs in the suburbs have also increased in importance as have welfare-to-work related trips. There are also significant numbers of riders who demand intercity trips between suburban communities.

SMART's community partners often focus on providing transportation solutions to the elderly and the disabled. Other community transportation providers supply transportation service to members of the general public. In addition to rides taken by seniors to medical appointments or to visit the local senior center, trips to retail or recreational locations are also common.

3.1.1 SMART Beginnings

SMART has been an innovator in coordination and ITS for over a decade. It was one of the first transportation organizations in the country to adopt the principals of mobility management, a management approach that affects every aspect of the way SMART provides transportation services to the residents of southeast Michigan. Advanced technology is necessary to supply the tailored service demanded by a system as large and complex as that served by SMART. To gain a better understanding of SMART's motivation for becoming a mobility manager, promoting coordination, and becoming an innovator in ITS, a review of it history is helpful.

SMART's predecessor, the Southeast Michigan Transportation Authority, or SEMTA, was established in 1967. It was assembled from existing transportation providers, including both commercial bus and rail service, that were suffering financially following the emergence of suburbs after World War II. SEMTA, operated under the authority of Wayne, Macomb, and Oakland Counties and the City of Detroit, was intended to continue to provide the metropolitan area with the same mass transit service as the firms it replaced. At the time of its creation SEMTA had no dedicated local funding source and relied on farebox revenue in addition to state and federal funding.

As a traditional mass transit service provider, SEMTA's purpose was to efficiently transport riders to and from their suburban homes and their central city workplaces. The only problem was that these jobs had been leaving Detroit since the end of World War II, increasingly so in the 1970's and 1980's. Without the required demand for its service, SEMTA, which was renamed SMART in 1989, suffered financially just as its predecessors did. With regular budget deficits and debts of $19.6 million in fiscal year 1994-1995, the continued existence of SMART became questionable.

3.1.2 Financing, Organizational Structure & the 1995 Millage

In early 1995, faced with dissolution due to increasing budget deficits, SMART went to the taxpayers of Macomb, Oakland, and Wayne counties to seek the approval of a transit millage that would ensure its survival. The 1995 measure asked for 1/3 of a mill property tax levy. This was estimated to generate $18 million dollars for the first three years it was in force.

For the measure to pass, local support was necessary from Detroit's suburbs where most of the metropolitan area's residents and wealth were now located. However, it seemed unlikely that residents of these communities would provide additional funds for the services that SMART had been providing. There was little demand for public transportation service to the inner city and the demand that did exist was spread unevenly across the suburbs. For the proposed tax increase to pass, service that met the needs of each community had to be provided and SMART devised an innovative way of doing just that. The answer was the Community Partnership Program, a unique coordination effort that has defined community transportation in southeast Michigan ever since.

Though additional efforts at coordination have been introduced, the foundation for the Community Partnership Program has remained the same since 1995. Under the program, each community that participates by contributing local property tax to the system would continue to receive SMART services as well as funds to provide locally tailored transportation. Those communities that failed to pass the millage would no longer receive SMART service.

Though some communities opted out of SMART, especially those on the periphery of metropolitan area, the initiative was quite successful. It not only provided the incentive for suburban communities to vote for its passage and provide the local funds that saved SMART, it provided a change in the way SMART looked at delivering transportation solutions to the communities it served.

In the decade since its passage only one community has opted out of SMART. The tax was renewed in 1998 and 2002, when the tax was increased to .6 mills. The local tax will be referred to the voters again in 2006.

3.1.3 Funding Mechanisms

SMART administers millions of dollars of funding each year to local transportation providers. In addition to the funds generated by local property tax, federal funds have supplied about 15 percent of SMART's operating and capital funds, state funds about 30 percent, and fare revenue less then 10 percent of operating funds in recent years. Two programs, the Community Credit and Municipal Credit Programs, deliver financial assistance to SMART's community partners and provide an incentive for local agencies to coordinate with SMART.

SMART provides funds generated by the local property tax to its community partners via The Community Credit Program. The program acts as a rebate on the monies spent by local transportation providers. Community Credit funds may be spent on either operating or capital costs.

As a condition of acceptance of Community Credit funds, local agencies must make efforts to coordinate with other transportation providers. This includes completing a Community Credit Coordination Plan. Each Coordination Plan identifies the transportation needs in a community and how existing services can meet these needs. It must also show how its efforts avoid duplication of service and how SMART resources can play a role in the proposed service, to make the most out of existing system capabilities.

SMART distributes funds to local transportation agencies though the Municipal Credit Program. Each year, the Michigan Department of Transportation (MDOT) allocates $3 million through a state reimbursement program. These funds are distributed to communities using a formula based on the population and the availability of fixed-route service. These funds may only be used to support the operating costs of transit services.

3.1.4 SMART's Service Design

In its role as a mobility manager for southeast Michigan, SMART delivers a number of transportation service alternatives to meet the many needs of transit users in the communities it serves. It also works closely with local agencies that provide transportation, which are referred to as Community Transit partners. SMART delivers traditional fixed-route service and demand-response service, which is referred to as Connector Service. To ensure compliance with the Americans with Disabilities Act, SMART also provides comparable paratransit service to eligible individuals. These diverse services provided by a SMART and its Community Transit partners are an excellent example of the mobility management concept defined by Birnie (2).

Note that the three services, fixed-route, Connector, and Community Transit service, do not operate exclusively of one another. On the contrary, coordination between each of the services was part of the original service design developed in 1995. Since that time, proposed Community Transit services have been required to complete an annual Coordination Plan for SMART to ensure that all steps have and will be taken to integrate new service into the larger system.

Service Name		Service Description
Fixed-Route Service		traditional line-haul service
ADA Service		ADA compliant paratransit service
Connector Service		
	Job Express	service from fixed-route stop to employer located in a Job Express Zone
	Flexible Route Service	curb-to-curb service, where fixed route is inaccessible
	Advanced Reservation	curb-to-curb service, trips scheduled at least two to six days prior depending on trip purpose
	Dial-A-Ride	same day demand-response service
Community Transit		locally designed and operated community transportation alternative, tailored to meet specific needs of each community

Table 1. SMART Transportation Services

SMART delivers traditional fixed-route, also referred to as line-haul, service to all of Macomb and portions of Oakland and Wayne Counties. Roughly 80 percent, more than $70 million, of SMART's operating expenses were attributed to its fixed-route operations during 2003. During periods of maximum service, more than 200 buses are on the road. SMART currently maintains 53 routes providing relatively uniform coverage throughout the southeastern Michigan communities it serves.

SMART uses the term Connector Service to refer to all other transportation services it operates directly. Connector Service consists of four main types: Job Express, Advanced Reservation, Dial-A-Ride, and Flexible Route Service. These transportation alternatives are designed to meet the unique mobility needs of the people in southeast Michigan. The Connector Services are complemented by Community Transit services provided by local agencies.

Job Express service transports riders from stops along fixed-route lines to their job sites. This service is provided only to those businesses that lie within one of a number of designated Job Express Zones. Small vehicles deliver the service between existing Job Express pick up points and the location of the rider's employment.

Flexible Route Service gives riders the option of curb-to-curb service in areas where fixed-route service may prove inaccessible. Riders may board the bus at designated stops but need to call in advance to arrange for pick-up sites in other parts of the service area.

SMART provides Advanced Reservation Service to four communities in southeast Michigan. Reservations need to be made six days in advance for medical appointments and two days in advance for other trip purposes. Service is curb-to-curb and ride availability is first-come first-serve.

In addition to advanced reservation service, SMART provides same-day or Dial-A-Ride service in a limited number of areas. Service is promised to begin within 60 minutes of the call requesting service. Advanced registration is not allowed.

SMART provides ADA mandated complementary paratransit service to rides that originate and terminate within three-quarters of a mile of its fixed-route service. Given SMART's relatively uniform fixed-route service throughout southeast Michigan, complementary paratransit is also available in most of the communities it serves. To be eligible to use the service, riders must have a disability that prevents them from using SMART's fixed-route service and be ADA certified. The service relies on advanced reservations and is provided curb-to-curb and covers the same areas, times, and transfers as SMART's fixed-route service.

Local transportation solutions delivered by SMART's community partners are referred to by the term Community Transit. The service alternatives vary greatly as they are designed and operated by local agencies to meet the unique needs of the communities they serve. Though some target the elderly or disabled populations, many Community Transit services are available to the general public. Three of SMART's Community Transit partners and their experiences with coordination and ITS are presented later in this section. These partners are Troy Medigo, Shelby Township Senior Center, and The City of Livonia.

As discussed earlier, providers of Community Transit service receive funding from both the Community Credit and Municipal Credit Programs. The former requires a Community Credit Coordination Plan be submitted to SMART. This plan is then used by SMART to ensure that the services provide by SMART and Community Transit providers make the most of available resources to meet the mobility needs of the communities they serves.

3.1.5 SMART Coordination Efforts

SMART provides a number of services to its Community Transit partners that are unrelated to ITS. SMART also shares its advanced technology with agencies not directly involved in proving personal mobility. SMART's vehicle procurement matching program provides funds for new vehicles used by community partners and manages the process of vehicle procurement with federal funds while ombudspersons serve as advocates, educators, and resources for SMART's community partners.

SMART helps its community partners acquire new vehicles as part of its Vehicle Procurement Matching Program. SMART's community partners, those agencies that serve communities which participate in the millage, provide 20 percent of the cost of a new vehicle. Federal funds that come through SMART cover the remaining cost of the vehicles. SMART manages the procurement process and holds the title. The vehicle procurement matching program allows SMART's community partners to focus on provided high quality service and avoid having to master the often-puzzling guidelines that are required during the procurement process. Because the vehicles are purchased with federal funds, regulations regarding preventative maintenance programs and drug and alcohol testing are enforced throughout the system.

SMART also provides vehicle maintenance for those vehicles operated by its community partners. SMART provides both required and additional training for its own employees and those who work for other local transportation providers. Community partners also benefit from the ability to purchase fuel and tires at reduced cost from regional suppliers. SMART also has two roving maintenance personnel. SMART is currently developing a community transit analyst position that is intended to help community partners better understand their system and identify and implement methods or technologies.

SMART employs three full-time ombudspersons to serve as advocates for local communities, agencies and residents. Once a month, the local ombudsperson, each of whom work with one of the three counties, meets in person with each Community Transit partner. During this time, new developments in SMART, including ITS, are shared and questions and concerns discusses. The ombudspersons also aid in the development of local agencies' transit plans which must be completed each year.

Beyond community transportation, SMART coordinates with snow removal efforts in southeast Michigan by providing use of its radio system and server. SMART also tried a cooperative effort with the City of Detroit Police Department including sharing some of the same telecommunications equipment, but encountered licensing problems.

3.1.6 SMART, ITS, & Coordination

SMART is different than many transit organizations. Because of its vested interested in the delivery of high-quality customer service at the local level in addition to its regional fixed-route and demand-response service, SMART itself requires a tremendous degree of coordination. To do this SMART relies on technology and continually looks to improve its service by changing its management processes and the technologies that it uses.

Early Developments

SMART was an early innovator in ITS. Its first efforts at ITS development were, at the time, quite innovative. Today, less than 10 years later, most of the technologies implemented are obsolete.

Much of the initial work by SMART occurred before the refinement of the concepts behind ITS architecture. Unsurprisingly, despite their best efforts and considerable planning there were missteps along the way, many of which would have been mitigated in the presence of an ITS architecture. This included an attempt to implement mobile data terminal (MDT) technology in 1995 that produced less-than-desired results.

Current System

The centerpiece of SMART's current intelligent transportation system is its real-time demand-response system. The system consists of three servers located at SMART's Oakland Terminal (which are referred to collectively as SMART TERM), Windows-based clients located at the Oakland Terminal and at community partner locations throughout the three county region, and the Internet which allows them to communicate with one another. Firewalls are located on both the SMART and remote locations to ensure the security of the system. Computer-aided scheduling and dispatch software is located on the servers as is the extensive geo-database that stores the information needed for the system to run.

A client is a computer that has access to services over a network. For example, when someone surfs the internet, their personal computer is acting as a client. In the case of SMART, the term thin client is more appropriate. A thin client is a client that processes only keyboard input and screen output with all application processing done by the server. This means that a relatively low-cost, unsophisticated machine that can access the server can take full advantage of SMART's system.

SMART currently maintains a license for five concurrent external users, which are available on a first-come first-serve basis. Agencies that use the system can reserve a ride on any vehicle in the system unless there is an existing restriction. In nearly all cases, organizations book trips on their own fleet.

The ability to commingle rides across vehicles and agencies has enormous possibilities and is seen as promising opportunity for future coordination. The system does not require that the organization making the reservation be a transportation provider. For example, reservations could be made or changed by hospitals or social service agencies.

The computer-aided dispatch and scheduling software is delivered system-wide; SMART relies on a single system. The software does contain certain nuances that need to be understood to take full advantage of its capabilities. These nuances can be taught relatively quickly, but take some time to completely master. The issue is not particularly of serious concern for community transit partners interested in providing rides to those in staying within a certain geographic region.

Currently all SMART Connector rides are managed with the centralized real-time demand-response system. Community partners, however, have been more hesitant to adopt the technology because of perceptions of the high cost of adoption relative to the benefits. Recently, 90 percent of community partners email their next day list to SMART. This data is then entered manually into the system by SMART employees. This method does not allow local transportation providers to make changes once the list has been submitted. Dealing with late additions and cancellations is a problem.

SMART also employs a regional toll-free trip scheduling phone line. A great deal of effort was used in designing and testing the system before making it available to the public. Users are guided through the reservation process and communicate information by pressing the buttons on a touch-tone keypad. As users may have difficulty with the system, it automatically defaults to a paratransit/senior ride scheduler. The system has been relatively successful and average 55,000 minutes of use each week.

Three radio towers with 13 channels of service are maintained to provide communication between drivers and dispatch anywhere SMART delivers service. It is also an example of the redundancy that is present throughout SMART's system. In addition to transmitting voice, the radio system is also used as part of SMART's automatic vehicle location (AVL) system.

3.1.7 Impacts of ITS

Separating and quantifying the effects of ITS and coordination in any community is a difficult task. Given the complexity of SMART's organization and the relationships it has with its community partners, efforts to provide transportation estimates that are either accurate or precise are even more difficult. This is especially true as ITS has been an integral part of how SMART has met southeast Michigan mobility needs for more than a decade. As a result there is no baseline with which to compare its service.

Organizational Structure

The relationship between SMART and its community partners was devised before 1995. The implementation and use of advanced technologies in delivering public transportation in southeast Michigan has not changed the association between the two groups though it has strengthened the bonds between them. For its mobility management approach to persist, SMART must provide a level of service that is perceived by local taxpayers of being of sufficient benefit to their community. Many of the services SMART provides and its quality are dependent on ITS. Without ITS, SMART would be unable to provide the services that it currently does to its community partners.

Financial Costs

It is relatively difficult to quantify the effects of ITS and coordination in SMART because of the absence of an adequate baseline with which to compare. The benefits from coordination in general have been estimated at approximately $2.7 million in 2002 dollars (1). This is the difference between the funding received by local transportation providers, $7 million, and the estimated cost of SMART delivering those same rides, $9.7 million. The latter value was found by multiplying the number of trips provided by SMART's community partners by the average SMART paratransit trip cost.

One often-overlooked group of recipients of the actions of innovators are late adopters. These individuals and organizations benefit from the lower cost of technology and the refined processes for managing them. Transit agencies across the nation benefit in small part because of the work SMART performed designing, testing, and operating an intelligent transportation system. The lessons that can be learned by other communities are of definite value, but are difficult to quantify.

TCRP Report 91 estimated the cost of SMART providing the service delivered by its community partners. For ITS, a practical alternative is to ask the converse: what costs would be imposed on community partners if they were to provide the same level of service using the same technologies as SMART does. This requires SMART's Community Transit partners to be separated into two groups, those that schedule their own rides using a remote client and those that forward their ride list to SMART via email. In each case there is significant support for the premise that SMART's centralized system saves money.

For Community Transit partners that currently use the remote client technology the marginal cost of SMART's central real-time demand-response system to the organization is insignificant given that it already has access to a personal computer and the Internet. The development and operation of its own system would require significant resources. These would include the upfront costs of the purchasing a server, building the database and paying initial software licensing fees. Hiring a consultant to aid in the implementation process might also be necessary. The cost of training would be negligible if the same or similar scheduling software was used. After implementation, the annual maintenance fee would be incurred as would the costs of maintaining the database and server. Additional technical support might also involve additional expenditures.

There are also significant costs resulting from the increased, unmitigated, cost of uncertainty. If for some reason the local technology failed, the Community Transit partner would need to address the challenge alone. In some cases this might involve system failure, with rides not being provided or the deterioration in the quality of customer service.

Community Transit partners not currently using the system would incur costs because of training and the changes in operations policy in addition to those experienced by the agencies that currently use the remote client technology.

3.1.8 Three Community Transit Partners

SMART provides transportation solutions to a large and diverse clientele. Many of these services are delivered in conjunction with its Community Transit partners. However, not only are each of the organizations and the communities they serve different, but what services local Community Transit partners provide and how they work with SMART differ as well. To better understand SMART's relationships with its Community Transit partners, its relationships with three of them are described.

Troy Medigo

Troy Medigo began as a volunteer service designed to provide transportation to Troy residents traveling to and from medical appointments. Over time, service was expanded to meet the needs of the mobility disadvantaged by traveling to locations other than hospitals and clinics and for non-medical purposes. Today, Troy Medigo is now affiliated with the city of Troy and receives assistance in the form of office space and local funding.

Troy Medigo provides door-to-door service for the elderly and disabled in its service area. Most trips provided by Troy Medigo require advanced reservation, though same day rides are subject to space availability. In addition to local hospitals and clinics, a number of trips are made to Troy's Community Center which provides a number of fitness, social, and dining opportunities.

Troy Medigo currently employs two part-time dispatchers and schedulers who use the SMART system using a remote client located at their office in the Troy Community Center. Before this system they used handwritten or typed messages, which made management and record keeping difficult. The transition to the computer-based system was difficult and some drivers left because of the increased capability introduced. The real-time demand response system is now "the basis for everything" for Troy Medigo.

SMART now handles much of Troy Medigo's paperwork allowing its staff to focus on delivering transportation. There remains a limited amount of contact between SMART and Troy Medigo. Following the training of dispatchers and schedulers on the two systems, communication has been mostly limited to that occurring due to weather events or vehicle breakdown. SMART's spare bus program has been utilized by Troy Medigo.

Troy Medigo is also very interested in the community transit analyst position being created. Like many agencies that provide community transportation, Troy Medigo has limited resources. The community transit analyst would provide recommendations on ways to improve service while allowing Troy Medigo to focus on providing service.

Shelby Township Senior Center

The Shelby Township Senior Center serves a number of needs facing the elderly living in this community located in the northeast suburbs of Detroit. It currently books rides on one SMART vehicle. The majority of these rides are destined either for the Senior Center or for dialysis.

At the present time, Shelby Township Senior Center does not currently use a remote client to book its trips. Instead it sends an excel spreadsheet to SMART each afternoon where the trips are entered into the system by a SMART employee. This arrangement prevents the Senior Center from booking additional trips after 4 p.m. or canceling reservations on the day they are to be delivered. Though the Senior Center would like to be able to make these scheduling changes, it is not particularly interested in making full use of SMART's system. This is because of a perception of introducing another layer of work, significant upfront costs, and uncertainty regarding the results.

Livonia Community Transit

Livonia Community Transit service began more than two decades ago to transport the community's elderly to and from a local senior center. Following the passage of the 1995 millage, Livonia Community Transit began its relationship with SMART. However, because of mounting concerns about the cost and service its residents receive, Livonia is considering opting out of its agreement with SMART, which would make it the first to do so in over a decade.

As of 2005, Livonia Community Transit operated five buses with plans to increase that number to seven because of unmet demand. The service provides transportation alternatives for handicapped and the elderly.

Livonia Community Transit is one of a limited number of Community Transit partners that currently make use of SMART's centralized real-time demand-response capabilities. Though it has been very pleased with the technology provided, the organization is not completely satisfied with its relationship with SMART, because it believes it could deliver better service to its clients at a lower cost without SMART. In light of this, the City of Livonia which oversees the agency believes that it could implement its own system that would include a license for the same computer-aided dispatch and scheduling software for less while maintaining if not improving the level of service.

3.2 R.Y.D.E.

R.Y.D.E. was established in January, 2000, to provide brokered public transportation to Kearney, Neb., and surrounding areas. Demand for its services grew quickly and it soon became evident that change was necessary if the organization wanted to adequately meet its community's mobility needs. The solution to the challenge came in the form of adopting technology that provided R.Y.D.E. the ability to better manage its operation. As part of the process, R.Y.D.E. developed and implemented its own ITS architecture, in agreement with the regional ITS architecture which was designed at the same time. This strategy continues to pay dividends to the organization.

Kearney is a city of 28,000 located on the Platte River in South-Central Nebraska. Like many cities of its size on the Great Plains, the local economy is dependent on agriculture and providing services, including retail and medical, to a multi-county region. It is also the home of the University of Nebraska at Kearney and a sizable manufacturing sector. Partially because of its location on I-80, tourism is also important to the city.

Kearney is a progressive, growing community that has long been open to innovative approaches to meeting its needs, including the coordination of social services. Some of this culture can be attributed to the presence of the university and the young leaders who take part in many of the community's organizations. The spirit of cooperation between social service providers is further complemented by the movement of key officials between these organizations.

R.Y.D.E. has provided service to the counties of Buffalo, in which the city of Kearney is located, Sherman, Kearney, Franklin, and Gosper. Its long-term plans involve providing service to the counties of Buffalo, Dawson, Custer, Sherman, Phelps, Howard, Kearney, and Adams, all in south-central Nebraska. Figure 2. displays these counties. These eight counties are home to more than 135,000 residents. Most of these individuals are located in Adams, Buffalo, or Dawson County which account for 99,851 of the area's residents. In two of these counties, Custer and Sherman, the percentage of the population that is elderly is greater than 20 percent.

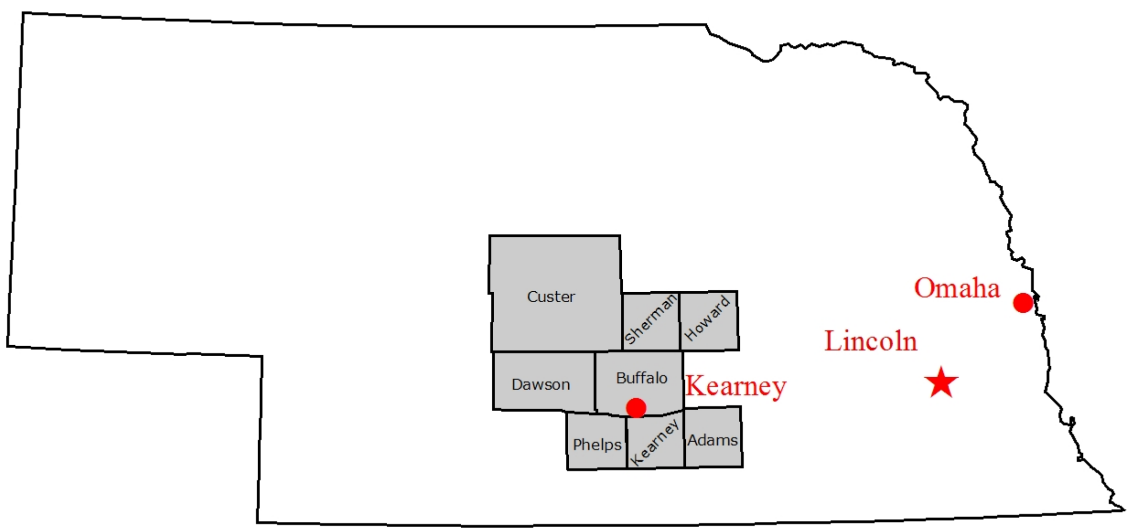

Figure 2. South-Central Nebraska

The demand for mobility solutions in Kearney is similar to similar-sized communities across the nation. Kearney's location in a predominantly rural area results in little need for a city resident to travel outside of the city limits. Similarly, for the smaller communities in the areas surrounding the city, most trips are destined for Kearney.

3.2.1 Reach Your Destination Easily

One of the first steps towards the creation of R.Y.D.E. occurred in 1994 when Good Samaritan Health Services, which operates the south-central Nebraska's regional health center located in Kearney, decided to provide a transportation alternative for its patients. It had long been recognized by Good Samaritan Health Services that mobility was a serious issue for elderly patients both in and around Kearney. There was growing concern that the absence of transportation alternatives for many of its patients was affecting their health. At the time, the cost of traveling to and from the city from outlying areas reached as high as $50 per round-trip.

In response, Good Samaritan Health Services introduced a transportation service that visited seven surrounding towns on a rotating basis throughout the five day work week at a cost of $8 per roundtrip. Unfortunately, many of the perceived economies of the service never materialized. In 1999, about 1,000 trips were provided at an average cost of $40. This led Good Samaritan Health Services to return to demand-only service.

In 1997, the Buffalo County Community Health Partners, a consortium that included Good Samaritan Health Services and other healthcare providers, decided to take a proactive approach to address the challenges of coordinating transportation services to Kearney and the surrounding areas. The need was readily evident as the hospital and nursing homes in Kearney often each had vehicles transporting a single rider to the same destination. As a result, the Transportation Goal Work Group was formed and efforts to determine the best solution for the community as a whole began. In addition to representatives from the organizations that made up the Buffalo County Community Health Partners, the Transportation Goal Work Group also included members from local taxi operators, the University of Nebraska-Kearney, the local school district, the Nebraska Department of Roads, Buffalo County, the City of Kearney, and social service agencies.

One promising approach to coordination that the Transportation Goal Work Group soon discovered was that of a transportation brokerage. The brokerage concept appeared to be having great success in meeting the mobility needs of Rock Springs, Wyo., and a site visit was soon arranged. The individuals who made the trip to Wyoming were further encouraged by what they saw firsthand. Upon their return, efforts to implement a brokerage in Kearney began in earnest. After two more years of planning, R.Y.D.E. began its service; becoming the first transportation broker in the state of Nebraska.

3.2.2 The Transportation Brokerage Concept

Transportation brokers act as administrators of transportation services in a given area. In general, brokers act as gatekeepers for those interested in receiving or delivering trips in the region they serve, though the particular duties vary from one brokerage to the next. Brokers may be responsible for gathering and managing relevant rider information, contracting with transportation providers, accepting and making reservations, and managing scheduling and dispatch functions. They may also provide driver training, aid in vehicle procurement, manage the risk of participating agencies and assure the quality of the service delivered. On the financial side, brokers often handle billing and record keeping, provide reimbursement to transportation providers, and maintain insurance. The benefits from a brokerage are similar to those arising from coordination in general, with the most significant being greater system-wide efficiency.

3.2.3 Service Commences

A number of arrangements were made before R.Y.D.E. began providing rides. Good Samaritan Health Services turned its transportation assets over to Mid-Nebraska Community Action, the local social service agency that would house R.Y.D.E., for $1. An agreement was reached that acknowledged that trips to or from certain locations would be reimbursed by Good Samaritan Health Services. The group also promised to provide $40,000 the first year with each following years' funding dropping by $8,000 until the program was self-sufficient. In return for the funding, R.Y.D.E. was required to make medically related trips its first priority. The Good Samaritan Hospital Foundation was expected to continue making charitable contributions as well. In addition to its altruistic motivation, Good Samaritan also had an interest in low-cost transportation service because the transportation alternative it provided was both expensive and not covered by Medicare. Mid-Nebraska Community Action provided office space, salaries and oversight for the new organization.

R.Y.D.E. service began in January 2000 with the vehicle purchased from Good Samaritan Health Services, a manager, a dispatcher and drivers. After its first year of operation, RYDE had acquired two more vehicles from another agency that had provided rides to the elderly and low-income populations. This commingling resulted in one nursing home leaving the arrangement.

Most importantly, by the end of 2000 R.Y.D.E. had provided 10,000 trips and its paper and pencil method of managing the system was beginning to reach its limits. On the average day it took more than an hour to prepare the schedule for the next day. Trips scheduled at this time averaged 2 to 3 miles. R.Y.D.E. was averaging 125 trips per day. Reporting and billing for the service was also particularly burdensome.

The demand for R.Y.D.E. services and the corresponding increase in the size of its fleet began to place significant pressures on its employees and administrators. They quickly realized that its traditional methods of managing the system were inadequate to meet the mobility needs of the Kearney community. The solutions provided by ITS were quickly identified and the process to change the way Kearney provided community transportation began once again. This time, however, a more formalized processed would be followed.

Developing a Regional ITS Architecture

As part of its implementation of advanced technologies to aid in the delivery of its service, R.Y.D.E. helped design and implement a regional ITS architecture. This effort formally began in late 2001 with a training workshop conducted by Battelle and completed under contract to the FTA to provide technical assistance to transit agencies. This was followed in April 2002 with a meeting where possible ITS solutions were discussed and the groundwork for preparing for the design of a regional ITS architecture began. A summary of the process is described at length in a Federal Highway Administration white paper (4).

During this time period, the manager of R.Y.D.E. also prepared himself for the process by taking some courses on systems engineering to help in the architecture development process. These courses were delivered at an introductory level in non-technical language. In addition to its intended goal, the courses resulted in a paradigm shift for R.Y.D.E.'s manager as it caused him to revisit the way in which he framed Kearney's mobility challenges and the ways in which R.Y.D.E.'s service could address the challenges most efficiently.

3.2.4 R.Y.D.E. Current System

R.Y.D.E. continues to follow the plans it laid out when preparing its regional ITS architecture. The pace of technology adoption has been more deliberate than initially planned. At the same time, the system in place today has already had significant impacts on R.Y.D.E., the service it provides, and the entire Kearney community.

As with SMART, the foundation of R.Y.D.E.'s intelligent transportation system is its computer-aided dispatch and scheduling software. The software is located on a server operating Microsoft SQL and is accessible by any of the three personal computers used by R.Y.D.E. Though the software platform used by R.Y.D.E. provides less functionality than that used by SMART, it more than meets the needs of the Kearney-based organization.

R.Y.D.E. also updated its telephone system which had been shared with Mid-Nebraska Community Action. This need had also arisen early in R.Y.D.E.'s existence as the demand for reservations was beginning to tie up all of the parent organization's telephone lines. R.Y.D.E. now has 14 digital lines.

R.Y.D.E.'s original radio technology only allowed one-way communication between a single vehicle and dispatch. The radio system has since been updated to a full duplex system which allows communications both ways at the same time.

Contracting for mobile data terminal (MDT) technology began in early 2005 with implementation expected to occur in mid-2005. It is expected that vehicles will be able to be outfitted for as little as $1,000 each. The MDT implementation will begin with the technology being placed on a single vehicle and then later being placed on the remainder of the fleet. The operating cost of the system is expected to be $5 per month per bus.

The next phase of ITS implementation will include acquiring pagers for memory impaired clients. The need for this technology arose following an event where a client went missing for a period of time before being found safe after a lengthy search. R.Y.D.E. is also interested in using interactive voice response technology (IVR) to aid in the reservation process. There is also interest in acquiring a generator in case a power outage occurs,

3.2.5 Impacts of ITS

R.Y.D.E. was an extremely young organization when it began initiating efforts to implement ITS technologies and processes. However, after only one year of existence it was evident that methods used to operate the system were reaching their limits. ITS provided the needed solutions and most of the changes in system-wide performance following the implementation of ITS technologies can be attributed to it.

As one of R.Y.D.E.'s goals is to provide transportation to the residents of eight counties in south-central Nebraska, further demands will be placed on the system. With this size of an operation, R.Y.D.E. will be able to further take advantage of the scalability provided by the technology it uses.

Organizational Structure

R.Y.D.E. itself has seen no change in its organizational structure since the introduction of ITS. As a broker, R.Y.D.E.'s initial organizational structure was intended to meet the changing mobility needs of its community. However, the high demand for mobility alternatives in Kearney quickly outgrew R.Y.D.E.'s ability to deliver them. ITS allowed R.Y.D.E. to take full advantage of the brokerage platform and provide the service Kearney's residents demand.

No one left R.Y.D.E.'s advisory board because of ITS though members came and left as terms expired. This is unsurprising as it was many of these same individuals who first worked to introduce the transportation brokerage concept to south-central Nebraska. R.Y.D.E. has added employees to accommodate the increased demand in service and to make use of the system and guide the continued adoption and proper use of ITS technologies.

Limited formal agreements are in place between R.Y.D.E. and the agencies whose clients it provides service to due to restrictions on 503 (c) agencies, a class of not-for-profit entities.

Financial Costs

The annual financial benefits arising from coordination in Kearney have been estimated to be $400,358 (1). This value was determined by multiplying the difference between pre-coordination and post-coordination per trip costs, $5.08, times the number of trips provided, 78,220. Before the introduction of ITS, R.Y.D.E. was quickly approaching the point at which traditional methods of scheduling and dispatch were no longer efficient. Most, if not all, of the $400,358 can be attributed to the introduction of advanced technologies and the processes used to manage them which allowed for further coordination to occur.

Changes in Service

Same-day service, which was not available before ITS, is now possible on a space-available basis. R.Y.D.E. has also expanded its service hours from 7 a.m. to 4 p.m. to 6 a.m. to 6 p.m. weekdays. Ridership rose immediately after the implementation of computer-aided dispatch and scheduling software from 125 to nearly 200 rides per week. The miles per pickup fell from somewhere in the range of 2 to 3 to 1.7 while the time in transit fell by one-half.

3.3 NDinfo.org

NDinfo.org is a novel statewide approach to addressing the challenges of mobility in North Dakota. Currently in its infancy, the intent is for NDinfo.org to mature into a hub of information on various social services, including transportation service, available to individuals throughout the state. One of the program's most promising characteristics is its proposed ability to allow for coordination of transportation services across North Dakota.

The communities of North Dakota are diverse and their demands for transportation are unique. Delivering transportation service across the sparsely populated parts of North Dakota is a challenging task. Managing the mobility of individual residents is also trying.

Communities in North Dakota can be readily classified as either rural or urban. Though their final destinations may be the same, mobility-challenged urban residents may demand trips a few miles in length while their rural counterparts may demand trips that are a hundred times that long. The relative demand for such trips will be further magnified as the rural population ages in the coming years.

The location of North Dakota's metropolitan areas: Bismarck, Fargo, and Grand Forks and Minot are presented in Figure 3. These four communities are regular destinations for residents of rural communities who seek medical, retail, or recreational opportunities. A handful of other communities throughout the state provide more limited services that meet the regular needs of their residents. Many of North Dakota's transportation-dependent population, including the elderly and the disabled, live in these larger communities to take advantage of the services they offer. The exception is the rural elderly, who choose to remain in their home communities though they lack many of the essential services they need. These rural residents are forced to make regular trips to larger communities.

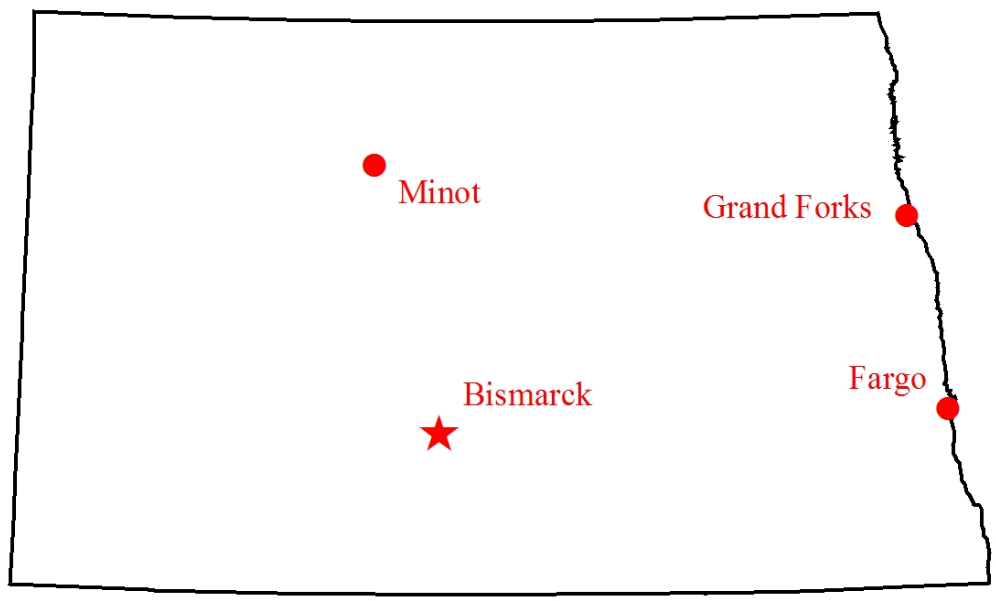

Figure 3. North Dakota

3.3.1 Transportation Services within the State of North Dakota

Many transportation services available within North Dakota serve individual communities while others provide transportation for multi-jurisdictional regions. Fixed-route and demand-response service areas are presented in Figure 4. In addition to individuals seeking mobility alternatives for themselves, a number of organizations provide or fund transportation in North Dakota. Nursing homes and developmental disabilities service providers are among this group. Other agencies include Medicaid, Head Start, Temporary Assistance for Needy Families, school districts, and Veterans Affairs.

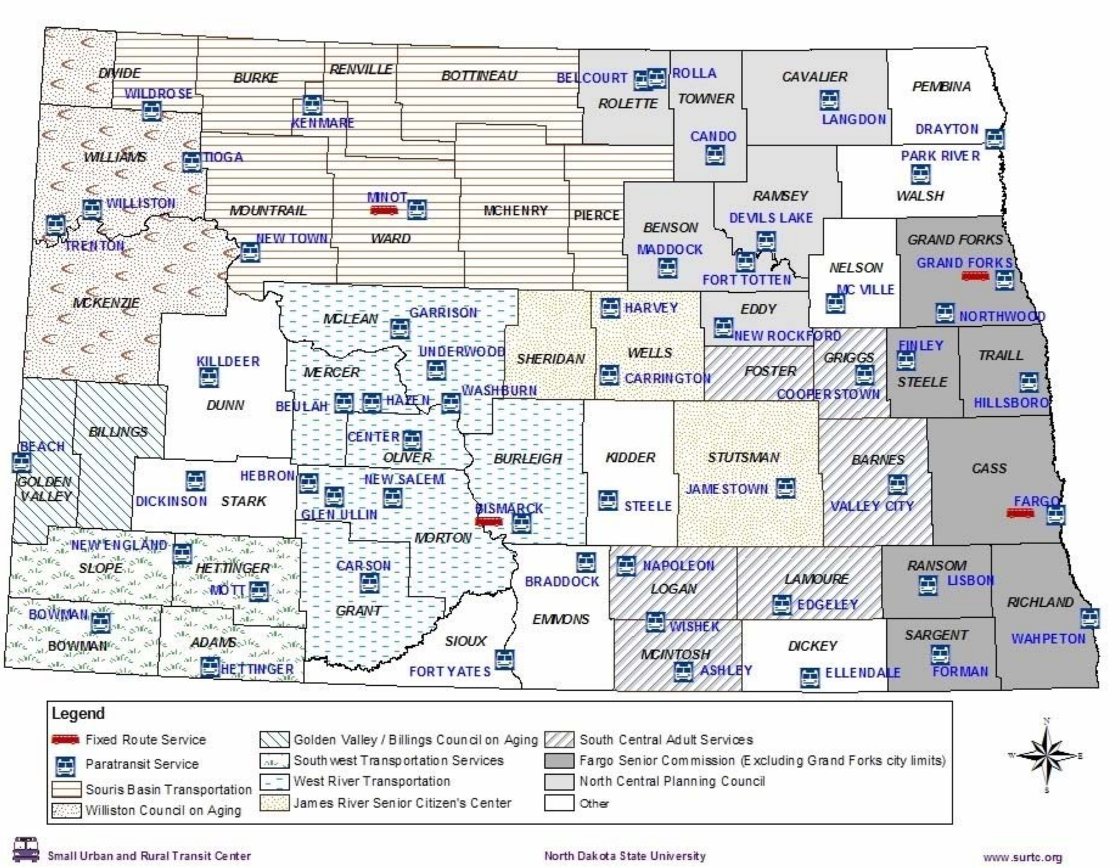

Figure 4. Fixed-Route and Regional Transit Service Areas in North Dakota

Source: *A Plan for Transportation Coordination in North Dakota, 2004*

North Dakota's four largest cities: Bismarck, Fargo, Grand Forks, and Minot operate fixed-route services. The systems in Fargo, Grand Forks, and Minot have been in existence for decades while Bismarck's fixed-route service commenced in May 2004. In Minot, the fixed-route service is used to transport students in the morning and mid-afternoon.

There are 40 demand-response systems in operation in North Dakota. While some serve individual cities, many operate on a regional, multi-county basis. There are varying degrees of coordination among demand-response providers.

Thirteen taxi cab companies operate in North Dakota. These entities provide an important mobility option, as in many cases they are the only transportation providers that operate outside of business hours in the communities they serve. Significant support from the North Dakota Department of Transportation and Department of Human Services in the form of 5311 funding or Medicaid reimbursements provide the funding to maintain taxi services in the state's smaller communities.

The amount of coordination of transportation services in North Dakota is relatively small (5), an issue that is currently being addressed by the North Dakota Department of Transportation

Except for cases where the fixed-route system also provides paratransit service as in Grand Forks and Fargo, the only other situation where coordination occurs is where local demand-response service work with taxi companies to ensure that transportation is available to meet riders' off-hour needs.

3.3.2 Identifying the Need for Transportation Information

Given the lack of coordination of transportation services in North Dakota, there are likely to be significant opportunities to improve the efficiency of the system. This has long been known to the agencies that provide transportation as well as those that provide the financing and oversight to such groups. What was missing was the impetus for the developing a solution to North Dakota's coordination issues. It came from a most unexpected place the 1999 Supreme Court decision in Olmstead v. L. C.

In addition to addressing the legal protection of disabled individuals, Olmstead v. L.C., played a role in the creation of NDinfo.org as well. In the decision, the Supreme Court ruled that states may not discriminate against disabled individuals who receive or benefit from Medicaid funding by institutionalizing them when they would be better served in a more integrated, community setting. Each state was required to either develop a formal plan, referred to as an Olmstead Plan, or develop some alternative strategy to ensure that the ruling of the court was followed.

In North Dakota, the process to address the Olmstead decision led to a series of focus group meetings held during the spring of 2002. In addition to meeting its designed purpose of identifying methods of ensuring that the rights of North Dakota's disabled population were protected, it was during these meetings that the need for a statewide social service coordination solution, which would later become NDinfo.org, was identified.

The Olmstead focus group meetings identified a number of issues facing the disabled community in North Dakota. Primary among these was the lack of readily available information on community-based services. Participants also felt that it was important to specifically highlight the services available to disabled individuals in the state.

With regard to transportation, the focus groups felt that it was important to identify and address gaps in transportation services within North Dakota. It was acknowledged that these services were lacking in rural parts of the state. There was also an absence of a centralized source of transportation information.

3.3.3 Designing NDinfo.org

The proposed solution to the multifaceted problem identified as part of the focus group meetings was NDinfo.org, an online, searchable, statewide human services directory. This centralized information hub would be accessible throughout North Dakota and beyond via the Internet. The ultimate goal would be to include information on all 4,400 North Dakota agencies that provide social services.

The transportation module was one of the more innovative components of NDinfo.org. The short-range goal for the module was to provide a database of transportation-related information, much like the rest of the site. Searches of the database by city, county, region, accessibility, payment options, and service type are currently possible. This allows for multiple trip options to be identified.

In addition to transportation, there were also plans to have portions of the site devoted to organizations providing education and medical services. Among the human services initially targeted during the planning for NDinfo.org were those for the elderly and children. City governments, volunteer groups, and religious groups were also included.

Making the site accessible to users was another objective. Special consideration was taken when designing the internet interface so that it could accommodate users with physical impairments. It was also important that new users be able to easily find the information for which they were looking.

The development of NDinfo.org was expected to be based on the availability of funding. Fortunately, NDinfo.org was relatively successful in securing funding including federal monies as well as support from charitable organizations. Two attributes of the NDinfo.org program allow for it to make the most out of funds it has available. First, the collection of social service agencies is provided by volunteers for in-kind service. NDinfo.org also allows social service agencies to establish and update profiles on the website. This ensures the system remains up-to-date while also minimizing the cost of maintenance. This service is available at no cost to the social service agency, though registration is required.

Following completion of the initial planning phase, efforts began to focus on programming the site and building the underlying database. In addition to its identified role in providing detailed transportation service information, focus has been placed on system security and site management issues. Password protection is provided for those who have access.

3.3.4 The Current System

NDinfo.org went live in October 2004. Its initial version included a bulletin board, community calendar, a job directory, and comments section. A help guide that contained a frequently asked questions section was also present. Within the system, agencies have the ability to access and change their own information as they see fit. This could include updating their service policy or altering their mission statement. Also, if an agency maintains its own website, it can be added as a link to its NDinfo.org informational page.

In the spring of 2005, NDinfo.org launched the first version of its transportation module. Presently, the transportation component provides an online searchable database, which will also serve as the basis for future capabilities. It also includes a trip planner that uses user-entered information to generate travel options. In addition to designating the locations of trip origination and termination, the search may be constrained by identifying specific payment options, the acceptance of reservations, accessibility, and the presence of a bike rack. Users may also identify if they need the use of special services such as a Geri chair or if pets may travel.

3.3.5 Long-Range Plans

The long-range plans for NDinfo.org address a number of more complex issues, many of which are related to coordination. Among the planned capabilities of NDinfo.org are the ability to plan for intercity trips, to prepare itineraries, and to reserve or pay for a trip. Interactive maps as well as directions and distances to bus strops will also be included. Information on carpools and bike information will be available. There are also plans to provide the ability to search for home delivery and freight solutions in future versions of the site. The ability to bulk email a list of designated recipients about proposed transportation deals is also expected.

3.3.6 Impacts of NDinfo.org

Given the infancy of NDinfo.org, it is difficult to quantify the impacts of the program. At the present time, NDinfo.org's transportation component provides little functionality beyond its searchable database. Its proposed content and capabilities show great promise for increased coordination among transportation providers in North Dakota. However, a significant amount of work that will help make this possible has yet to be completed.

4. Lessons Learned

This section presents lessons that can be learned from the experiences of SMART, R.Y.D.E., and NDinfo.org in implementing ITS to improve coordination in their area. Most of the lessons described are related to both ITS and coordination. Some however, are not. They are included due to their pragmatic value and uniqueness. Those interested in guidelines for success in improving coordination in general are referred to *TCRP 100: Toolkit for Rural Community Coordinated Transportation Services* (6). *TCRP Report 76: Guidebook for Selecting Appropriate Technology Systems for Small Urban and Rural Public Operators* (7) provides a non-technical guide to ITS design and implementation.

Topics discussed in this section relate to the importance of understanding and educating the community, identifying, tailoring, and adopting the right technology, and making the most of available resources. A general description of the primary concept involved is presented for each topic. This general description is followed by a discussion of the particular case from which the concept was drawn.

4.1 Understanding and Educating the Community

Every community and its transportation needs are unique. The same is true for the barriers to coordination that they face. Without intimate knowledge of the institutions, individuals, and relationships that exist among them, improving a community's transportation system is difficult. Providing solutions to nonexistent or relatively unimportant issues can result in continued inefficiency and the misuse of public funds. At the same time, the solutions that ITS can bring to a local community must be accepted and used for them to be successful.

In this section the importance of understanding the community transportation system, identifying actual needs, promoting adoption, and educating employees and the community are illustrated with examples from the three cases cited earlier.

4.1.1 Understanding the Community Transportation System

Individuals who have worked to provide public transportation to a community for a number of years are a valuable and irreplaceable resource when it comes to improving residents' mobility. Knowledge of ridership behavior, especially on demand-response systems in small communities, can become quite intimate. An understanding of the capabilities, strengths, and shortcomings of their system is needed when transportation service managers work with others in their community to increase system efficiency with coordination.

Improved coordination may result in significant changes in service for community transportation providers. Being able to predict with some degree of certainty the response of riders and other shareholders in the community to a change in service is both difficult and important. Though complex quantitative models could be constructed to estimate community reactions, in most small urban and rural areas the costs and the inaccuracy of such estimates would diminish their pragmatic value.

For coordination to be successful, especially those parts that rely on ITS, it is necessary to formally define the challenges that stand in the way of improved mobility, the relationships between individuals and organizations, and the processes that exist. Efforts to do so should occur early on in the ITS/coordination planning process. The absence of such efforts may result in overlooked challenges not being addressed and potential resources not being put to their best use.

Describing these aspects of a community transportation system allows consideration of big-picture concepts that are often ignored because of the demands of managing and operating the existing system. Doing so rigorously provides outside parties, including those with more technical backgrounds, with the ability to quickly understand the challenges the community faces, what resources it has to draw from, and which solutions might work best.

R.Y.D.E. and its Introduction to Systems Engineering

Early in the ITS planning process, R.Y.D.E. Transportation Director Jeff Rumery participated in an introductory systems engineering course. The course was designed to be accessible to a broad audience of transportation professionals, not just engineers and other technicians. The course proved to be an invaluable asset by helping Rumery better understand the broader transportation system of which his agency is a part.

The framework provided by systems engineering courses is designed to induce transportation providers to think about the entire community transportation system and the relationships between the many parts and people of which it is composed. It is not necessary to have a technical background or to master jargon from the field to take full advantage of such training. In fact, individuals from a non-technical background may be more likely than others to experience a paradigm shift as a result of the course. This may further stimulate the creativity necessary for coordination to be innovative and successful.

4.1.2 Identifying Actual Needs

A thorough understanding of the actual needs of the local community is necessary early in the planning stages for ITS and coordination. These efforts and the resulting changes in service are likely to be less successful when individual or organizational needs assessments are incomplete or incorrect.

Coordination efforts require the involvement of all stakeholders in the region. The absence of participation by any organization or individual with an interest in community transportation is likely to lessen its practical value. With the focus on ITS, the need for coordination with external agencies moves beyond those groups and individuals directly involved with transportation. For example, local police and fire departments, and other emergency management agencies may also play a role in ITS development. An exhaustive list of the organizations with a stake in ITS deployment in community transportation systems could include dozens of agencies for even the smallest of communities.

Identifying the Needs of North Dakotans

During the early stages of the development of NDinfo.org, public forums were held in Fargo, Grand Forks, Bismarck and Minot. At each of the meetings it became immediately evident that many attendees had little knowledge of the transportation options available in their local community.

Despite their lack of knowledge of existing service, attendees expressed strong interest in a number of functions they felt their transportation system should provide. Among these functions was a single source of information, including fixed-route schedules and other transportation alternatives. It was also acknowledged that an understanding of the service design of transportation for group homes in each local community was necessary to ensure program success.

For a novel project such as NDinfo.org, public participation was necessary to identify the concerns and needs of the people of the state. The absence of such activity would have likely hindered the success of the project as it seems unlikely that a board could have recognized and properly emphasized those issues raised during the public forums.

4.1.3 Promoting Adoption

In many cases, ITS solutions designed and implemented at the regional or state level may be available to community agencies at a lower cost than if they had been developed and deployed locally. In spite of this, many of the agencies that would benefit from technology adoption remain hesitant. For regional or state entities to spend the large sums of money that is needed to design and implement high-tech intelligent transportation systems only to see them go unused is unfortunate.

The aversion to or absence of technology adoption may be due to one of a number of reasons. In many cases, the benefits resulting from adoption are unknown or are expected to outweigh the perceived costs. In others, a fear of technology or change may also result in agencies forgoing adoption.

For those organizations that expect long-term benefits to outweigh the costs, high upfront costs may still prevent adoption. This can also be true where regional or statewide ITS solutions are available. The resources required for educating the operators of ITS are not negligible, especially in smaller systems where resources for such activities are usually scarce. This is often compounded with the costs of the technology that must be implemented at the local level to make use of the regional or statewide capabilities.

The uneven adoption among agencies or their clientele may damage the region-wide value of ITS. This is especially true if one of the primary goals for adoption is coordination because gaps in intended service may arise and many of the planned efficiencies evaporate. This may also have the effect of eroding community support for the changes. Given the need for local funding to cover some portion of the operating expense of most community transportation system, uneven adoption could have devastating consequences.

Unaccepted ITS Solutions

Despite the development of a system that would readily and relatively easily meet the technology needs of SMART's partners at a low cost, there has been resistance by many agencies to adopt the technology. Causes include a misunderstanding or fear of technology, inability to afford initial training, software and hardware fees, and complacency. Of course, some of these agencies may already be making use of the optimal level of technology and would not benefit from further adoption.

This situation is not particularly unique. What is different is that SMART has developed a high-quality system that can be operated at minimal cost, both financially and in terms of required expertise. Unfortunately, it has been adopted by relatively few of the community transportation providers that it was intended to serve.

4.1.4 Educating Employees and the Community

Much of the decision making involved with ITS planning and implementation occurs at an executive level. However, to be successful, employees and the community must learn to appreciate and use the system. Acceptance, both internal and external, is often limited because of an absence of knowledge of the expected positive impacts.

Following the implementation of ITS, employees will often need to be retrained and may see a significant change in job descriptions. It is important that employees understand the benefits that result from ITS and improved coordination, especially when the only immediately noticeable result is an increase in work load. In some coordinated systems, these concerns may be magnified by an appearance that the burdens and benefits associated with the new system are not evenly shared among agencies or clients.

Members of the community, both riders and non-riders alike, may have similar difficulty in being able to see the benefits that result from technology adoption. Efforts are needed to educate the public on the changes in service, operation, and the expected positive impacts. This should begin before the actual implementation of ITS to provide time for the community to adjust to the changes being made.

Understanding the Impacts of Change in Kearney

After the adoption of computer-aided scheduling and dispatch software by R.Y.D.E., a dispute between drivers and dispatchers arose because of dramatic changes that occurred with the adoption of the new technology. Drivers resisted following the schedule produced by the software and often improvised their own schedules based on their experience before the technology was adopted. To address the situation, drivers were informally educated on the technology used by dispatchers and how it helped R.Y.D.E. provide a higher level of service to its riders.

4.2 Identifying, Tailoring, and Adopting the Proper Technology

The number of ITS technologies available to community transportation systems is large and growing. The number of combinations that these technologies can take is extensive. Effectively planning for the implementation of such technology to best serve the needs of a particular community can be quite demanding and often requires the expertise of outside individuals. At the same time, the task of developing and implementing ITS should not be simply delegated to consultants.

In this section, the value of ITS architecture, staying focused on outcomes, and the user friendliness of systems are presented. Centralization, scalability, and the concept of redundancy and backup are also covered.

4.2.1 Importance of Developing and Adhering to an ITS Architecture

As of April 2005, a regional ITS architecture is required to be in place wherever Highway Trust Fund or Mass Transit Account dollars are used to fund ITS projects. Though ITS architecture is mandated, an understanding and appreciation of it should be acquired by those implementing ITS. This is especially true in smaller systems where the upfront cost of complying with the existing architecture or designing and deploying new ITS architecture, including the development of an understanding of its underlying concepts, is high.

Improved coordination of transportation services is a strong selling point for ITS architecture. Though many of the technical aspects may be better left to consultants, there is much to be gained from understanding the process and its merits. The basis for the development of ITS architecture is that it allows transportation systems to communicate and coordinate with one another while remaining flexible enough to adapt to changes in technology.

In locations where a regional ITS architecture for advanced public transportation systems have not yet been designed, the development process provides an opportunity for involved parties, including those not directly involved in human service transportation, to come to the table to present their wants and needs and to list their assets and liabilities. The process is quite similar to those typically used to improve coordination in general and may result in better coordination among transportation providers even if it was not the primary reason for ITS implementation.

R.Y.D.E. Builds its Foundation

The merits of developing, implementing, and maintaining ITS architecture were reinforced by the experiences and sentiments of those at R.Y.D.E. It is viewed by the agency as both the “first and best” thing to do when planning for ITS projects. Instead of being valued on its technical merits, the sentiment at R.Y.D.E. is that the architecture design process served as a good instrument to initiate communication among organizations concerning available assets, existing relationships, and desired outcomes. R.Y.D.E. revisits its architecture every few months as it evaluates what has, can, and will be done with ITS to better serve Kearney’s mobility needs.

Despite the merits of ITS architecture, R.Y.D.E. felt that the initial presentation of ITS architecture usually makes it difficult for many to grasp initially. This is especially true as few managers of small transit systems are educated or have experience as engineers or technocrats. It is perceived as being too technical too fast.

4.2.2 Staying Focused on Outcomes

The application of ITS technologies to the challenges faced by public transportation providers can be quite exciting. However, those implementing ITS should focus on the effects ITS has on system-wide performance, including customer service. They should avoid becoming enamored with the process or the technology and should instead think about the positive impacts they will make. Unfortunately, a culture of implementing ITS just to implement ITS, regardless of its impact on riders and other members of the community, does occasionally arise.

Coordination may help reduce the likelihood of such a culture from evolving. As more parties are involved in the planning process, pressure increases to use the funds to meet the needs of the entire community. The adoption of high-cost, cutting-edge technologies that do not provide a cost-effective method of improving coordination are less likely to be adopted when there are more needs to be addressed. There is also a greater likelihood that someone will object to the inefficient use of ITS or coordination funds.

R.Y.D.E. and its Focus on Performance

R.Y.D.E. felt that it was paramount to stay focused on outcomes when designing and implementing its intelligent transportation system in Kearney. Despite having significant ITS funds at its disposal, R.Y.D.E. remained focused on the positive impacts that would result. The intelligent transportation system in place at R.Y.D.E. appears to be on track to achieving its goal of better serving the transportation needs of its community without having adopted unsuitable technologies.

4.2.3 User Friendliness

User friendliness is closely related to the just-discussed concept of staying focused on event outcomes. Any change in transportation service design needs to keep its focus on riders as well as other members of the community. Maintaining or increasing the user friendliness of a system will encourage continued or increased use of the service.

In the context of ITS, there will be a broad range of users as nearly all individuals and organizations that interact with public transportation may be affected. These parties can be classified into two groups: external and internal. External users of ITS could include riders, trip planners, funding agencies, those with oversight authority, fire, police, and emergency response, to name just a few.

Internally, schedulers and dispatchers may see their job processes change significantly. In smaller systems this may include the move from paper to electronic management systems. Drivers may need to learn to continue to deliver safe, timely transportation while making use of new technologies like mobile data terminals.

Many ITS technologies demand little from the individuals who use them. Managers planning on using ITS to improve coordination should keep the abilities of their employees in mind. In some cases, technologically adverse employees may not desire to maintain employment following ITS introduction, often because of initially negative experiences with the technology. This issue and its impacts on the system need to be considered during the initial planning stages.

Retraining employees, be they schedulers, dispatchers, drivers, or others is usually necessary following the implementation of ITS. However, during the planning process, the impacts and demands placed on these individuals should be considered. The higher the degree of user friendliness, the easier the initial training and subsequent operation of the system will be.

The User Friendliness of NDinfo.org

The importance of user friendliness is critical to the success of NDinfo.org. As a web-deployed service the site is expected to be easy to use with no special skills required. Of course, individuals who are unable to use NDinfo.org themselves should still benefit from the system by being assisted by an individual who can navigate the site.

4.2.4 Centralization

Many ITS technologies provide the opportunity for improved efficiency via centralization. The ability of many organizations to use a single shared resource and avoid the costs of duplication can provide immediate benefits.

Centralization embodies one of the major benefits of ITS with regard to coordination. A single expert can develop an expertise in managing the more technologically advanced components of the coordinating agencies. Similarly, a single server can manage the operational data or radio tower can handle signals used by more than one agency.

SMART's Tech Hub

SMART's Oakland Terminal serves as a telecommunications and computational hub for the entire system, including its community partners. SMART also provides technical assistance to its partners including record generation, maintenance support, service analysis, and training resources. This allows SMART's community partners to focus on the demanding task of managing their respective organizations, thereby improving the efficiency of the regional transportation system as a whole.

4.2.5 Scalable Technology

In addition to centralization, certain ITS technologies readily allow scalability. Scalability exists when the incremental cost of increasing the capacity of a system is small. It allows for the ability to increase capacity or functionality without replacing the system. The low marginal cost of additional computational storage is one example. Often technology provides excess capacity that will be utilized some time in the future.

Room for SMART Growth

SMART's system, including its telephone, bandwidth, and computational capabilities, is capable of serving the needs of a clientele many times larger than its present level. If needed, it is also readily scalable to further expand at a minimal cost. A significant increase in ridership on SMART or community partner vehicles that use the system can be easily accommodated. Adoption of the technology solutions hosted by SMART by additional transportation agencies in southeast Michigan could also be handled by the system in its current form.

4.2.6 Redundancy & Backup

Coordination relies on an increased sense of trust among organizations as the actions taken by one may have an increased impact on those with which it coordinates. Likewise, instead of having only a local impact as might have been the case before, uncontrollable events may have system-wide ramifications following an increase in coordination of transportation services. Related concerns about dependence upon the technology used to provide transportation alternatives are an additional concern that gain greater importance in coordinated systems.

The failure of an intelligent transportation system due to an event such as a power failure or a computer glitch could have serious impacts on its users' wellbeing. Additionally, coordination and ITS may add an increased level of complexity to a transportation system, making it much more difficult to operate when certain unforeseen events occur.

The answer to concerns regarding uncertainty is to introduce redundancy and backup into the system. This may involve duplication or alternative methods of achieving a function. For example, the loss of power can be mitigated with an on-site generator, electronic files can be stored in more than one location, and communications between drivers made possible through radio or cellular phone. Though the cost of redundancy may not be small, increasing the reliability of service may be worthwhile.

Backup in Southeast Michigan

With the centralization of technology in a single location and the large area and population relying on its service, the effects of system failure could have devastating effects on SMART and its customers. To address this, SMART has many built-in redundancies with regard to its computer, power, and telecommunications systems that ensure the reliability of the system for all but the rarest of events.

4.3 Making the Most of Available Resources

The resources available to transportation agencies are always limited. The same is true for monies to implement and operate intelligent transportation systems. Making the most of available resources through diligent planning and management is of paramount importance.

Just as transportation needs vary by community so do the resources available to improve the efficiency of its transportation system through ITS and coordination. High costs are often placed on innovators; a technologically adept manager at a single agency may provide significant assistance during the implementation of ITS, and in many cases outside help may be necessary. By adopting generic technology, considering long-term costs, and ensuring that the new system can be managed once it is in place the probability of success increases. These issues are discussed in this section.

4.3.1 The High Cost of Being the First Mover

The cost of being an innovator is high in any field and the same is true for those who are pioneers in designing, implementing, and managing intelligent transportation systems. Cutting-edge technology is usually more expensive and provides less functionality than its successors. Processes and techniques for making the most of the available resources often begin as theories and may take years to refine. In the case of community transportation, the parties who gain most are those who adopt later generations of technology and use tested management methods.

Though ITS is far from being universally present in transportation systems and the evolution and improvement of technologies that aid in its operation continues, much of the costly innovation has already occurred. For many small urban and rural transportation providers, the relative complexity of the transportation system and its challenges may be addressed sufficiently with tested and refined technology at a low cost. By following tested processes paired with the assistance of external parties that have experienced ITS implementation, the cost of developing a successful system falls while the probability of it having its desired effect increases.

SMART Innovation

Being one of the first movers in the field, not only in regard to adopting technology, but also in developing internal processes to manage the system, SMART was required to dedicate a great deal of resources to reach the point where it is today. Many of the technologies employed were much more expensive than present-day successors.

There were also missteps along the way, especially because SMART was an innovator in the pre-ITS architecture period. However, it appears that SMART has not only benefited, but flourished, because of the challenges it faced. A secondary benefit to the innovation that occurred at SMART is that it is now home to many tech-savvy individuals and an organizational culture that embraces technology and the solutions it offers to public transportation.

4.3.2 Attracting technologically adept managers

Managers of agencies that provide community transportation come from a variety of backgrounds; few, however, are college-educated engineers. The absence of this formal education or equivalent technical experience does not preclude an individual from being able to manage the planning, implementation, or operation of intelligent transportation systems. At the same time, a basic understanding of certain technological fundamentals, curiosity, and the ambition to improve upon the status quo are helpful.

Often, all that is needed is a single individual with these traits among the many people that are involved in coordinating a community's transportation. These qualities combined with the ability to communicate with other transportation managers about ITS increases the likelihood of success.

Managing ITS in Kearney

R.Y.D.E. was fortunate to have a manager who was willing to dedicate the time and resources to develop an understanding of the technologies and processes they were considering. Having such a resource in Kearney has been an asset during both the development and operation of its intelligent transportation system.

4.3.3 Making use of consultants

Few, if any, transit agencies serving small urban or rural communities possess the expertise necessary to independently handle the design and implementation of ITS. On the other hand, having adequate knowledge available to oversee the work that is being done by consultants is needed to ensure the proper stewardship of public funds. Identifying what can and cannot be done in-house should be done early in the planning stages. This issue is also present following implementation because it is difficult to manage a system that its manager does not understand.

Consultants should be able to explain, and transportation managers understand, what is going on. Though some of the individuals involved in coordination efforts may have a deeper understanding of what is occurring, managers who are having difficulty should not defer technological issues to others but should request that a clearer explanation be given.

Using Low Cost Resources First

While few, if any, rural and small urban transit agencies have the technological background necessary to independently manage the implementation of ITS, it was the sentiment of R.Y.D.E. that in many cases consultants are not used correctly. It was their view that agencies should begin by using state and federal resources and previous innovators' expertise to educate themselves. Consultants should be contacted only after the agency has identified what it can and cannot do on its own. This approach led to the more effective use of resources while also developing in-house expertise that could be utilized by the agency and by other entities.

4.3.4 Staying Generic

There are a great number of alternatives to choose from when deciding upon what ITS technologies best meet the needs of a community. There is also usually a strong correlation between the cost and functionality of a product. Low cost products may, however, provide all the functionality that a small community needs to meet its transportation needs.

Being able to identify off-the-shelf and other low-cost technology alternatives may not be easy. In some cases, adopting these technologies requires onsite customization that may offset the initial savings. This is especially true in smaller communities where the skills needed to provide such customization may not be readily available.

SMART Does it Off-the-Shelf and In-house

With the exception of the software used to manage the demand-response fleet, the software used to manage SMART's system is available off-the-shelf. Though a degree of technical expertise, which SMART has located in-house, was necessary to connect the components in the desired fashion, a large of amount of money was saved by avoiding the use of specialized software.

4.3.5 Accounting for Long-Term Viability

The design and implementation of ITS in public transportation usually requires significant upfront costs to cover items such new capital, training, and initial data entry. Fortunately, external funds are often available to cover such costs while regular operating costs typically rely more on local support.

Being able to cover the operating expenses of ITS in a coordinated system is paramount to its long-term viability. As these costs may be shared among users in coordinated systems, identifying where and how funds will be generated and how much burden each organization will bear should occur during the planning stages. Lowered costs or increased fare revenue may provide the needed source of local funds.

The Development of NDinfo.org

The initial grant that funded NDinfo.org came from the US Department of Transportation and the Federal Transit Administration. While the USDOT does not object to funding development projects, it is not interested in providing long-term funding to sustain them. During a quarterly meeting with the USDOT and the Community Access Program, the NDinfo.org system was identified as self-sustaining because the project involved multiple services that can assist many different service delivery agencies and businesses. This was thought to provide for collaborative efforts and a greater opportunity to bring in more partners to help support and sustain the long-term needs of the project.

4.3.6 Managing ITS Independently

Though few community transportation systems regularly employ individuals who can develop and deploy ITS technologies without outside help, the ability to manage a system with minimal external assistance is usually necessary to ensure that the costs of its operation remain in check. One benefit of the use of ITS by a number of agencies is that in many cases, there may only be need for a single expert to manage these components. In many cases, transportation providers may want continuing technical or maintenance support for the technology they adopt, which may be provided for in the original contract or via an additional service contract.

Maintaining NDinfo.org

It was important to have internal management tools built into the NDinfo.org system. The ability to make changes to the database and other modifications to the website without the need for programmers or website developers was a functionality desired by the project directors. For example, within the transportation module, transportation authorities have the ability to access and change their own transportation information as they see fit. This can include updating fare increases or decreases for certain rides offered by that authority, or altering their mission statement. Also, if a transit authority develops its own website, it can be added as a link to its NDinfo.org informational page.

5. Summary of Findings

The experiences of SMART, R.Y.D.E., and NDinfo.org provide unique insights that may aid others involved in the design and implementation of ITS. In each case, the organizations view themselves as mobility managers, as opposed to managers of agencies that provide transportation for their communities. As a result, coordination of transportation services was an integral part of the service design.

Both the ability to coordinate and the benefits from doing so are enhanced with ITS. ITS technologies provide the capability needed to manage the more complex system. Agencies that are already coordinating their services with others may see further gains in efficiency arise following the adoption of additional ITS technologies.

There are significant benefits to implementing ITS at the regional level, many of which coincide with the benefits of coordination in general. Centralization of ITS technologies and increased connectivity are primary among these. The design of an intelligent transportation system provides an excellent opportunity to bring people to the table. Designing a successful intelligent system requires that all potential stakeholders participate in order to allow them to be able to communicate their needs and describe their assets.

SMART's initial motivation to become a mobility manager to southeast Michigan began during its struggle for survival. From this period of adversity came innovation in service design and ITS that has proven to be a model nationwide. Though the cost of innovation in ITS was high, SMART is now home to a group of individuals well-versed in the technologies and processes that allow for the operation of a complex system that involves a number of local transportation providers.

Rapid growth in ridership and knowledge of further unsatisfied demand for mobility led R.Y.D.E. to consider ITS. As part of its ITS implementation, R.Y.D.E. was required to design a regional ITS architecture. Though the cost of doing so was considerable, it provided a number of benefits. In addition to considerable planning, it also required that interested parties participate in its design.

Realizing that there was significant need but limited local funds, organizations in North Dakota decided that a statewide solution would best meet its residents' mobility needs. The resulting website, NDinfo.org, aims to provide a statewide user-friendly mobility solution based on identified needs. The importance of system sustainability and the ability of the site to be maintained by non-technical individuals were identified.

Every community and its transportation needs are unique. The same is true for the barriers to coordination that they face. Without an intimate knowledge of existing institutions, individuals, and relationships, improving a community's transportation system is difficult. Providing solutions to nonexistent or relatively unimportant issues can result in continued inefficiency and the misuse of public funds. At the same time, the solutions that ITS can bring to a local community must be accepted and used in order for them to be successful.

Though demanding, going through the process of designing a regional ITS architecture has many benefits including becoming intimately knowledgeable about one's transportation system and what roles various agencies, technologies, and processes can and will play. When deciding upon which ITS technologies to adopt it is important to stay focused on outcomes and not become enamored with the technologies themselves. To ensure the use of ITS once implemented, user friendliness should emphasized during the design phase. Efficiencies in ITS arise because of the benefits from centralization and the scalability of many technologies. System reliability is very important when designing intelligent transportation systems in human service transportation because system failure may affect the well-being of those who rely on it.

It is important to note that high costs are often placed on innovators in any field, including ITS. Having a technologically adept manager at a single agency may provide significant assistance during the implementation of ITS, though in many cases outside help may be necessary. The probability of success increases if implementing agencies adopt generic technology, consider long-term costs, and take steps to ensure that the new system can be managed once it is in place.

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