

Advanced Rural Transportation Information and Coordination (ARTIC) Operational Test Evaluation Report

Location:

Arrowhead Region of Northeastern Minnesota

Prepared for:

Minnesota Department of Transportation
Office of Advanced Transportation Systems

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Advanced Rural Transportation Information and Coordination (ARTIC) Operational Test Evaluation Report

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1.0 Executive Summary

1.1 Summary



Minnesota's 7-County
Arrowhead Region

This report presents the results of a one-year evaluation test of an Intelligent Transportation Systems (ITS) project known as Advanced Rural Transportation Information and Coordination (ARTIC) located in the Arrowhead Region of Northeastern Minnesota. The objective of the project focused on combining resources and streamlining dispatching operations for four transportation agencies: District 1 of the Minnesota Department of Transportation (Mn/DOT), Minnesota State Patrol (MSP) District 3100, City of Virginia Dial-a-Ride, and Arrowhead Transit Services.

Before deployment of this project, the above agencies worked independently of each other, with overlapping functions, duplicate record keeping, and stretched already scarce resources that resulted in degradation of the quality of service to the public.

The focal point of this project is a centralized communications and dispatching center, where the dispatchers communicate with maintenance and emergency vehicles, and dispatch vehicles based on an integrated database that includes functionality, availability, and real time location of vehicles in the field.

A number of evaluation methodology impacts and external influences caused the need to refine the evaluation methodology from that envisioned by the Evaluation Plan.

1.2 Conclusions

Based on the Evaluation Test results contained in this report, the following conclusions are made regarding the ARTIC Evaluation Test:

ITS projects in general and the ARTIC project specifically are difficult to evaluate using traditional transportation infrastructure evaluation methods. The evolving nature of the communications technology external and internal to the project and other factors make it difficult to isolate the effects of the project for adequate evaluation. Scientifically, the evaluation of projects represents “uncontrolled experiments” because of the number of internal and external variables that can influence evaluation measure outcomes.

Overall, the results were very positive with the major accomplishment of a newly formed relationship of Mn/DOT and the MSP. Not only did it improve the morale and productivity of both groups, but it also dramatically improved Mn/DOT and MSP response to accidents, incidents, and other emergency requests.

Student worker labor and annual training expenses were eliminated and replaced by professionally trained, seasoned MSP dispatchers with continually expanding skills critical in addressing emergency situations and incident management.

The support for the ARTIC project is demonstrated by the \$30 million statewide initiative to implement eight additional Transportation Operations and Communications Centers (TOCCs) across rural Minnesota modeled after the ARTIC project. The TOCCs will include similar elements to ARTIC including a consolidated communications center, mobile unit equipment, a wireless communications path and computer network/supporting software, and a multi-frequency high capacity radio console. All centers will have consistent information, management and control systems including traffic management, Computer Aided Dispatch (CAD), internet access, email, word processing/ spreadsheet software, Road/Weather Information System (R/WIS) access, Minnesota Condition Acquisition Reporting System (MnCARS) (formerly PCRS) access, a weather forecasting link, and other web based applications.

Operational personnel gained valuable experience in several areas. The project highlighted the technical and operational issues affected by the introduction of the ARTIC technologies and shared resource methodology. Significant lessons learned were accomplished in the areas of equipment specifications, personnel training, software maturity, and communications system performance.

The project illustrated the value of data exchange between related and unrelated transportation databases. There is a need to integrate

information from the ARTIC system with other databases. The information gathered from one source augments data derived from other sources. Examples of this are the State Patrol system used to conduct driver license and registration checks and the Mn/DOT maintenance management system.

1.3 Introduction/Background



ARTIC mobile roadway units

The test was initiated and funded as an ISTE/ITS federal operational test by the FHWA and conducted by four transportation agencies (Mn/DOT, the Department of Public Safety/MSP, Arrowhead Transit, and City of Virginia Dial-a-Ride). Evaluation test assistance included SRF Consulting Group for the preparation of the field operational test program application and SEH/C.J. Olson Market Research for conducting this operational test evaluation.



Satellite link communications path for vehicle location and data communications

1.4 Project Description

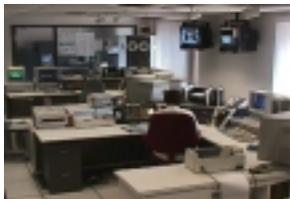
The objective of this project focused on combining resources and streamlining dispatching operations via a single centralized communications center for the four transportation agencies. ARTIC was expanded to serve the Minnesota Department of Natural Resources (MnDNR) fixed wing aircraft.

The ARTIC operational system is characterized by five primary elements including:

- A consolidated communications center serving the MSP, Mn/DOT, the Department of Natural Resources, cellular 911 calls, and other roadway system and emergency communications.
- Mobile unit equipment, including global positioning system (GPS) receivers, satellite transceivers, and mobile data terminals (MDT). The in-vehicle equipment collects location information, collects two-way messages, and sends data packets back to the communication center.
- The wireless signal path connecting the mobile units to the communications center. The communications link consisted of Motient's (formerly American Mobile Satellite Corporation) mobile messaging system (MMS), which uses geosynchronous satellite for end-to-end transmission/reception.
- New radio console equipment that provides increased channel capacity, and the ability to support and control multiple workstations. The console interfaces with radio base stations, telephone switching networks, and provides for routing audio between radio and telephone sources. The system is easily expandable as demands increase.



Old MSP Dispatch Center



New MSP/DOT Comm Center

-
- A computer network with shared workstations configured with the FLEETMAN software package for joint dispatching and call center activities. The network included a central database, network server, digital maps, and map viewing software for the storage, distribution, and display of information in a Windows NT environment.

1.5 Procurement and Project Evolution



New radio console work station with capacity to service all participants

ARTIC evolved from a single vendor/system integrator procurement to separate procurement and implementation of major components. Separate procurement and implementation was determined necessary because it was found that a single vendor could not meet the needs of the project within the available budget.

The local project team and agency advisory team worked closely to develop a systems acceptance test plans and RFPs for individual component procurement.

The local project team played a large role with the selection of individually procured major components of the project.

A summary of how the project was built up incrementally is chronologically summarized below by individual procurement component.



Mn/DOT plow truck with AVL/MDT

New Communications Center – Physically brought multiple agencies together in a centralized dispatch center and integrated work functions. The physical presence of the center also created enthusiasm and confidence that project implementation was progressing. The building elements for the communications center were provided internally by Mn/DOT with opportunities for direct input from the end users.

New Radio Console System – Provided centralized dispatch function to occur for Mn/DOT, MSP, Arrowhead Transit, and City of Virginia Dial-a-Ride. The procurement for the radio console system was designed/purchased and installed by Mn/DOT's Office of Electronic Communications (OEC).

Communications Link – The wireless communications link provided the interface between the mobile unit equipment and the communications dispatch center. Local project participants were able to field test satellite and cellular technology to comparatively evaluate and select satellite as the preferred communications link. The RFP for this element was then able to designate satellite as the communications link technology.

AVL/MDT – These mobile components were installed in MSP vehicles, Mn/DOT maintenance, and transit vehicles. This provided full mobile vehicle communications capabilities with the dispatch



Dynamic Message Sign, one of four controlled by the ARTIC CommCenter

center. The specifications for these components were based on a thorough understanding of the satellite communications link. Mobile unit components were expanded to include a State Patrol fixed wing aircraft and a DNR fixed wing aircraft.

Software – The software components were designed on a well-defined specification with the communications link and the mobile equipment already defined. The software has a Windows NT platform requirement. The CAD element of the software is intended for transit function. The CAD component is presently being tested by MSP. Upon test completion, the CAD component will be deployed statewide including the ARTIC communications center.

This approach has allowed new components to be brought on line gradually, which allowed numerous benefits and refinements detailed in Section 5.0 of this report.

1.6 Evaluation Plan Methodology Impacts and External Influences

A number of project changes and external influences had a significant impact on the envisioned evaluation methodology for the test. There were three major influence areas:

- The Transit Plan Component is on hold and has not been evaluated because of failure by the software vendor to deliver all system software requirements.
- The limited one-year test period does not provide a statistically significant database for some of the identified quantitative evaluation techniques and measures of effectiveness (MOEs).
- Dynamic influences affected the evaluation results include increasing cellular telephone ownership/ usage, the mild winter during the operational test, and the continually evolving nature of the project.

1.7 Refined Evaluation Methodology

The impacts and external influences resulted in a refined evaluation methodology.

Two of the four evaluation techniques originally envisioned are included in this study; case studies and interviews/focus groups. Data source analysis and user surveys were eliminated.

The measures of effectiveness were refined in correlation with the limited evaluation techniques. The four measure of effectiveness categories were retained, but the transit and customer/public input components were eliminated mainly because the transit element failed.

1.8 ARTIC Test Evaluation

The Evaluation Test results are summarized below according to the four measures of effectiveness categories.

User Acceptance and Satisfaction

Dramatic improvement in the communications, cooperation, mutual respect, understanding, and coordination between Mn/DOT and the State Patrol.

A greater sense of control in performing duties in a work environment characterized by many uncontrollable factors.

Reduction in paperwork allows more resources allocated to critical duties.

Excitement regarding further enhancements such as integration of the Criminal Justice Information System (CJIS).

Over time, even skeptical users adapted and integrated the computer-based system into work functions.

System Performance and Reliability

The performance and reliability of the system was rated as very good by system users. Only sporadic loss of the GPS signal in a State Patrol vehicle and some faulty brackets for the MDTs in maintenance trucks were reported.

The 20-minute GPS vehicle location polling interval does not provide enough precision for state trooper vehicle needs. As communications technology becomes more cost effective, this precision will be improved. The 20-minute polling interval is acceptable for maintenance vehicles in a rural environment.

System performance continues to improve with training and experience.

System Efficiency and Effectiveness

Tremendous positive impact in system efficiency with the integration of Mn/DOT and MSP communications. Although difficult to measure in the short one-year test period, system effectiveness has improved in many ways:

- Improved incident locating time/accuracy.
- Faster response times
- Improved allocation of fleet resources
- Reduced public exposure to hazardous conditions
- Reduced staff hour allocation to communications function
- Increased efficiencies in reporting and tracking information

-
- Twenty-four/seven service by seasoned professional staff.
 - Cost of student workers/annual training eliminated.

System Costs

ARTIC is currently under budget for project capital cost elements. The actual capital costs are \$1.573 million, which is \$221,000 under the budget of \$1.794 million. The remaining budget will fund the transit component of the project and remaining operational test evaluation.

Legal and Institutional Issues

The main legal/institutional impact on the ARTIC Evaluation Test has been failure of the transit component to progress for inclusion in the ARTIC system. The transit component issue is under litigation and is not discussed farther in this report.

Other transit solutions are being implemented by Mn/DOT on other projects (Twin Cities Area Southwest Transit Link program). As these solutions are implemented, they will be applied to the ARTIC project.

Mn/DOT and the Minnesota Department of Public Safety are working to deploy nine co-located TOCCs throughout greater Minnesota. The genesis for this TOCC deployment is the ARTIC project.

The ARTIC system continues to evolve and integrate with other ITS activities. Examples include R/WIS (current), traveler information system linkages, traffic management, CAD, Internet access, email, word processing/spreadsheet software, Minnesota Condition Acquisition Reporting Systems (MnCARS), a weather forecasting link, and other web based applications.

1.9 Evaluation Test Methodology Review

The start-up of an ITS project, such as ARTIC, presents unique challenges that are not addressed by traditional Evaluation Test approaches

The combined continuously evolving nature of the project, postponement of the transit component, short one-year test period, and external influences make it very difficult to isolate the effects of the ARTIC project.

This Evaluation Test indicates a refined methodology may be appropriate that focuses on the following:

- A concise definition of changes in agency function before, during, and after the test period (This was provided in the ARTIC evaluation by the pre, mid, and post test interviews).
- Documentation of project technology migration to other agencies/user groups.

-
- Evaluate the effects on operating and staff expenses over a longer period.
 - Only incorporate public/user surveys on projects that are highly visible/interactive with the public. Seamless service technologies do not typically have a measurable impact on public perception even though they can provide valuable benefits to safety and mobility.

2.0 Introduction

This report documents the activities and results of a one-year Evaluation Test of an ITS demonstration project known as the Advanced Rural Transportation Information and Coordination (ARTIC) project.

ARTIC was conceived because of the need for more efficient and effective emergency services in the Arrowhead Region of Northeastern Minnesota (see map Figure 1).

This area covers approximately 18,200 square miles with an aging, low density population (17.1 persons per square mile). It is characterized by harsh winters and is serviced by scattered and inefficient use of transportation resources.

The test was initiated by the FHWA and conducted by Mn/DOT, the Department of Public Safety/MSP, Arrowhead Transit, and City of Virginia Dial-a-Ride. Evaluation test assistance included SRF Consulting Group for the preparation of the field operational test program application and SEH/C.J. Olson Market Research for conducting this operational test evaluation.

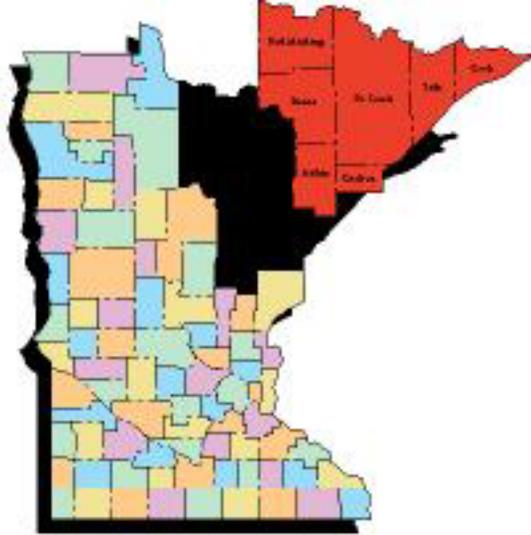
Federal evaluation guidelines require a systematic process for planning, implementing and reporting results of operational tests such as ARTIC. These federally funded operational tests are intended to serve as learning tools and models for potential deployment of advanced technologies throughout the country.

The ARTIC test was based on the Evaluation Plan¹ developed by Edwards and Kelcey as part of the federal evaluation process. This report provides a focused discussion of the Evaluation Test results of the ARTIC project with references to key information from the Evaluation Plan.

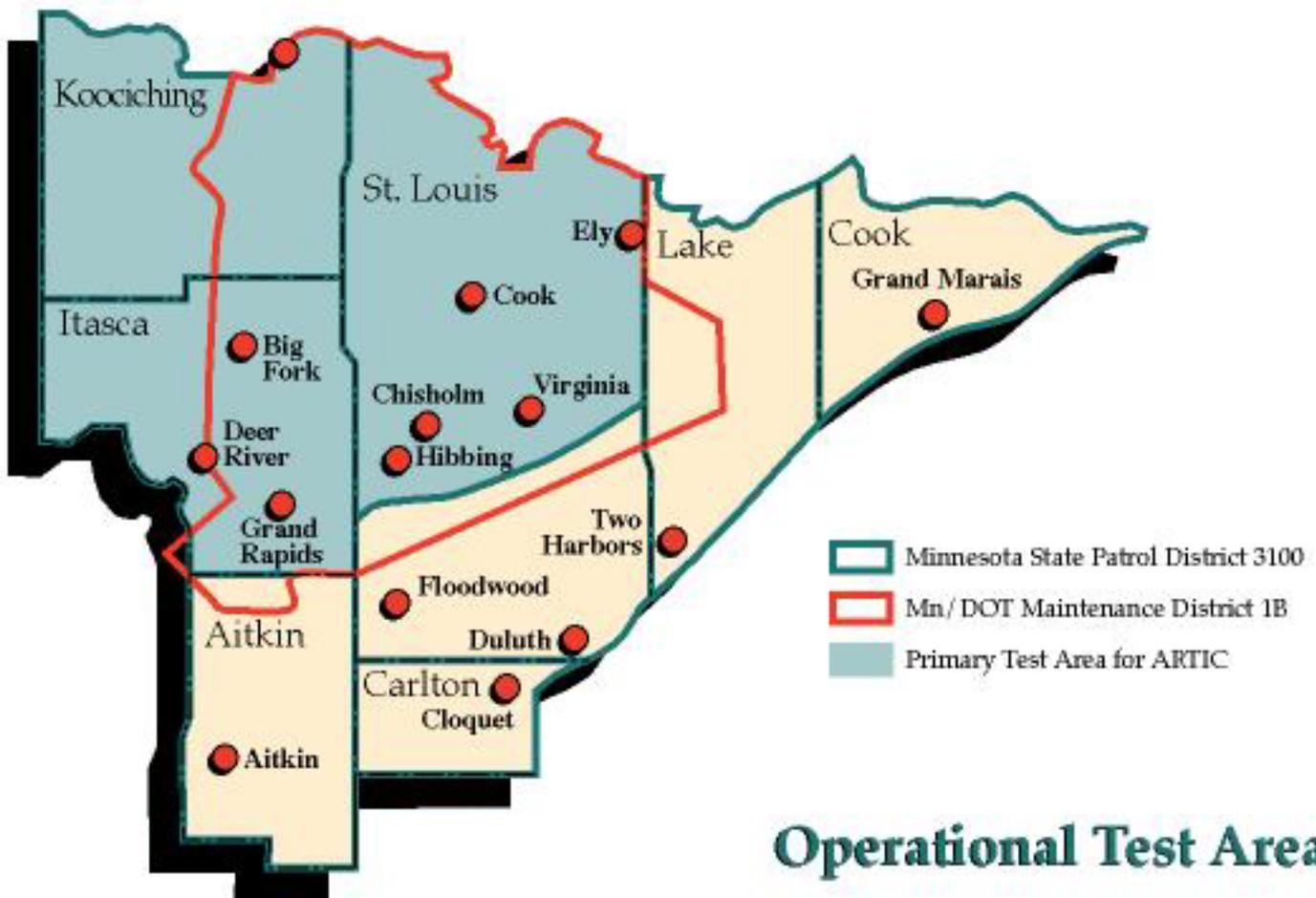
Due to the nature of this project, emphasis is given to individual responses of users (i.e. MSP officers, central dispatch operators, maintenance vehicle drivers, and management) rather than addressing the public or analyzing accident statistics.

Measuring public reaction would be very difficult since the effects of this system are not readily visible to the drivers or other users of the transportation system. Response to accidents would also be difficult to measure as it depends on so many variables that are hard to quantify, and therefore, compare (i.e. severity and location of accidents, use of cellular phones, and weather variability such as mild winters, luck of snow etc.).

¹ Advanced Rural Transportation Information and Coordination (ARTIC) Operational Test, Evaluation Plan, prepared by Edwards and Kelcey for Mn/DOT, February 1997.



Minnesota's 7-County Arrowhead Region



Operational Test Area

It was, therefore, decided that case studies and discussions with actual users would provide the best understanding of the new system and a reasonable comparison of the “before and after” conditions.

This report begins with a brief background and project setting followed by a description of the evaluation methodology and results. Lessons learned by the Evaluation Test and conclusions made by project participants are then presented.

3.0 Background

Summaries of the pre-ARTIC communications capabilities and responsibilities of each of the four participating agencies are repeated from the Evaluation Plan below.

The Minnesota State Patrol District 3100 communications center served State troopers, the Department of Natural Resources (DNR), Bureau of Criminal Apprehension (BCA), Department of Emergency Services, and other state agencies. The District 3100 communications center monitored the Public Safety Department's activities, Mn/DOT Traffic and messages from the Criminal Justice Information System (CJIS). Mobile units were alerted to emergencies and administrative messages that included information sharing and service request with Mn/DOT. In case of an emergency, the appropriate response units were mobilized and set to the scene.

District 3100 operated a 24-hour radio service 365 days per year. Its communications system had been geared towards State Patrol activities. The team participants believed that through consolidated communications and dispatch with others in the area, more efficient and effective delivery of service could be provided.

Mn/DOT District 1B serves the northern part of the Arrowhead region; its mission is to maintain roadways and respond to maintain roadways and respond to emergencies related to roadways and natural disasters. Maintenance fleets are dispatched from the District offices in Virginia and Duluth. Dispatching was provided as a secondary function by staff during business hours. During the winter season, student workers were employed to cover hours outside the 8:00 a.m. to 4:30 p.m. shift. Because of budget constraints dispatching service could not be provided 24 hours per day, seven days per week. This resulted in slow response time to weather emergencies, poor coordination, and communication with the State Patrol and other agencies, and poor quality dispatching techniques. Elimination of the student service with ARTIC in place results in a savings of \$17,000 per year.

Arrowhead Transit, a department of the Arrowhead Economic Opportunity Agency, is the primary public transportation provider in the counties of Aitkin, Carlton, Cook, Itasca, Koochiching, Lake, and St. Louis (except Duluth). It offers commuter service, as well as routing for medial and shopping trips. The system incorporates fixed route, route deviation, dial-a-ride, demand responsive and volunteer driver services.

Arrowhead Transit is the only transportation option for a large segment of the population of the seven counties. It is viewed, therefore, as a necessity, a means to complete business and life support

activities, and to go to and from school and work, and is registered with the Minnesota Department of Human Services as a Special Transportation Provider to wheelchair recipients.

The operations of Arrowhead Transit are decentralized to the county level. Each county essentially operates its own service. Requests for service from users are directed to local offices where call takers manually schedule service. Most requests for demand-responsive service or route deviations must be made a minimum of 24 hours in advance to allow for efficient vehicle scheduling. These local offices are also responsible for dispatching trip information to vehicles and for maintaining trip and vehicle records.

The communication system for Arrowhead Transit is neither efficient nor completely effective. Arrowhead Transit does not have full radio communication coverage of its service area. The present system consisted of five dispatch locations, each with its own radio tower site. Dispatch locations included Gilbert, Grand Rapids, International Falls, Two Harbors, and Cloquet. Because the towers are relatively short, the coverage was limited to less than 35 percent of the transit service area.

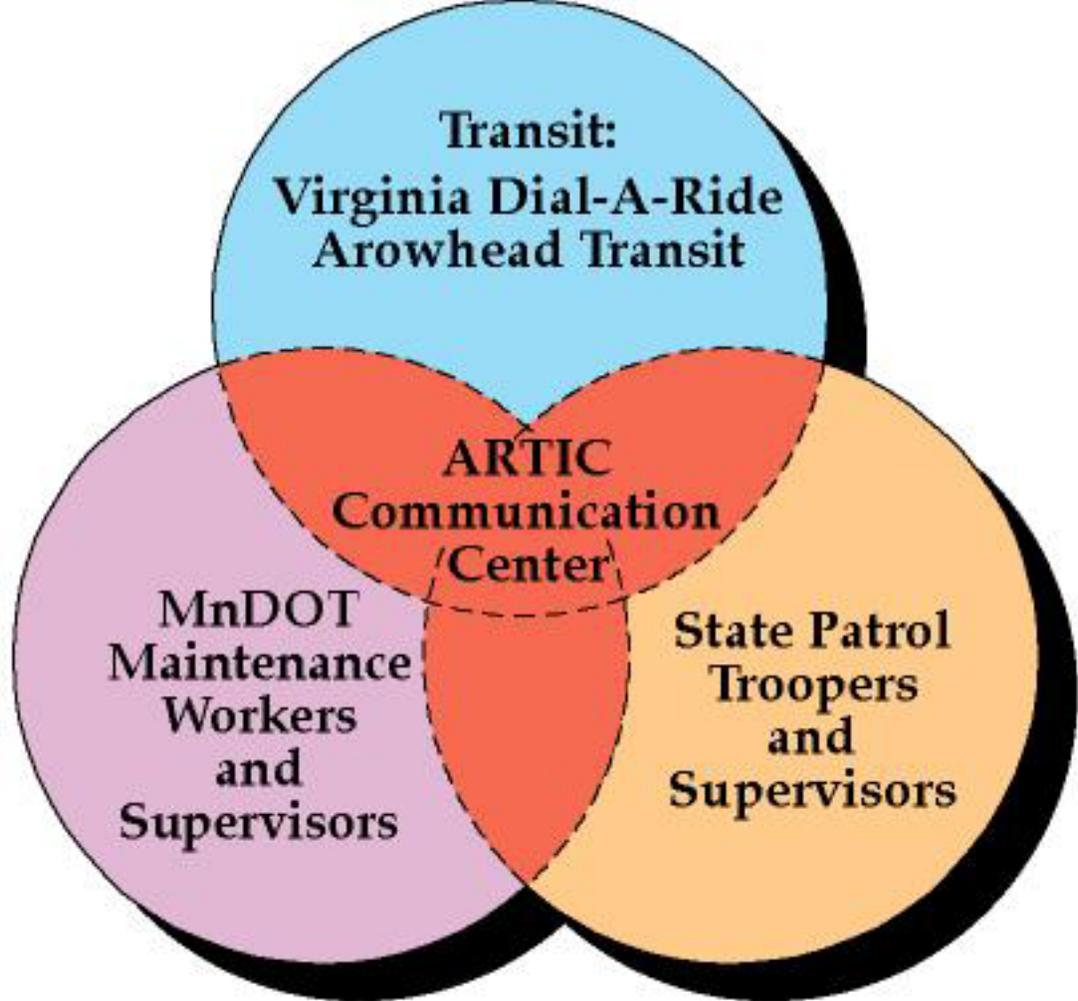
The ARTIC test provided the opportunity to locate transit radio equipment on Mn/DOT radio towers and bring radio communications from International Falls and Grand Rapids into the ARTIC communication center and the Gilbert transit facility.

City of Virginia Dial-a-Ride (VDAR) – The City of Virginia subcontracts with a private company to operate the City’s Dial-a-Ride program within City limits. Frequent destinations are medical facilities and shopping areas. The system has three small buses in operation during most services hours, providing a mix of demand responsive, subscription, and “jitney” services. Hours and fares vary for each type.

VDAR uses a communication system called telephone patch. In phone patch, there is no dispatcher and dispatch center, the radio phone rings into the fixed route bus, and the driver handles the incoming calls. The drivers of the demand-activated vehicles can hear the conversations and can respond to the call appropriately. However, the radio phone allows only one person at a time to speak. This poses problems for many of VDAR senior citizens who use the service. Also, without a dispatch center, trips are not efficiently planned. In cases of emergency, phone patch does not have the ability to locate vehicles, especially in bad weather or if the driver may be injured and cannot respond to the call.

VDAR aims to continue providing mobility to the transportation disadvantaged within the City, who consist of senior citizens, students, the handicapped, non-drivers, and persons without a car at their

disposal. Volunteer drivers are also used to serve Social Service clients.



ARTIC Facilities:

- **Integrated Understanding of Agency Mission and Capabilities**
- **Integrated Approach for Serving the Motoring Public**

4.0 ARTIC Project Description



ARTIC mobile roadway units

The main goal of the ARTIC project was to improve communications and resulting service to the public by streamlining and sharing dispatching operations between the four agencies discussed in the previous section. This was accomplished by centralizing communications for all agencies involved, which, in turn, resulted in eliminating duplication, optimizing resource allocation, and helping different government agencies operate as a team with the same goal: to improve motorist safety, convenience, and efficiency.



Automatic Vehicle Locator (AVL)

Due to the large geographic area served and the reality of limited resources, it became apparent that it was necessary to integrate the agencies functionally so that limited resources could be shared based on proximity of equipment and other factors.

The increase in efficiency is not only due to the simplified process, but also to the capacity to dispatch the closest vehicle or other resource as needed. Due to better communications, teamwork, roles, functions, and boundaries became more flexible with the main objective to provide the best service while maintaining priorities, especially as they relate to emergency situations.

The ARTIC operational system is characterized by five primary elements as described below.



Mn/DOT plow truck with vehicle location and tracking system and onboard mobile data terminal for two-way messaging via satellite link

4.1 Consolidated Communications Center

This new facility houses the MSP and Mn/DOT communications systems with the capability for expansion to include transit communications functions. This center has been functional since December of 1996. The ARTIC communications center is staffed and operated by MSP, and services MSP, Mn/DOT, the Department of Natural Resources (DNR), cellular 911 calls, and other roadway system and emergency communications. Photos of the center are shown in Figure 3. The integrated communications benefits are shown in Figure 4.

4.2 Mobile Unit Equipment

Mobile unit equipment, including global position system (GPS) receivers, satellite transceivers, and mobile data terminals (MDT). The in-vehicle equipment collects location information, collects two-way messages, and sends data packets back to the communications center. The equipment has been installed on 15 Mn/DOT vehicles, 4 MSP vehicles, and 15 transit buses. During the test period, this equipment was expanded to include a State Patrol fixed wing aircraft, a State Patrol helicopter, and a DNR fixed wing aircraft.

Figure 3 – ARTIC Communications Center



Old MSP Dispatch Center

- single console
- 2-way radio
- pencil log
- phone, fax
- typewriter



New MSP/DOT CommCenter

- multiple console
- new radio system
- computer aided dispatch
- integrated systems
- NT network



State Patrol unit with satellite antenna used with tracking and data messaging equipment; mobile data computer with satellite based communications link

4.3 Communications

A wireless communications path connects the mobile units to the communications center. MMS is a two-way data messaging and vehicle tracking system. The MMS system provides Automatic Vehicle Location (AVL) capability through the use of the GPS. The MMS uses Motient's geosynchronous satellite, which has coverage of North America and operates on L-band frequencies.

The Virginia Communications Center (VCC) is connected to Motient's Land Earth Station (LES) in Reston, Virginia via a dedicated lease line from Sprint Communications. The communications software and mapping software are located on the server and workstations at the VCC. The mapping software is called TransCAD and is a fully featured Geographic Information System (GIS) package from Caliper of Newton, Massachusetts.



DNR Aircraft System Expansion

4.4 Radio Console

New radio console equipment provides increased channel capacity and the ability to support and control multiple workstations. The console interfaces with radio base stations, telephone switching networks, and provides for routing audio between radio and telephone sources. The system is easily expandable as demands increase.



Arrowhead Transit MDT two-way messaging

4.5 Computer Network

A computer network is provided with shared workstations configured with the FLEETMAN software package for joint dispatching and call center activities. FLEETMAN software was developed by NAVTEK exclusively for Motient's MMS system. The network included a central database, network server, digital maps, and map viewing software for the storage, distribution, and display of information.

The ARTIC equipment provides the following capabilities:

- Provides communications operators with up-to-date information on vehicle location and availability and improved information during emergency situations.
- Provides supervisors and field personnel with remote access to system data.

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- Facilitates routine data transmission and record keeping needs.
 - Tracks all incoming and outgoing data messages and position locations.
 - Provides capabilities (to be developed) for immediate response to transit user trip requests.

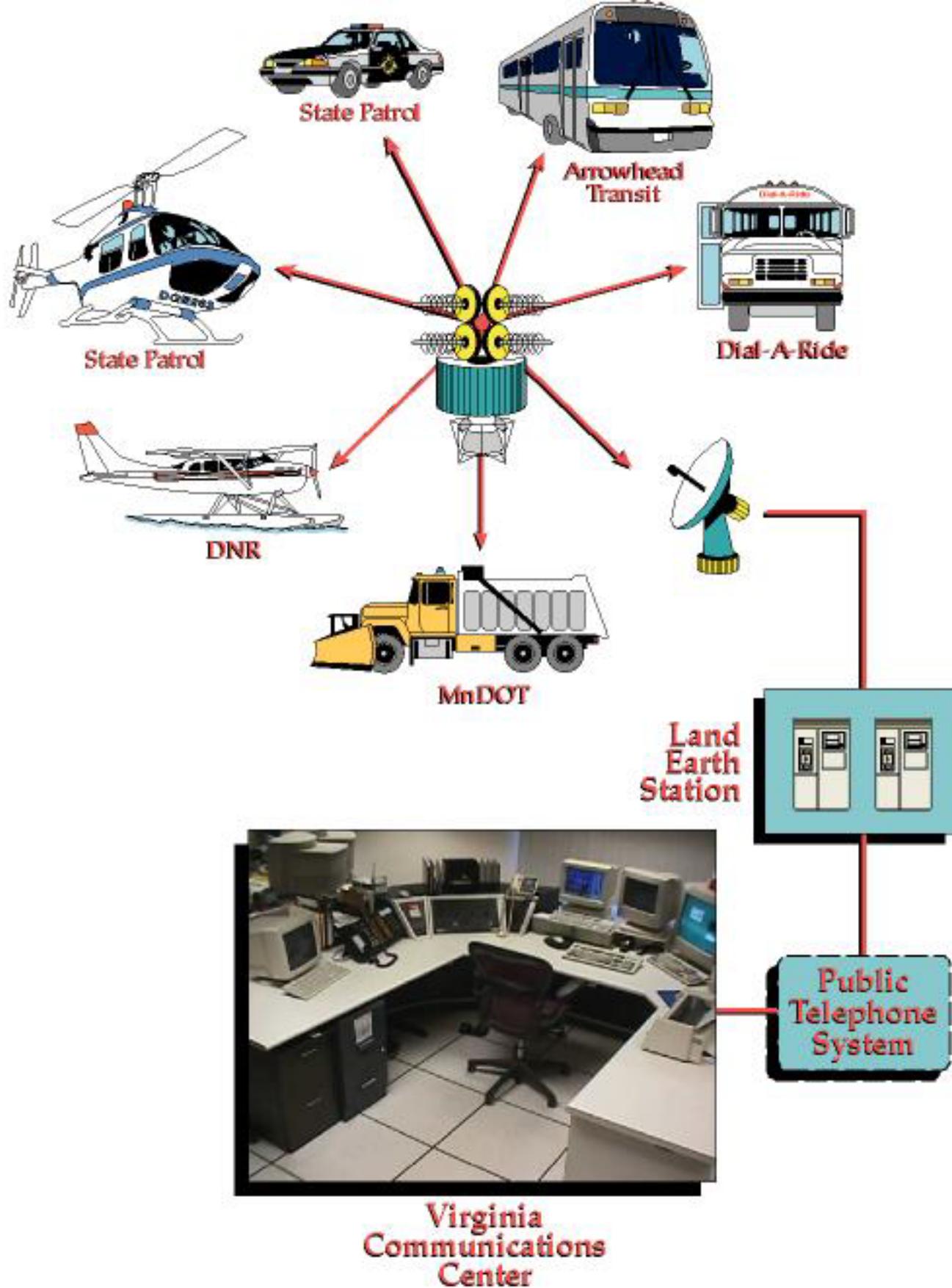


Figure 4
System Diagram and
Communications Path

5.0 Procurement & Project Evolution

ARTIC evolved from a single vendor/system integrator procurement to separate procurement and implementation of major components. Separate procurement and implementation was determined necessary because it was found that a single vendor could not meet the needs of the project. A comparison of traditional single vendor/system integration procurement with ARTIC procurement is provided in Figure 6.

The local project team and agency advisory team worked closely to develop a systems acceptance test plan and RFPs for individual component procurement.

The local project team played a large role with the selection of individually procured major components of the project.

A summary of how the project was built up incrementally is chronologically summarized below by individual procurement component.

New Communications Center – Physically brought multiple agencies together in a centralized dispatch center and integrated work functions. The physical presence of the center also created enthusiasm and confidence that project implementation was progressing. The building elements for the communications center were provided internally by Mn/DOT.

New Radio Console System – Provided centralized dispatch function to occur for Mn/DOT, MSP, Arrowhead Transit, and City of Virginia Dial-a-Ride. The procurement for the radio console system was specified and purchased Mn/DOT's Office of Electronic Communications (OEC).

Communications Link – The wireless communications link provided the interface between the mobile unit equipment and the communications dispatch center.

AVL/MDT – These mobile components were installed in MSP vehicles, Mn/DOT maintenance, and transit vehicles. This provided full mobile vehicle communications capabilities with the dispatch center. The specifications for these components were based on a thorough understanding of the satellite communications link. Mobile unit components were expanded to include a State Patrol fixed wing aircraft, a State Patrol helicopter, and a DNR fixed wing aircraft.

Software –The software components were designed on a well-defined specification with the communications link and the mobile equipment already defined. The software has a Windows NT platform requirement. The CAD element of the software is intended for the

transit function. The CAD component is presently being tested by MSP. Upon test completion, the CAD component will be deployed statewide including the ARTIC communications center.

This approach has allowed new components to be brought online gradually, which resulted in several benefits including:

- End user input on procurement and implementation.
- More time to consider project needs.
- Better knowledge base for decision making based on system operational experience.
- The use of the latest generation equipment that could best meet the needs of the system, manageable implementation better cost control with project broken into smaller pieces.
- Reasonable pace for technology integration by end users.

This process has allowed the ARTIC system to evolve with continual improvement and refinement since its inception and throughout the test period. Some of these improvements and refinements include the following:

- AVL and MDT functional enhancements
- Communications operator skill development, operating enhancements
- Mn/DOT and State Patrol user skill development
- Mapping software enhancements
- Rural Weather Information Systems (WIS) interface
- Communications Center control of variable message signs
- New radio equipment
- Telephone system enhancements including cellular 911

Advantage/Characteristic	Traditional Procurement - Single Vendor/System Integrator	ARTIC Procurement - Separate Procurement and Implementation of Major Components
Allows a large number of qualified vendors to respond to individual component RFP's ensuring competitive bids.	No	Yes
Results in tightly defined RFP's/ operating specifications.	No	Yes
Provides knowledge base for additional component decision making based on system operational experience.	No	Yes
Maximizes time to consider project needs.	No	Yes
Allows postponement of components that need to evolve in the marketplace.	No	Yes
Allows incremental integration of latest technology advances over time.	No	Yes
Provides reasonable pace for technology integration by end users.	No	Yes
Allows integration of existing and currently developing agency skills/ technical components from other projects into the ARTIC project.	No	Yes
Procurement of individual components allows integration with existing (known) project foundation components that minimizes; unknowns, vendor risk and resultant owner costs.	No	Yes
Project development responsibility closely linked with agency project leadership.	Maybe	Yes
Minimizes the separation between agency staff and vendors/ subcontractors.	No	Yes

6.0 Evaluation Plan Methodology

The methodology for the ARTIC Evaluation Test was fully developed in the Evaluation Plan. The Evaluation Plan documents a comprehensive process to be used for the Evaluation Test. This process includes development of the following information summarized below:

- ARTIC Goals and Objectives
- ARTIC Support of National Objectives
- ARTIC Partner Objectives
- Evaluation Goals
- Relation of Evaluation Goals to Project Objectives
- Evaluation Approach- General
- Evaluation Measures and Techniques

During the test period, it was learned that although the evaluation approach is valid, some of the evaluation measures and techniques were either not feasible or would not provide meaningful information.

The impacts and external influences that affect the Evaluation Plan methodology and the resulting refined evaluation methodology are discussed in the next two sections (7.0 and 8.0).

7.0 Evaluation Methodology Impacts and External Influences

There were a number of project changes and external influences that had a significant impact on the evaluation methodology defined in the Evaluation Plan. These influences are listed below with an explanation of how the Evaluation Plan measures of effectiveness are impacted and are shown graphically on Figure 5.

7.1 Transit Component Not Evaluated

The transit component of the test is on hold because of failure for the vendor to deliver system software requirements. This component of the test is under litigation and is not addressed in the evaluation of the ARTIC project. Specifically, the Arrowhead Transit and City of Virginia Dial-a-Ride participants were not included in the evaluation tasks. The elimination of the transit component severely limits the values of user surveys given that the rest of the ARTIC system is virtually invisible to the traveling public.

7.2 Limited Test Period

The one-year test period is not sufficient to assess the implications of the ARTIC project. Because much of the benefit is to improve safety, the one-year period does not yield a statistically significant amount of data for many of the data analysis components recommended in the Evaluation Plan. An example of this is the proposed crash history analysis for the period. Current accident analysis guidelines recommend using a three-year period for a crash history analysis to provide statistically significant assessment. The mild winter in Minnesota during the test period demonstrates how an assessment based on a small sample of data can be flawed. The mild winter reduced the traveling public's exposure to adverse driving conditions resulting in less accident potential. The lack of adverse driving conditions limited the opportunities to implement and evaluate ARTIC system performance. It may be useful to monitor the project over a five-year evaluation period.

7.3 Dynamic Influences

There are a number of external and internal influences that affect the ARTIC system evaluation. Externally, the dramatic increase in cellular phone ownership and use during the test period has increased the public's immediate accessibility to the ARTIC system. Internally, the ARTIC system continually evolved throughout the test period and is still evolving as discussed in Section 5.0. This includes additional system components, continued user acceptance, and expanding user skills. These dynamic influences contribute to the difficulty of assessing available data sources relative to ARTIC system performance.

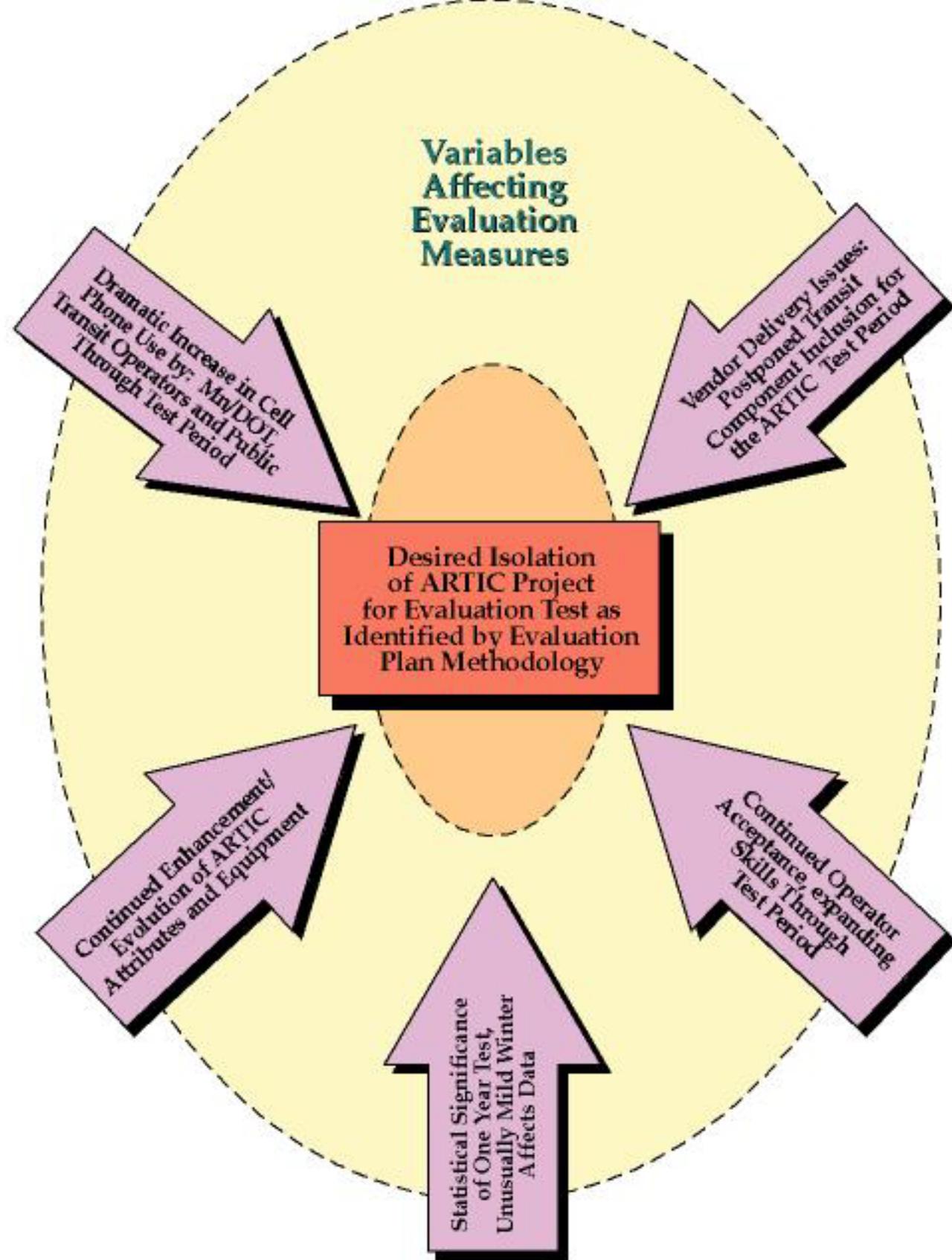


Figure 6
Variables Affecting
ARTIC Evaluation Data

8.0 Refined Evaluation Methodology

The evaluation methodology impacts and external influences described in Section 7.0 indicate that a refined evaluation methodology is required to limit the ARTIC test evaluation to appropriate/meaningful measures of effectiveness. Based on this, two of the four techniques envisioned by the Evaluation Plan have not been included in the ARTIC test evaluation (excluded elements shown in ~~gray~~ text).

- Case studies
- Interviews/focus groups
- ~~Available data analysis~~
- ~~User surveys (questionnaires)~~

The measures of effectiveness have been refined in correlation with reduced evaluation techniques.

User Acceptance and Satisfaction for Each of the Following System User Groups:

- ~~Customers/public~~
- System operators/drivers (i.e. dispatchers, ~~bus drivers~~, troopers, maintenance vehicle drivers)
- System managers/administrators

System and Technical Functional Performance for Each of the Following Components:

- Central Computer hardware/software for ~~reservations~~, scheduling, dispatching, etc.
- Communications links/devices (i.e. AVL, MDTs, cellular phones, LANS)

System Efficiency and Effectiveness, Focusing on Three Key Elements:

- ~~Transit ridership~~
- Personnel and equipment deployment
- Safety and security
- Inter-agency cooperation

Document and Address System Costs including:

- Planning and design
- Procurement and installation
- Operation and maintenance

Document and Address Legal and Institutional Issues and System Transferability including:

- Legal issues impact on the operational test
- Institutional impact on the operational test
- Potential applications to other locations
- Future integration with other ITS activities

9.0 ARTIC Test Evaluation

This section presents the evaluation of the ARTIC test based on the refined evaluation techniques and measures of effectiveness described in Section 8.0. Given that the evaluation techniques have been limited to case studies and interviews, the ARTIC test evaluation is limited mainly to qualitative information based on the participant experiences and perceptions.

9.1 User Acceptance and Satisfaction

Review of the case studies and the user surveys for the before, mid-term, and end testing periods indicates a number of key findings summarized below.

User Surveys

- Dramatic improvement in the communications and cooperation between Mn/DOT and State Patrol personnel. This is by far the most important benefit perceived by the users.
- Having the State Patrol take on dispatching for Mn/DOT was looked upon as a very positive move. ARTIC users report that they now fully understand each other's jobs and the mutual respect between them has increased.
- Working as a team has provided ARTIC users with a sense of having more control over their jobs; this is very important in a work environment characterized by many uncontrollable factors such as weather, accidents etc.

Case Studies

- Significant reductions in paperwork have allowed the troopers to dedicate more time to their "real jobs".
- There are still a few skeptic users that have not adapted to the new system perhaps due to a lack of ease with computer technology and insufficient training.
- Most troopers are very anxious to having the Criminal Justice Information System (CJIS) integrated into the ARTIC system.

...A "belly dump" truck dumped a full load of ¾-inch aggregate on TH 169. Since Mn/DOT maintenance is on the same radio dispatch as State Patrol, they immediately knew what should be done. The clean up was completed faster than it would have been before ARTIC.

Coordinated Response By Dispatch

...At Anchor Lake, a logging truck hit a car and left the scene. The accident occurred on a curve with limited visibility. A Mn/DOT truck that was sanding the road came upon the scene. The operator moved

back upstream from the accident scene in the left lane trying to slow traffic down and move them to the right lane to protect the scene and the trooper. In response to a call to the dispatcher, another Mn/DOT truck with flashing lights parked further upstream; traffic slowed down and stayed in right lane and additional accidents were avoided.

9.2 System Performance and Reliability

The reliability of the system was rated as very good by the ARTIC users. Only sporadic loss of the GPS signal in a State Trooper's vehicle and some faulty brackets for the MDTs in maintenance trucks were reported.

The 20-minute interval between signals for the AVL does not produce enough precision especially when State Trooper vehicles need to be located. At the speeds that these vehicles are operating, especially in emergency situations, a lot of distance can be covered in 20 minutes. This, however, is a shortcoming that can be improved in the near future, as the communications technology becomes more cost effective. The 20-minute polling interval is acceptable for maintenance vehicles in a rural environment.

More extensive training and experience with the system will also improve the overall system performance.

Representative Case Study

...A cellular call to 911 originating from a snowmobiling party reported that a person in the group was having a heart attack. The party was on a snowmobile trail and provided a location using their handheld GPS unit. Using the GPS data and hard copy maps of the trails, the dispatcher was able to dispatch medical assistance to the heart attack victim very quickly.

9.3 System Efficiency and Effectiveness

In addition to the tremendous impact of the integration of the Mn/DOT and State Troopers teams and databases, the system effectiveness has improved in many ways:

- Locating incidents has improved using ARTIC through the use of GPS and AVL technology.
- Quickly locating the vehicle(s) needed at any incident, not only results in faster responses to emergency situations, but also adds the benefit of optimizing allocation of resources with the dispatch operator able to dispatch the closest located resource.
- Although difficult to measure in the short one-year test period, quick responding to maintenance related incidents results in reduced severity and frequency of accidents.

-
- The combination of resources of Mn/DOT and State Patrol has resulted in a decrease in staff hours for Mn/DOT personnel.
 - Due to better and easier record keeping, it has become possible to produce timely reports and track information on specific incidents.
 - Decrease in staff hours and \$17,000 per year savings for student workers. Eliminated annual training of the student workers.
 - Twenty-four hours a day, seven days a week service provided by professionally trained seasoned MSP dispatchers with continually expanding skills critical in addressing emergency situations and incident management.

Representative Case Study

...An automobile accident on TH 53, just north of Virginia, resulted in one dead and four critically injured. An air ambulance to transport the injured to Duluth was needed. The helicopter that would be used could not use the launching pad due to a civic event at that time. An alternative location six miles away from the hospital would have to be used. Instead, the dispatcher proposed a nearby golf course that could be used as a landing site and was able to provide the helicopter pilot the longitude and latitude of the site via electronic mapping and the AVL component. The dispatcher also asked the local police to secure the site. A quick landing site became possible very close to the accident site. (Mn/DOT and the State Patrol report that this type of incident occurs regularly.)

9.4 System Costs

Budgeted and actual costs, as provided by Mn/DOT, are presented in the following table:

**Table 1
ARTIC Project Costs**

Measurement and Data Source			
State Patrol		Mn/DOT	
Capital Costs	Budgeted	Actual	Remarks
Communications Center	\$190,000	\$215,000	(includes unanticipated \$20,000 architecture fee)
• Communications equipment	93,000	319,000	(includes expanded system at Arrowhead Transit)
• Communications links	75,000	59,000	
• Computer hardware	120,000	133,000	
• MSP CAD software	70,000	0	(CAD system will be acquired in 2000-2001 as part of statewide deployment)
• AVL/MDT equipment	521,000	509,000	
• Transit software	107,000	48,000	(paid to date; product is unacceptable; issues are being resolved, worst case cost is \$107,000)
• Project design/support	291,000	232,000	
• Evaluation	127,000	58,000	(evaluation is not complete; projected final cost is \$127,000)
Total	\$1,794,000	\$1,573,000	
Operating Costs			
• Dispatching staff			
• System maintenance staff			
Total <i>(all work completed with existing resources)</i>			

As indicated by the table, ARTIC is currently under budget for the projects capital cost elements. The actual capital costs are currently at \$1.573 million, which is \$221,000 under the budget of \$1.794 million. The remaining budget will fund the transit component of the project and remaining operational test evaluation.

The efficiencies that the ARTIC system brings to interagency operations have not added tangible costs to labor and maintenance in this rural operating environment.

9.5 Legal and Institutional Issues

The main legal/institutional impact on the ARTIC Evaluation Test has been the failure of the transit component to progress for inclusion in the ARTIC system. As stated earlier, the transit component issue is under litigation and is not discussed further in this report.

The pre-test interviews indicated an expectation that operations of the State Patrol and Mn/DOT could be more efficient and less frustrating through the integrated approach envisioned under ARTIC.

The mid-test interviews indicated both Mn/DOT and the State Patrol were very pleased with the consolidated dispatching provided by ARTIC with more efficient communications resulting in faster response to incidents.

By the post-text interviews, Mn/DOT and State Patrol representatives were enthusiastic about increased understanding between the two agencies regarding each one's responsibilities and operating methods, as well as increased operating efficiencies. The basic ARTIC attribute of occupying the same site has allowed interagency relationships to develop between individual staff members, which was cited as a major benefit in cooperative work efforts.

Dispatch staff has been trained to be sensitive the type of information being communicated over the radio when visitors are present, some information is classified as private.

The use of MDTs provides documentation of activities that is a benefit in case of litigation. The State Patrol would like all trooper vehicles equipped with mobile data computers (MDCs) to provide two-way data communications and improve onsite documentation.

Applications to Other Areas

Mn/DOT and the Minnesota Department of Public Safety are working to deploy nine co-located TOCCS throughout greater Minnesota.

The genesis for this TOCC deployment is the ARTIC project.

Integration with Other ITS Activities

The ARTIC system continues to evolve and integrate with other ITS activities.

- R/WIS (remote weather information system)
- Evolving snow plow/maintenance vehicle monitoring sensors
- Traffic management systems (vehicle message signs, cameras, sensors, etc.)
- MSP criminal apprehension
- Traveler information system linkages
- CAD systems
- Minnesota Condition Acquisition Reporting System (MnCARS)
- Weather forecasting linkages

10.0 Evaluation Test Methodology Review

The ARTIC test evaluation process has been a productive learning experience for the Evaluation Test study team. The evaluation methodology report on which the Evaluation Test was designed did an admirable job in attempting to anticipate the measures of effectiveness criteria and the measurement tools for the ARTIC project.

The problems with the ARTIC Evaluation Test methodology relate to the largely traditional transportation infrastructure approach that inherently assumes a fairly static condition, such as a roadway geometric improvement or bridge structure that can easily be isolated for evaluation.

The start-up of an ITS project, such as ARTIC, presents unique challenges that are not addressed by traditional Evaluation Test approaches. The intent of this section is to document what has been learned regarding methodology and to recommend changes that might be considered for future Evaluation Tests on other ITS projects.

The first major lesson learned relates to the evaluation methodology impacts/external influences as discussed in Section 7.0. As the ARTIC test evolved, it was realized that the combined continuously evolving nature of the project, postponement of the transit component, short one-year test period, and external influences make it very difficult to use some of the qualitative measurement tools to isolate the affects of the ARTIC project for a valid assessment of Evaluation Test results.

It is recommended that refinement of Evaluation Test methodology be considered to take on more of a “value added approach” similar to the methodology used in private industry. The goal of this methodology would be to provide a valid evaluation while recognizing the dynamic nature of project evolution and the affects of external influences.

This methodology should also attempt to minimize the time commitment of affected agency staff that are immersed in the daily effort of providing a public service while learning to use a new process introduced by the ITS project.

This refined methodology should focus on the following:

- A concise definition of the changes in affected agency function before, during, and after the test period. This was provided in the ARTIC evaluation by the pre, mid, and post test interviews.
- Documentation of project technology migration to other agencies/user groups over time. This is an indication of the value recognized by peer agencies/user groups familiar with project function details.

-
- Evaluate the affects on operating and staff expenses over a longer period of time. Typically, there is an increase in operating/staff resources allocated during the initial stages of new technology implementation for training and ancillary equipment. Over time, the benefits of the project are realized as user skills increase and a broader range of application is developed. It is only after skills and significant knowledge base is attained that staff begins to find efficiencies not recognized upon initial implementation..
 - Only incorporate public/user surveys on projects that are highly visible/interactive with the public. Many ITS technologies are functioning at their best when the public is unaware that they exist!
 - Seamless service technologies do not typically have a measurable impact on public perception even though they provide valuable benefits in safety and mobility.
 - Documentation/communication of lessons learned during the test period.

Applying this philosophy to the ARTIC Evaluation Test, the following refinements would have been desirable:

- Retain the pre, mid, and post test interviews as measurement tools. This is the most appropriate methodology for assessing user acceptance.
- Retain cost estimate information, but relate it to the evolution of the technology during the test period.
- Document the anticipated continued evolution of the technology. Document whether the project is a step in a larger plan.
- Increase test period to more than one-year if data analysis is desired for inclusion in the plan. The reality of current tight operating budgets and busy agency staff schedules is that staff time will need to be specifically allocated—internal to the agency or through a consultant—to collect and monitor the submission of this data throughout the test period.
- Eliminate surveys of public user groups (significantly impacted by postponement of transit component).
- Retain legal and institutional issues.
- Retain documentation/communication of lessons learned.

11.0 Summary/Conclusions

11.1 Summary

This report presents the results of a one-year evaluation test of an Intelligent Transportation Systems (ITS) project known as Advanced Rural Transportation Information and Coordination (ARTIC) located in the arrowhead region of northeastern Minnesota. The objective of the project focused on combining resources and streamlining dispatching operations for four transportation agencies: District 1 of Mn/DOT, MSP District 3100, City of Virginia Dial-a-Ride, and Arrowhead Transit Services.

Before deployment of this project, the above agencies worked independently of each other, with overlapping functions, duplicate record keeping, and stretched already scarce resources that resulted in degradation of the quality of service to the public.

The focal point of this project is a centralized communications and dispatching center, where the dispatchers communicate with maintenance and emergency vehicles, and dispatch vehicles based on an integrated database that includes functionality, availability, and real time location of vehicles in the field.

A number of evaluation methodology impacts and external influences caused the need to refine the evaluation methodology from that envisioned by the Evaluation Plan.

11.2 Conclusions

Based on the Evaluation Test results contained in this report, the following conclusions are made regarding the ARTIC Evaluation Test:

ITS projects in general and the ARTIC project specifically are difficult to evaluate using traditional transportation infrastructure evaluation methods. The evolving nature of the communications technology external and internal to the project and other factors make it difficult to isolate the effects of the project for adequate evaluation. Scientifically, the evaluation of projects represents “uncontrolled experiments” because of the number of internal and external variables that can influence evaluation measure outcomes.

Overall, the results were very positive with the major accomplishment of a newly formed relationship of Mn/DOT and the MSP. Not only did it improve the morale and productivity of both groups, but it also had dramatic effects on response on accidents, incidents and other emergency requests.

Student worker labor and annual training expenses were eliminated and replaced by professionally trained, seasoned MSP dispatchers with

continually expanding skills critical in addressing emergency situations and incident management.

The support for the ARTIC project is demonstrated by the statewide initiative to implement eight additional Transportation Operations and Communications Centers (TOCCs) across rural Minnesota modeled after the ARTIC project.

Operational personnel gained valuable experience in several areas. The project highlighted the technical operational issues affected by the introduction of the ARTIC technologies and shared resource methodology. Significant lessons learned were accomplished in the areas of equipment specifications, personnel training, software maturity, and communications systems performance.

The project illustrated the value of data exchange between related and unrelated transportation databases. There is a need to integrate information from the ARTIC system with other databases. The information gathered from one source augments data derived from other sources. Examples of this are the State Patrol system used to conduct driver license and registration checks or the Mn/DOT maintenance management system.

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Appendix A

ARTIC Case Study Development Interviews

**Advanced Rural Transportation and Information and
Coordination Project (ARTIC) Operational Test**

ARTIC Case Study Development Interviews

Experiences - Issues - Expectations - Suggestions

August 10 - 12, 1998

October 1 - 6, 1998

Prepared for:

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August 25, 1998

Revised November 3, 1998

ARTIC Case Study Development Interviews

Experiences - Issues - Expectations - Suggestions

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ARTIC Case Study Development Interviews

Experiences - Issues - Expectations - Suggestions

Introduction

Mn/DOT is conducting an operational test of the Advanced Rural Transportation Information and Coordination (ARTIC) Project to test whether the use of technology to enhance inter-agency coordination and information sharing can contribute to higher levels of operational effectiveness and efficiency. SEH Inc., assisted by C. J. Olson Market Research, was retained by Mn/DOT to prepare an evaluation of the ARTIC Project.

One aspect of the evaluation plan is the collection of ARTIC case studies. The case studies are envisioned to be stories about how the processes and technologies introduced to the partner agencies through the ARTIC Project have affected the way in which their agency missions and goals are carried out. The evaluation also includes collection of hard data for the before and after time periods as well as other data. However, the hard data may not capture the essence of ARTIC's performance. In order to capture the essence of ARTIC performance, the evaluation includes interviews with system users - maintenance workers and supervisors, troopers and dispatchers - to hear first-hand of their personal experiences with the ARTIC system.

Staff from Arrowhead Transit and Virginia Dial-A-Ride were not interviewed. These agencies were not able to participate in the ARTIC operational test due to the unavailability of the computer aided transit scheduling system which was to have been developed within this project.

The information received during the interviews is presented in a series of seven tables in this report. The information is presented, at this time, without attribution. The tables in this report are:

- **Table 1 - Interview Subjects:** Names and positions of subjects and the locations and times of their interviews.
- **Table 2 - Case Studies:** Fifteen stories related by one or more interview subjects regarding the use of ARTIC technology to improve their performance.
- **Table 3 - Current Benefits:** Comments by interview subjects describing how ARTIC systems have improved their ability to carry out their assignments.
- **Table 4 - Effectiveness/Efficiency Effects:** The interview subjects described ways in which they thought that the ARTIC system was already making them more efficient in their jobs
- **Table 5 - Expected Future Benefits:** The interview subjects generally expressed the opinion that the system would improve over time and then described what they thought those improvements would be.

ARTIC Case Study Development Interviews

Experiences - Issues - Expectations - Suggestions

- **Table 6 - Needed System Enhancements:** The interview subjects felt that the current ARTIC system had some weaknesses. They described the form which they thought the improvements should take.

Interview Process

Information regarding the ARTIC project was collected in two rounds of interviews. The first round of interviews was conducted, with only one exception, in a one-on-one setting. The only exception was that two State troopers were interviewed together. The interviewer began by describing the evaluation process, concluding with the thought that while hard data would be collected where it existed, it was felt that personal experiences with the ARTIC systems would be a valuable component of the evaluation. The subjects were then asked if they had a personal experience in which the ARTIC system had helped them, or hindered them, in doing their job effectively. The interviews generally took about one to one-and-a-half hours. The interviewer recorded the comments of the subjects and classified them for inclusion in one of the tables. Although the purpose of the interviews was to collect case studies (Table 1), the thoughts contained in the other tables provides additional insights to the experiences of the subjects.

This report was prepared and reviewed in draft form by all the interviewees, by other staff who were meant to be interviewed but who were missed, and by other Mn/DOT staff. Group interviews were then held to collect comments and suggestions. Interviews were held in groups to allow participants to interact during the discussion and to build on each others comments.

Findings

In spite of the variety of positions held by the people who were interviewed, all appeared to be pretty well focussed on a single mission, which is to serve travelers. Some talked about using the system to eliminate paperwork and spend more time being a Road trooper.® Others spoke of being able to keep in closer touch with people on the road and keep them better informed of developing situations. The maintenance supervisor said that ARTIC provides better information which results in a more proactive maintenance force and better road conditions.

Most of the interview subjects described situations which they had experienced in which ARTIC had an effect on the way in which they performed their jobs. Most appreciated the assistance they received through ARTIC.

There was a range of reactions to the ARTIC technologies. Some were embracing the technology and developing their own applications for it to simplify their work. Other used the technology as

it was. Some expressed skepticism about the potential benefits and tended to continue to rely to a greater extent on prior procedures. People with computer experience, and those who received training with the system, were more likely to be enthusiastic about the system.

Conclusions

The input received from the interview subjects is presented in Tables 1 - 6. The conclusions which can be drawn from this input is summarized in the following paragraphs.

1. The combination of Mn/DOT and State Patrol dispatching has significantly enhanced the degree of cooperation between the two agencies. There have been many situations, some of which are described in Table 2 - Case Studies, in which the coordination of Mn/DOT and State Patrol resources has improved the level of service provided to the traveling public.
2. The distrust which existed between the two agencies has virtually disappeared since the dispatching functions were merged. The two agencies have learned to rely on each other for information and for operational support.
3. Both Mn/DOT and the State Patrol are able to work more effectively and efficiently with ARTIC in place. Many more calls are being handled now than in the past.
4. Mn/DOT maintenance vehicles are able to respond to requests for assistance at accident scenes much more quickly than before the system was implemented.
5. The AVL system provides information to emergency helicopter flights which allows them to locate and fly directly to accident scenes, providing emergency medical assistance more quickly than before.
6. ARTIC participants are generally pleased with the way in which ARTIC enhances their ability to perform their assignments, and about the potential to improve ARTIC to further enhance their performance.
7. State Troopers are very anxious to have computerized access to the Criminal Justice Information System (CJIS) in their cars. They thought that this was part of the original proposal, and are disappointed that it has not been installed.
8. Mn/DOT and State Patrol users want more flexibility in equipment installation to match the needs of individual users.

ARTIC Case Study Development Interviews

Experiences - Issues - Expectations - Suggestions

Table 1					
Interview Subjects					
Name	Agency	Round 1		Round 2	
		Date	Time	Date	Time
Sgt. Jon A. Moe	State Patrol Officer, Ely	Aug 10	1600	Oct 1	1020
Bruce Erjavec	State Patrol Dispatcher	Aug 10	1740	Oct 6	1330
Myrna Simmons	State Patrol Dispatcher	Aug 10	2245	Oct 6	1330
Sgt. Fred Wilson	State Patrol Officer, International Falls	Aug 11	0930	Oct 5	1530
Kathy Schultz	State Patrol Dispatcher	Aug 11	1030		
Greg Pierzina	Mn/DOT Maintenance Supervisor, Virginia	Aug 11	1115	Oct 6	1030
Tom Ralidak	State Patrol Dispatch Supervisor	Aug 11	1245	Oct 6	1330
Dick Maddern	ARTIC Project Manager	Aug 11	1400	Oct 6	1200
Mona Putzel	State Patrol Dispatcher	Aug 12	1430	Oct 6	1330
Sgt. Clifford L. ALarry@ Adams	State Patrol Officer, Hibbing	Aug 12	1650	Oct 1	1020
Sgt. Roger Waleski	State Patrol Officer,	Aug 12	1640	Oct 5	1530
Bob Bahr	Mn/DOT Maintenance Supervisor, International Falls	Canceled due to work conflict			
Nola Wright	Mn/DOT Maintenance Supervisor, Virginia	Canceled due to work conflict			
Roger Paradis	State Patrol Dispatcher	Canceled due to vacation		Oct 6	1500
Doug Aho	Mn/DOT Maintenance Operator, Virginia	Canceled due to vacation		Oct 6	1030
Steve Smith	Mn/DOT Maintenance Supervisor, Virginia			Oct 6	1030

ARTIC Case Study Development Interviews

Experiences - Issues - Expectations - Suggestions

Table 2 Case Studies		
No.	Date/ Time	Narrative
1	Winter 97-98/ ?	The Patrol dispatcher was unable to contact a trooper on the radio. Checking the AVL, the dispatcher noted that the trooper's vehicle was located at the Virginia Police Department. The dispatcher was able to contact the trooper through the VPD.
2	Dec 95/ 0300	Doug Aho, working the Dawn Patrol, was plowing the southbound lanes on TH 53, north of Cotton at about MP 45 or 46. He received a radio call regarding a vehicle stopped in the center of the northbound lanes with no lights. The driver was sleeping in the back seat. Doug was able to save time by notifying the Patrol directly through the dispatcher rather than working through the Mn/DOT dispatcher and supervisor.
3	Mar 96/ afternoon	With freezing drizzle conditions indicated by the RWIS system for the late afternoon hours, the Hibbing and Grand Rapids shops decided to keep maintenance staff on the job while the Virginia shop let their staff go home. District-wide freezing drizzle occurred, and caused severe icing on TH 169. Because of the road conditions, Virginia staff needed at least two hours to return to the shop.
4	June or July 98/ ?	Trooper Fred Wilson was in pursuit of an escaped prisoner in the International Falls area. The escaped prisoner had led Trooper Wilson off the trunk highway to county roads, township roads and logging roads, where he left his vehicle and fled into the woods. Trooper Wilson knew that the State Patrol had a helicopter in the area on another issue, and requested assistance. Trooper Wilson did not know his specific location, so he asked the dispatcher to give the helicopter pilot the latitude and longitude of his patrol car from the AVL system. Using GPS-generated data, the helicopter pilot was able to locate Trooper Wilson. The escaped prisoner was apprehended before the helicopter arrived.
5	May 97/?	An Air National Guard helicopter crash-landed in a swamp near Lake Winnibigoshish. The crash disabled their communications. Due to the ground conditions, rescuers could not reach the crash site on foot, in cars, in boats or in ATVs. A rescue helicopter was dispatched from the Twin Cities and located the crash using latitude and longitude data pulled from the AVL system.
6	Aug 98/?	A traffic accident which occurred on TH 2 near Floodwood was reported to the Duluth State Patrol dispatcher. The call was transferred to the Carlton County dispatcher, and then to the Virginia State Patrol dispatcher. Using the AVL mapping, the Virginia dispatcher was able to determine that the accident site was in the Duluth State Patrol area of responsibility.

ARTIC Case Study Development Interviews

Experiences - Issues - Expectations - Suggestions

Table 2 Case Studies		
No.	Date/ Time	Narrative
7	Aug 98/?	A truck carrying a slurry traveled along TH 53 with an open valve, spilling the slurry on the road along its route. The slurry contained petroleum products and was considered a hazardous material. The material also made the road surface slippery. The resolution of the problem required close cooperation of the State Patrol, Mn/DOT, the Minnesota Pollution Control Agency and local cleanup contractors. The dispatcher credited improved inter-agency communications with facilitating the cleanup process.
8	Aug 10, 98/ morning	Sgt. Fred Wilson's radio was out and, during the time he drove to Virginia to have it repaired, he and the dispatcher were able to communicate using the MDT.
9	Spring 98/?	A cell phone 911 call received by the State Patrol indicated a car in the ditch off of TH 53 near Cotton. The responsible State Trooper was tied up with an accident. A nearby Mn/DOT truck, located by AVL, was asked to check the vehicle and report to the dispatcher. The Mn/DOT truck operator determined that the driver only needed a tow from the ditch. The State Patrol dispatcher called for the tow truck. The Mn/DOT truck operator returned to the site soon after and verified that the tow operator had arrived. (Mn/DOT and the State Patrol report that this type of incident occurs regularly.)
10	?/?	A State Trooper came upon a vehicle off the roadway due to icy conditions. The trooper requested a truck with sand. The dispatcher was able to determine, using the AVL, that a maintenance truck was on the road. Before the Mn/DOT truck arrived, a second vehicle went off the road in the same spot, nearly colliding with the patrol vehicle. The trooper called the dispatcher again to find out if help was coming. The dispatcher determined from the AVL that the truck was in the yard loading additional sand, and would be on the scene shortly.
11	Aug. 11/ 1315	A caller complained of four trucks speeding, passing and generally driving erratically on TH 2 east of Grand Rapids. The dispatcher knew that a trooper was in the area, but didn't know the exact location because the trooper's vehicle was not AVL equipped. The dispatcher called the Brainerd district dispatcher to warn them that the trucks were headed in their direction. The dispatcher also informed the trooper of the complaint. If the dispatcher had immediate access to the trooper's location, he could have given better information to the complainant and to the Brainerd dispatcher concerning potential actions.

ARTIC Case Study Development Interviews

Experiences - Issues - Expectations - Suggestions

Table 2 Case Studies		
No.	Date/ Time	Narrative
12	Winter 97/?	A cellular 911 call from a snowmobiling party reported that one of their group was having a heart attack. The party was on a snowmobile trail, and provided a location using their GPS unit. Using the GPS data and hard copy maps of the snowmobile trails, the dispatcher was able to determine how to most quickly get medical assistance to the heart attack victim.
13	mid-June 1998/?	An automobile accident on TH 53 just north of Virginia resulted in one dead and four critically injured at the scene. An air ambulance was needed to transport the injured to the hospital in Duluth. Normally, the injured would have been transported to the helicopter landing pad at the Virginia Hospital. Due to a civic event, however, the landing pad (which was also a parking lot) was unavailable. The hospital contingency plan called for meeting the helicopter at the Eveleth Airport, which is located about six miles south of the hospital. Using her knowledge of the area, the dispatcher determined that there was a golf course very near the accident scene. After determining that the golf course was available as a landing site, the dispatcher provided the latitude and longitude of the landing site to the helicopter pilot, and then asked local police to secure the landing site. (Mn/DOT and the State Patrol report that this type of incident occurs regularly.)
14	?/?	While supervising a wide load move, the trooper discovered that his radio was not working. At the same time, it became apparent that the permit issued for the wide load was not correct. The moving contractor wanted to keep moving. The trooper was able to get the information he needed by using the MDT to communicate with the dispatcher.
15	?/?	A belly dump@truck dumped a full load of 3/4 inch aggregate on TH 169. Because Mn/DOT maintenance workers are on the same radio as the State Patrol, they immediately knew what should be done. The clean up was probably completed more quickly than it would have been using prior practices.
16	Winter 97/?	At Anchor Lake, a logging truck hit a car and left the scene. The accident occurred on a curve with limited visibility. A Mn/DOT truck which was sanding the road came upon the scene. The operator moved back up stream from the accident scene and sat in left lane trying to slow traffic down and move them to right lane to protect the scene and the trooper. In response to a call to the dispatcher, another Mn/DOT truck parked further upstream. Traffic eventually slowed down and stayed in right lane.

ARTIC Case Study Development Interviews

Experiences - Issues - Expectations - Suggestions

Table 2 Case Studies		
No.	Date/ Time	Narrative
17	Jun 98/?	A fatal accident at Jammer Lake involving a car and a tanker truck resulted in closure of both through traffic lanes. Mn/DOT truck operators, located by AVL and dispatched to the scene by the Patrol dispatcher, protected the scene and directed traffic.
18	?/?	A car spun out on glare ice on northbound TH 53 near the 2nd Avenue loop. There was a trooper and a wrecker on the scene. The trooper needed to slow traffic down and get sand on the pavement. At the trooper's request, the dispatcher activated the nearby variable message sign to move traffic into right lane. The Mn/DOT truck closest to the scene (as determined by the AVL system) had no sand on board, but went to the scene to warn approaching traffic. A second Mn/DOT truck, which was sanding near Gilbert, heard the communication about the need for sand. That operator brought sand to the scene. Use of the variable message sign resulted in appropriate behavior by traffic; traffic flowed through site without incident..

ARTIC Case Study Development Interviews

Experiences - Issues - Expectations - Suggestions

Table 3	
Current Benefits	
No.	Narrative
1	Except for time-critical situations, AVL and MDT provide a higher level of security for troopers and higher level of comfort for their significant others.
2	Able to inform dispatcher of plans/locations/other confidentially using the MDT-s.
3	Ability to develop applications for personal use by using word processing, notepad or other software (telephone numbers, schedules, investigation notes, etc.).
4	Direct communication between the patrol and Mn/DOT has meant that more information regarding maintenance operations and safety conditions is exchanged, and the understanding both agencies have gained has improved their ability to serve their common customers. For example: <ul style="list-style-type: none"> • New asphalt pavement seeps asphalt to the surface for 12 - 18 months after construction and becomes slippery more quickly than older asphalt pavement. • Virginia-area taconite plants and the power plant release moisture into the air which can, under certain atmospheric conditions, cause icing conditions on nearby roadways.
5	Great cooperation between the State Patrol and Mn/DOT
6	Mn/DOT truck drivers use the combined dispatching to: <ul style="list-style-type: none"> • Request additional Mn/DOT trucks • Obtain weather updates and forecasts • Obtain road condition reports from RWIS sensors • Request traffic control assistance from the State Patrol • Report incidents
7	International Falls area had probably the poorest radio coverage and benefits greatly from the satellite communications.
8	MDT is an immediately-available backup for radios. Communication by MDT is slower than by radio.
9	Dispatcher provides maintenance operators information regarding potential problems forecasted by RWIS.
10	Combined dispatching is the biggest success story because it has caused: <ul style="list-style-type: none"> • Better communication • Better road conditions • More proactive treatment of road conditions
11	Ability to locate maintenance crews working outside of trucks

ARTIC Case Study Development Interviews

Experiences - Issues - Expectations - Suggestions

Table 3	
Current Benefits	
No.	Narrative
12	Maintenance operators are very willing to assist the State Patrol by checking incident reports and providing assistance as needed.
13	Combining State Patrol and Mn/DOT dispatching under State Patrol has resulted in an increase in the efficiency of State Patrol dispatchers.
14	With combined dispatching, troopers know immediately when Mn/DOT has trucks on the road and can request assistance if necessary.
15	Mn/DOT Dawn Patrol maintenance workers provide up-to-date road condition information to State Patrol allowing an update of conditions for the road conditions telephone report.
16	Customer complaints can be checked against AVL records-
17	Accident records can be compared to maintenance records to see if changes in maintenance procedures are indicated.
18	Provides evidence of Agood behavior@ by maintenance staff. This information can be used to provide feedback as a reinforcement of the behavior.
19	MDT=s allow officers to communicate with their dispatchers from anywhere, while radios are limited to their patrol district.
20	There are more observers of maintenance Ahot spots@ such as the Mitchell Bridge, and quicker responses are possible.
21	Reports by Mn/DOT maintenance workers seem to get to the Patrol officers more quickly.
22	Mn/DOT truck operators feel safer when they are able to check on vehicles which they encounter before approaching the vehicle.
23	Numerous participants in the interviews stated that the most important factor in the improvement in customer service under ARTIC is the enhanced working relationship between Mn/DOT and the State Patrol.

ARTIC Case Study Development Interviews

Experiences - Issues - Expectations - Suggestions

Table 4	
Effectiveness/Efficiency Effects	
No.	Narrative
1	Automated accident reporting system (installed July 98) will save time and paperwork.
2	State Patrol can contact Mn/DOT directly and more quickly to: <ul style="list-style-type: none"> • Report equipment failures • Report spills • Report objects in the roadway
3	The computer is difficult to use outside of patrol car when creating incident reports on the scene.
4	Combined dispatching by State Patrol and Mn/DOT allows many interactions to take place more quickly and smoothly.

Table 5	
Expected Future Benefits	
No.	Narrative
1	Enhanced software with greater capability.
2	The systems will be much more useful in a more typical winter season.
3	Use to automate highway sign inventory.
4	Use to audit permits (e.g., advertising signs).
5	Mn/DOT maintenance activities during storms could be replayed immediately after the storm using digital data regarding accident locations and maintenance resource allocation to refine road maintenance plans for future storms.
6	Mn/DOT staff performing duties which require travel in irregular patterns and on irregular schedules (e.g., traffic counting or signing crews) can be located more quickly and easily.

ARTIC Case Study Development Interviews

Experiences - Issues - Expectations - Suggestions

Table 6	
Needed System Enhancements	
No.	Narrative
1	Direct access to Bureau of Criminal Apprehension (CJIS) computer system to check drivers licenses, stolen vehicles and wants and warrants. Although considered by troopers as a critical part of the original concept, implementation has been delayed.
2	Integration of the statewide Patrol Computer-Aided Dispatch (CAD) system.
3	Some type of emergency (Mayday) communicating capability.
4	Shorter interval between location polling would enhance effectiveness and efficiency and may also enhance trooper and operator security.
5	Real time data from truck regarding material application rates.
6	Reports of where maintenance trucks have been and what has been accomplished.
7	Make equipment more operator-friendly (monitor is in the way and not used much anyway; cab is getting too crowded; radio is easier to use).
8	Installation should be flexible enough to allow individual operators to arrange equipment in the way which suits them.
9	Include snowmobile trails on mapping.
10	Icons representing Mn/DOT vehicles on the AVL mapping should indicate the type of equipment on-board.
11	Agreed upon modifications to equipment mounting were slow to be implemented.
12	Training should be available or required to familiarize users with system capabilities.
13	Troopers should keep dispatchers informed of their activities so that dispatchers are better able to assess troopers situations and needs.
14	Encourage users to develop ideas for system enhancements.
15	Automate trooper activities when it allows troopers to spend more time in law enforcement, not to reduce clerical time for office.
16	Training should be provided during work time.
17	Training should be provided only after the computer equipment is available.

ARTIC Case Study Development Interviews

Experiences - Issues - Expectations - Suggestions

Table 6 Needed System Enhancements	
No.	Narrative
18	Speed up MDT message transmission.
19	Consider using less expensive computers as a means of getting them into more general use.
20	Equipment in trucks must intrude less on operator work space.

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Appendix B

Pre-Test Evaluation of Project Participants' Attitudes

ATTITUDES OF PROJECT PARTICIPANTS
TOWARD PRE-ARTIC SYSTEMS
FOR EVALUATION PURPOSES

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May 1, 1998, Pre-Artic #9846

OBJECTIVES

Mn/DOT is conducting an operational test of the Advanced Rural Transportation Information and Coordination (ARTIC) project to test whether the use of technology to enhance interagency coordination and information sharing can contribute to higher levels of operational effectiveness and efficiency.

SEH, Inc., assisted by C.J. Olson Market Research, has been retained by Mn/DOT to prepare an evaluation of the ARTIC project.

The primary objective of this qualitative research was to determine the attitudes of Project Participants toward how calls were received and dispatched for transportation, emergency, and maintenance services, before the ARTIC system was installed and deployed.

To accomplish this primary objective, the following information was gathered and analyzed:

- Description of usual handling of calls for service, Pre-ARTIC.
- Attitudes toward capabilities of old system.
- Description of interaction between Mn/DOT, Minnesota State Patrol, and Arrowhead Transit/Virginia Dial-a-Ride.
- Strengths and weaknesses of old system regarding incident location, weather and road information, and dispatching capabilities.
- Staff management issues, and Pre-ARTIC.
- Expectations of the ARTIC system:
 - Improvements in speed of dispatch/scheduling
 - Reliability of information
 - Training and other staffing issues
 - Impact on operating and maintenance budgets
 - Impact on general public
 - Impact on survival rates

METHODOLOGY

Following definition of the project objectives and scheduling of the focus groups, a discussion guide was designed. Dave Warner of SEH and Dick Maddern of Mn/DOT, District 1 approved this instrument.

Dick Maddern recruited and scheduled the mini group participants and the one-on-one interviews. The discussions took place in Virginia and Gilbert Minnesota.

- Group I – Minnesota State Patrol Personnel at Mn/DOT Offices in Virginia, Minnesota
- One-On-One Interview – Mn/DOT Supervisor at Mn/DOT Offices, Virginia, Minnesota
- Group II – Arrowhead Transit and Dial-a-Ride Supervisors at Arrowhead Transit Offices, Gilbert, Minnesota

All discussions were audio recorded and transcriptions were completed for analysis purposes.

SUMMARY OF FINDINGS

PRE-ARTIC SYSTEMS

- **THE MINNESOTA STATE PATROL PERCEPTIONS:**

In describing how calls were received and dispatched prior to ARTIC, the Minnesota State Patrol group participants shared some of their highway incident experiences. The usual Pre-ARTIC procedure included the Minnesota State Patrol identifying a hazardous road condition, contacting Mn/DOT, who then followed their method for handling such things. A typical response was:

“When we would recognize there was a problem, we’re having spinouts or accidents or whatever, and we’d call for sand or assistance from Mn/DOT. It was maybe by chance we might get it right away, but very unlikely. A lot of times a foreman had to come out and also observe what the Troopers were observing, and then make a determination to call somebody out. And sometimes we were 80 miles away from where the foreman lived.”

This procedure, which apparently happened frequently, would obviously contribute to create the image among their customers that the Minnesota State Patrol and Mn/DOT are unresponsive.

The Mn/DOT respondent described their Pre-ARTIC procedure for receiving and dispatching calls as they came in saying the receptionist would receive information from callers and then dispatch it to the appropriate person or area. Based on this individual’s response, the calls received after-hours or on weekends were either not answered, or in the winter, were answered by student dispatchers in Virginia. During snowstorms, extending some shifts covered additional hours. The Mn/DOT Supervisor pointed out that a fair number of calls were probably missed because they did not have a voice mail system. They had no idea how many were missed. Radio communication with drivers appeared to be undependable, as there were periods of time when contact was lost all together.

- **ARROWHEAD TRANSIT/VIRGINIA DIAL-A-RIDE PERCEPTIONS:**

When the Transit group was asked how calls were received prior to ARTIC, it was mentioned that no specific person took the calls. Rather, whoever answers the phone would take down ride request information and pass it to the Dispatcher. One group participant described the process as:

“It’s been real labor intensive, in that you’re recording information by hand. Sometimes, it would sit there and they’d say, oh no, we forgot to let him know.”

The Virginia Dial-a-Ride calls are routed directly to the bus drivers who take the information as they are operating their vehicles. This communication system was described by the Director as sometimes difficult for customers to use because it only allows one party to a conversation to talk at a time and involves a communication delay in the system, which some riders have difficulty with.

- **PHONE SYSTEM BREAKDOWNS:**

The participants discussed the possibility of breakdowns in their phone systems. The Minnesota State Patrol group said that this was rarely a concern, however, the Mn/DOT Supervisor said that 10-15 years ago this was often the case. He mentioned how the phone company, at that time, was a smaller carrier that did not maintain lines in the rural areas, as was necessary. There was often no phone service between cities. It appears that in recent years, however, this problem has been non-existent. The Transit respondents felt that phone system breakdowns are not a concern for them.

When asked about the number of calls their systems can handle simultaneously before callers get busy signals, the Minnesota State Patrol group mentioned that the Pre-ARTIC system did not allow many calls at one time. They were unsure of the actual number of lines available. The respondent from Mn/DOT said there were often times when callers received a busy signal due to the fact that there were only two incoming lines available, Pre-ARTIC. The Arrowhead Transit respondents indicated that they were not aware of any callers having trouble getting their calls through to their offices. They mentioned that the calls go through their main agency offices. The Dial-a-Ride system handles only one call at a time.

- **Mn/DOT-MSP-AT/VDAR RELATIONSHIPS:**

The Minnesota State Patrol group described their relationship with Mn/DOT before ARTIC as strained. The time delays involved when responding to a call from the Minnesota State Patrol seemed to be the most critical issue. The discussion centered on the issues discussed earlier, page 3, relative to the Minnesota State Patrol calling for emergency sanding from Mn/DOT, not getting it fast enough because of Mn/DOT needing to have these situations reviewed by a Supervisor before actually deploying the vehicles for sanding. The Minnesota State Patrol group and Mn/DOT staff said that they did not have much contact with Arrowhead Transit, or Virginia Dial-a Ride.

A typical comment describing this relationship was:

“It’s hard to have good relations when you have a Trooper at the scene of cars that are spinning out and you request sand or some sort of work to be done to help prevent this. And the response is we’ll send a foreman out. It’s hard to have a working relationship that is any kind of a trusting relationship. And you think, you know, I’ve been doing this job for 16 years, I can tell you when it’s slippery or when it’s not. This doesn’t foster good will at all.”

The Minnesota State Patrol participants mentioned other situations that were handled with difficulty, such as the process for reporting a traffic sign down, that could take a few days to see a resolution.

The strained relationship was also experienced on the Mn/DOT side. This respondent said there was aggravation and general misunderstanding between the Minnesota State Patrol and Mn/DOT. His comment was, “We had a working relationship, but I wouldn’t call it a real good one.”

- **INCIDENT LOCATION ISSUES:**

The Minnesota State Patrol and Mn/DOT research participants were asked to discuss any difficulties they may have had locating accidents or incidents before ARTIC. Both groups indicated that identifying incident location was a common difficulty. The use of maps and making a visual search of a portion of highway were both common methods for clarifying the location of vehicles.

- **REPORTING ISSUES:**

When questioned about the handling of incident reports and other written reports prior to the ARTIC system, the Minnesota State Patrol respondents described a very unsophisticated system of hand-writing the incident reports, then mailing the reports to the Minnesota State Patrol office weekly. They mentioned that most Troopers did not report on every incident they handled. Because this system was not computerized, a manual search for a report of an accident that could have happened years before, was necessary.

The Mn/DOT system of reporting was even less sophisticated than the Minnesota State Patrol's system. There were few times when reports were written at all. Records were kept only on unusual situations that occurred and only occasionally.

Arrowhead Transit participants described reports being written in their organization by many different people on staff. Someone said:

“Reports are handled by many people for all different reasons. They’re handled by one person for statistics, they’re handled by another one, for say, payroll purposes. They’re handled by another one for accounts receivable.”

It was further mentioned that Arrowhead Transit had no system in place for keeping records of their customer base.

• **MANAGEMENT ISSUES**

Most of the participants in the discussions were involved in managing other staffing issues in their organizations. When asked how satisfied they were with the way they were able to manage their staff before ARTIC, typical responses were:

Minnesota State Patrol:

- Incident reports were only mailed in once a week, making it difficult to monitor troopers’ activities.
- When accident reports were requested, the reports were not even in the office because the weekly report had not been received.

Mn/DOT:

- Office staff experienced a great deal of stress due to the number of complaints by the public regarding lack of road maintenance. This contributed to staff who felt overwhelmed by repeated calls related to the same incident, because of the lack of communication capabilities from the office to the trucks.
- Not knowing the location of trucks made it difficult to respond to complaints, such as a road that was not plowed without having a supervisor actually driving out to the site and confirming the problem.

Arrowhead Transit:

- Not having periodic reports from the bus drivers made it difficult to know whether or not buses were on schedule.
- Longer runs, such as to Ely, do not have radio contact with the center

Virginia Dial-a-Ride experiences no particular management problems.

• **LEGAL OR INSTITUTIONAL CONCERNS:**

In discussing the possibility that legal or institutional concerns might interfere with the way that they can most efficiently do their work, Minnesota State Patrol officers expressed some legal concerns surrounding the use of deadly force during pursuits. They also mentioned concerns about sexual harassment issues. The Mn/DOT respondent mentioned possible legal concerns, which could arise if a highway was not properly treated, resulting in an accident.

The Transit group spoke more of institutional concerns, which interfere with how they service the public. One Arrowhead Transit respondent said:

“Dial-a-Ride service covers the city of Virginia. Our service covers the balance of the area, and that’s a 4-city region that is really pretty closely connected. We don’t provide service in Virginia. We provide service into the city and out of the city...The relationship is such that I think right now we’re going to need to move toward doing what’s best for the customer, rather than what’s best for each system. So, if the Arrowhead Transit buses will go out on a call from Virginia, the Arrowhead Transit bus could pick that person up...working together much more closely and eliminating the institutional barriers of city boundaries.”

In general, the feeling was that being able to cover for each other, on occasion, makes the operations of Mn/DOT and the Minnesota State Patrol more efficient and less frustrating. This co-operation ought to enable the two groups to communicate with one another more efficiently.

EXPECTATIONS OF THE ARTIC SYSTEM

- **ANTICIPATION OF ARTIC CAPABILITIES:**

The participants in this Pre-ARTIC research were generally very positive and optimistic about what the capabilities of the ARTIC system will mean in their work. Some felt that ARTIC is the “wave of the future”, while others mentioned specific improvements like timesaving for staff.

Training staff on the operation of the ARTIC system did not appear to be a major concern for these research participants. Some had already completed training and found it to pose no problems. Others said that the staff members were anxious to get started with the program and anticipated that the training would go well.

The question regarding how they expected the people they work with to react to ARTIC was answered in a variety of ways. The Minnesota State Patrol respondents mentioned that some of their staff members fear ARTIC simply because it's new. The Mn/DOT Supervisor felt that some of the drivers were skeptical of the program. The Transit group saw no problem with their staff and thought that people in their organizations were excited about the capabilities of the ARTIC system.

There were those that mentioned they were impressed with the high level of reliability of the information provided by ARTIC.

Expectations regarding the reliability of the system, in general, appear to be that ARTIC will be primarily trouble-free. The Arrowhead Transit staff discussed some software problems currently, which they expect to resolve before actual use of the system. One of the Minnesota State Patrol respondents said that he expects ARTIC to be trouble-free. However, the thought of up-grading would be necessary in 3 to 4 years.

- **COMMUNICATIONS FACILITY:**

The new shared communications facility at the MN/DOT offices was discussed at some length. The concept of locating the dispatching functions for all three agencies in a centralized location was met with primarily positive responses. One of the Minnesota State Patrol participants mentioned how combining the job functions had already improved the situation for everyone.

- **IMPACT ON STAFFING AND PAYROLL:**

The Minnesota State Patrol and Mn/DOT participant had a much different view of how ARTIC will impact staff hours and payroll from that of the Transit participants'. Minnesota State Patrol and Mn/DOT participants mentioned the following ways that ARTIC will decrease hours and payroll costs:

- Mn/DOT dispatching duties are being partially taken over by Minnesota State Patrol Dispatchers, which will result in less dispatch hours needed.
- Mn/DOT trucks will be able to more accurately report accidents and will sometimes save the Minnesota State Patrol a trip to the scene.
- Mn/DOT could save time and mileage by having more accurate information, which would avoid lengthy searches and second trips to the scene if necessary equipment was not brought with them.

The Transit group said they felt the ARTIC system would add to the staff hours and payroll because of the administrative time needed to operate the system. It was believed, however, that drivers' hours would probably not be affected, both within Arrowhead Transit and Virginia Dial-a-Ride.

- **IMPACT ON OPERATING AND MAINTENANCE BUDGETS:**

A related question was asked regarding what effect ARTIC could have on operating and maintenance budgets. All three groups appeared to think that maintenance budgets would probably see no change. However, several respondents thought the operational budgets would be affected. The Minnesota State Patrol and Mn/DOT personnel seemed to think the operational budget requirements would be lower with ARTIC due to increased efficiency.

Conversely, the Transit staff interviewed expressed the opinion that the operational budget would need to be higher to cover an increase in administrative costs. One Transit participant said:

“If anything, it may increase it (operational budget) because of our monthly costs for this equipment and for the satellite time, particularly. We pay a monthly fee for that, that we didn’t have before.”

It was mentioned, however, that revenues could also increase with improved customer service. Such comments included:

“What it may do though, or at least we’re hopeful it will do, is it’ll make us more productive. All concerned can gain access, allowing easier access, and it’ll be more seamless, from their perspective. And if that happens, then that’ll help our productivity. As far as passengers per hour is concerned,... that will increase our revenues.”

- **IMPACT ON DRIVING PUBLIC:**

Those participating were asked what effect ARTIC would have on the driving public. Most thought the public would receive better service from Mn/DOT, the Minnesota State Patrol, Arrowhead Transit, and Virginia Dial-a-Ride. There were, however, a few people who thought the public would not be aware of any change, regardless of the fact that the roads may be in better condition. Other comments regarding ARTIC’s possible affect on the driving public were:

- Enhanced public safety
- Increased value for their tax dollars
- Quicker response times
- Improved road conditions
- Improved bus service
- Increased survival rates due to faster response time and improved communication network

CONCLUSIONS

In reviewing the information gathered in this baseline research, the following conclusions are presented. This Pre-ARTIC information will be tested again in mid and post research to measure change, for evaluation purposes.

PRE-ARTIC SYSTEMS:

- Pre-ARTIC systems handling ride requests from Arrowhead Transit are excessively labor intensive and inefficient.
- Virginia Dial-a-Ride's Pre-ARTIC system is frustrating to some due to the fact that it allows only one party to the conversations to speak at a time, and because of the delay built into the communication system.
- The Minnesota State Patrol's system for obtaining needed assistance from Mn/DOT was described as extremely inadequate and slow.
- Prior to ARTIC, residents calling the Minnesota State Patrol or Mn/DOT were often unable to reach the appropriate staff to deal with their complaint or concern.
- Mutual respect and interaction between all involved agencies is very important to staff's job satisfaction and efficiency. Pre-ARTIC location of offices and limited communication capabilities contributed to the inefficiencies.
- For the Minnesota State Patrol and Mn/DOT, a major contributor to management problems has been the inability to locate or communicate quickly with their staff/drivers/troopers.
- Agency interaction difficult and contributes to the inability to provide desired level of service.
- Lack of timely activity reports contributes to inadequate record keeping necessary for tracking information on specific incidents.

EXPECTATIONS OF ARTIC:

- There is a normal apprehension among some drivers and other staff regarding the use of ARTIC because it is different from what they are used to.
- Deployment of the ARTIC system is expected to improve communication between all these groups, Mn/DOT, MSP and Transit.
- Transit participants expect ARTIC to improve the communication between Arrowhead Transit and Virginia Dial-a-Ride, to the point that the institutional barriers of municipal boundaries will be eliminated. This will impact positively on service to their customers, as well as staffing costs.
- MSP and Mn/DOT participants expect ARTIC to improve dispatching of vehicles in the event of incidents requiring road service such as sanding and salt. Apparently, it is believed that prompt attention to dangerous conditions will reduce the liabilities that could result from delayed dispatching to address such incidents.

RESPONDENT PROFILE

State Troopers Group

Length of time with the Minnesota State Patrol:

- 17 years
- 19 years
- 24 years
- 27 years

Position/Title

- Captain
- Lieutenant
- Lieutenant
- Dispatcher

Mn/DOT One-on-One

Length of time in current position:

- About one year

Position/ Title:

- Area Supervisor

(Dick Maddern of Mn/DOT also participated in the first portion of this interview to give some background information that the Area Supervisor was not aware of due to his relatively recent promotion.)

Arrowhead Transit/ Dial-A-Ride Group

Length of time in current position:

- About one year
- Remaining respondents did not indicate

Position/ Title:

- Assistant Administrator for ARTIC Project for Arrowhead Transit
- Dispatcher for Arrowhead Transit
- Director of Arrowhead Transit
- Public Works Supervisor for the City of Virginia (works with Dial-a-ride)

Stage of Involvement with ARTIC:

- Minnesota State Patrol Group - Had begun working with ARTIC a short time
- Mn/DOT Interview – Had begun working with ARTIC a short time
- Transit Group – Had not started to use ARTIC due to continued set-up of system

Appendix C

Mid-Test Evaluation of Project Participants' Attitudes

**Advanced Rural Transportation
Information and Coordination Project
(ARTIC) Operational Test**

**Mid-Test Evaluation of
Project Participants'
Attitudes**

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REPORT NO. 9875

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PROJECT OBJECTIVES

Mn/DOT is conducting an operational test of the Advanced Rural Transportation Information and Coordination (ARTIC) project to test whether the use of technology to enhance inter-agency coordination and information sharing can contribute to higher levels of operational effectiveness and efficiency.

SEH, Inc., assisted by C. J. Olson Market Research, has been retained by Mn/DOT to prepare an evaluation of the ARTIC project.

The primary objective of this qualitative research was to determine the attitudes of project participants toward the ARTIC system at the mid-point of the operational test.

The following information was gathered for this analysis:

- Positives and negatives of the ARTIC system
- Specific evaluation of:
 - MSP and Mn/DOT shared dispatching
 - ARTIC's impact on locating incidents
 - Changes in the number of incident calls
 - Handling of road and weather calls
- Management Issues
- The System's performance compared to Expectations
- Training Issues and Staff Morale
- System Reliability
- ARTIC's impact on:
 - Speedy Dispatch
 - Staff Hours
 - Operational and Maintenance Budgets
 - Survival Rates
- Suggestions for Improvement

- Expectations for the Future of ARTIC at Arrowhead Transit

METHODOLOGY

Following definition of the project objectives and scheduling of the group and individual interviews, a discussion guide was designed. Both Dave Warner of SEH and Dick Maddern of Mn/DOT District 1 approved the questions included in the guide.

Dick Maddern completed the scheduling of the interviews and all discussions took place at the Mn/DOT District 1 offices in Virginia, Minnesota.

The five interviews were as follows:

- State Patrol Radio Communications Supervisors and Dispatcher (3 respondents)
- Mn/DOT Manager (1 respondent)
- Arrowhead Transit Manager (1 respondent)
- State Patrol Trooper (1 respondent)
- Mn/DOT Supervisor (1 respondent)

The qualitative interviews took place on May 18 and 19, 1998. The interviews were audio recorded and the tapes were transcribed for analysis purposes.

RESPONDENT PROFILE

The following titles and positions were included in this qualitative research study:

- State Patrol Lieutenant
- State Patrol Radio Communications Supervisor
- State Patrol Radio Communications Operator
- Mn/DOT ARTIC Project Manager
- Arrowhead Transit Director
- State Patrol Sergeant
- Mn/DOT Maintenance Supervisor

MID-ARTIC RESEARCH FINDINGS

I. MN/DOT AND MINNESOTA STATE PATROL PERCEPTIONS

A. ARTIC PROGRESS REPORT:

POSITIVES:

The Mn/DOT and State Patrol participants were generally satisfied with how the ARTIC Program is working at this point in the operational test.

The specific areas expressed as being positive were:

- The new radio system is much improved over the previous system.
- The telephone system used in ARTIC is more sophisticated than the old system as it has many new capabilities.
- The computer technology in ARTIC has improved staff efficiency.
- The new Dispatch Center provides more space and a much better work environment.
- The MDT's used in the State Patrol vehicles provide the ability to send messages back and forth to the Dispatch Center without broadcasting over the radio.
- The Global Positioning System, GPS, is helpful in some search situations.
- Mn/DOT has the ability to be pro-active rather than reactive when dealing with winter road conditions.

- Communication between Mn/DOT and the State Patrol has improved response times and is believed to have prevented some crashes from occurring.
- Improved staff efficiency, increased job satisfaction and employee morale.

NEGATIVES:

The following areas were specifically mentioned as disappointments or frustrations when discussing the progress of the ARTIC test:

- Staff members have not had the opportunity to work with the system enough to truly experience all capabilities.
- There have been instances when the GPS satellite signal shuts down for several hours in the State Patrol vehicles.
- The Mn/DOT Maintenance Truck Drivers are not using the Mobile Data Terminals to communicate with the Mn/DOT office. The drivers do not find it to be practical communication because of the computer messaging required.

B. DETAILED EVALUATION OF ARTIC:

The following section describes several aspects of the ARTIC Program, which were evaluated, in detail, by State Patrol and Mn/DOT participants.

• **STATE PATROL TAKING ON MN/DOT DISPATCHING:**

When asked how satisfied they were with Mn/DOT's dispatching being handled by the State Patrol, both organizations appeared to be very pleased. By eliminating the number of channels the State Patrol needs to go through to receive Mn/DOT's services, such as sanding a slippery area on a highway, the response time has been drastically reduced.

The open communication was also credited for allowing Mn/DOT Maintenance Workers to assist the State Patrol with situations they hear about over radio communication. This interaction between the two organizations was repeatedly praised as a way to provide faster and more effective services to the public.

Several participants spoke of a telephone system breakdown in the Dispatch Center, discussing an incident and how it was handled as a team rather than individually. The participants mentioned that before ARTIC, the two organizations would not have cooperated with each other and the problem would not have been dealt with as effectively.

- **LOCATING INCIDENTS:**

When State Patrol participants were asked how the ARTIC Program helped them in locating incidents, they said having the Mn/DOT drivers out on the highways and reporting accidents to the State Patrol was a big advantage. The State Patrol indicated that this was very helpful since the Mn/DOT Workers knew their own location much better than most cellular telephone callers who report an accident.

The AVL capabilities were also mentioned as being beneficial when a Trooper with this equipment is on the scene of an accident. In addition, Mn/DOT research participants said that having the State Patrol Dispatchers involved aided them in locating incidents because of the Dispatcher's expertise in obtaining location information from callers.

- **NUMBER OF INCIDENT CALLS:**

State Patrol and Mn/DOT respondents were asked to indicate the number of incident calls their office or center handles on a daily basis. The State Patrol participants were somewhat reluctant to estimate the number of calls due to the variety of requests and situations. They did state that in one day up to 400 lines of log sheets can be filled, keeping in mind that the majority of the calls take more than one recording line on the log.

The State Patrol mentioned that a range of 20 to 80 911 calls were received daily and as many as 4,400 non-911 calls per month. The Mn/DOT Supervisors indicated the amount of calls handled by their administrative personnel has decreased dramatically due to the State Patrol handling the dispatching for Mn/DOT.

When reviewing log records from 1993, and comparing them with records from 1998, the difference is obvious. Mn/DOT previously responded to all calls from the State Patrol requesting assistance as well as other requests for service. With ARTIC in place, these calls are now handled by the State Patrol. The Mn/DOT administrative position has now changed from primarily answering calls to handling only a few calls per week, which has expanded job functions into word processing.

A Mn/DOT Supervisor made one comment describing how calls are handled:

“...I would say the calls related to emergency response or highway problems, they no longer come to the maintenance side. They go directly to where they need to be handled, State Patrol. And then we have that real open communication between State Patrol and Mn/DOT. And it works.”

• **ROAD AND WEATHER INFORMATION CALLS:**

Road and weather information calls that were handled by Mn/DOT prior to ARTIC, are now taken by a recorded message line. In the past, the recording was not used as much due to inaccurate and outdated information.

Currently, the State Patrol is maintaining and updating the information on the recording seven days a week. The State Patrol and Mn/DOT respondents said they receive few requests for road and weather information since the ARTIC Program was put in place. The public appears to have accepted the recorded message line as the information source. The telephone number for this message line is published in the local telephone directory. Though no advertising efforts have been made to promote using this information line, it appears to be a success.

C. MANAGEMENT ISSUES:

STATE PATROL MANAGEMENT:

Positive reactions came from State Patrol Supervisors when asked how satisfied they are with managing their staff now that ARTIC is in place. The Radio Communications Supervisor thought that having the technology, equipment and new Dispatch Center has affected the Radio Operators in the following ways:

- Improved working conditions have decreased the stress level in staff.
- They feel more confident in their own abilities due to the new equipment they are using, which enables them to do their jobs more effectively.
- There appears to be more job satisfaction.
- They are willing to take on additional job responsibilities because they have the equipment to accomplish more duties.

MN/DOT MANAGEMENT:

The Mn/DOT Manager and Supervisor were asked how satisfied they were with managing their staff with ARTIC in place. They also saw positive changes in the way the Maintenance Workers performed their duties. These changes included:

- Drivers now hear about a problem over the radio and are ready to help before they are even called.
- They have taken on more responsibilities and help in situations where in the past they wouldn't because they had no knowledge of what the State Patrol was dealing with.

Mn/DOT respondents also mentioned that ARTIC has enabled them to look at the Mapping Screen in the Dispatch Center and see the current location of the trucks. This is an advantage when scheduling trucks to work at different sites.

D. SYSTEM'S PERFORMANCE COMPARED WITH EXPECTATIONS:

AREAS WHERE EXPECTATIONS ARE BEING MET:

Research participants from the State Patrol and Mn/DOT were asked to discuss how the ARTIC System is performing compared to their expectations. In general, respondents felt ARTIC is meeting or exceeding their expectations. The specific aspects of the program mentioned as meeting expectations were:

- The new Communications Center.
- The cooperative efforts between the two organizations.

- The capabilities of the equipment in the Communications Center such as conference calls and GPS location capabilities.
- The shared radio communication between Dispatch, State Patrol and Mn/DOT.

AREAS WHERE EXPECTATIONS ARE NOT BEING MET:

The ways that the ARTIC System has not met expectations include:

- A Mn/DOT Supervisor indicated that he was expecting the MDT (Mobile Data Terminals) to be used more for communicating from the trucks to the office. This has not yet occurred, as the drivers do not find it practical to key in messages as opposed to using the radio, to which they are accustomed.
- A State Patrol Trooper expected to use the system's capabilities early on, however, has not been able to because of few opportunities and limited training.
- There have been some challenges in integrating the new equipment with pre-existing equipment.

TRAINING ISSUES:

Some of the State Patrol research participants expressed frustration regarding the amount of training staff members received on the ARTIC equipment. It was discussed that some Troopers who have the AVL in their car would like more training to fully understand its' capabilities. It appeared that Dispatchers learned much of what they know from on the job training and from each other as they discover new implementations of the technology.

Similarly, the Mn/DOT respondents mentioned that there could have been more training initially. However, they also said the staff would need

to be retrained or refreshed on the information they learned initially because the staff does not use the ARTIC System on a daily basis. To counteract some of this lost information, "cheat sheets" have been developed to aid the employees when using the computer system.

RELIABILITY OF THE SYSTEM:

The State Patrol Dispatcher and Radio Communications Supervisor seem very impressed with the quality of the ARTIC Program's equipment. Specifically mentioned were the telephone system, radio, and computer systems. The State Patrol Trooper, who has the AVL in his vehicle, however, mentioned again that the GPS signal is not always functioning correctly. The State Patrol Trooper has observed some loss of the signal approximately every other day.

Despite the telephone system breakdown, the Mn/DOT respondents appeared to perceive the ARTIC equipment as very reliable. A comment was made that some equipment problems should be expected during an operational test. One Mn/DOT respondent said that it was necessary to replace several brackets that hold up the terminals in the trucks. The brackets failed due to the vibration in the maintenance vehicles.

E. ARTIC'S IMPACT

SPEED OF DISPATCH:

The Radio Communications staff and the State Patrol Supervisors included in this study felt ARTIC can improve the speed of dispatch. They mentioned the ability to send an aircraft directly to an exact location of an incident when a State Patrol vehicle equipped with AVL is on the scene. Similarly, the speed of dispatch is expected to increase when they have CAD, Computer Aided Dispatch, which is expected to be installed in the future. The State Patrol Trooper with AVL thought the speed of dispatch was improved when the Radio Operator used the mapping capability to decide which car to send to an incident. The State Patrol mentioned that some Dispatchers do not use mapping, which can slow the response time.

The Mn/DOT respondents saw an improvement in the speed of dispatch. The primary factors mentioned were the new combined dispatching process and the fact that the State Patrol Troopers now report problems for Mn/DOT so they learn about the incidents earlier.

STAFF HOURS:

When asked how ARTIC is impacting staff hours, the State Patrol participants discussed how the Dispatchers now have more responsibilities due to adding Mn/DOT dispatching duties and the new equipment. One respondent mentioned that a fifth Dispatcher was recently hired. The additional hours may not only be a result of ARTIC, but also could be the result of increased 911 cellular calls.

The Mn/DOT Supervisors commented that the use of ARTIC equipment has eliminated the need for four to five part-time student Dispatchers who worked evenings and weekends during the winter months. There is no longer a need for these employees now that the State Patrol Communications Center is handling the Mn/DOT calls.

OPERATIONAL & MAINTENANCE BUDGETS:

Based on these discussions, it appeared MN/DOT and State Patrol participants appeared to think the operational and maintenance budgets would be positively affected overall, due to agencies working together and offering better service to the public.

An example of shared personnel and resources was brought up by one of the State Patrol participants:

“...The sharing of resources...having the MIS person come in, like yesterday, to help out, without having to call someone out of St. Paul or somewhere else. Just that alone, just sharing some of the people, and more resources, like equipment. It can be bringing in a fax machine from Mn/DOT to cover us because, well they provided the fax machine because we're doing so much work for Mn/DOT. But where before we'd have to try to get a fax machine.”

Again, Mn/DOT mentioned eliminating the part-time student Dispatchers as one of the major ways ARTIC is impacting budgets. The administrative employee who previously handled the daytime dispatching for Mn/DOT has now been freed up to take on other duties which previously may have required hiring part-time clerical help.

SURVIVAL RATES:

When asked what impact ARTIC is having on survival rates, State Patrol and Mn/DOT respondents said it is difficult to measure. However, they were very confident that faster response time to accident scenes and slippery areas on highways does decrease additional crashes, which should improve survival rates.

F. SUGGESTIONS FOR IMPROVEMENT

POSSIBLE PROBLEMS MENTIONED BY STATE PATROL:

The following issues were brought up during the State Patrol interviews:

- The new computer and communication equipment is being integrated with the older equipment, which sometimes can cause problems.
- The project's purpose and expectations were not adequately communicated to some Troopers using the equipment.
- More training and utilization of the AVL and laptop is needed for Troopers.
- Improved availability of computer programmers is needed to solve some of the system's software problems.

POSSIBLE PROBLEMS MENTIONED BY MN/DOT:

The Mn/DOT respondents described the following items as problems with the ARTIC Program at this point in the operational test:

- The Maintenance Workers do not currently utilize the MDT's as they could, due to their apprehension regarding using the terminals.
- Many staff members do not recall the operational functions of the equipment due to low utilization of the system.

II. ARROWHEAD TRANSIT

A. ARTIC PROGRESS REPORT:

When talking with the Director of Arrowhead Transit, it appears that staff members are not currently utilizing the ARTIC Program. The reason given for the delay was software problems.

It was explained that the original schedule stated they would be operational in the Gilbert Office in July 1998, and add the other four offices by the end of August 1998. This, however, appears to be unattainable due to the delays created by the software vendor.

The primary barrier, explained by the respondent is:

“And right now we’re continuing to face problems with not so much the basic software operating in a voice dispatch, but we’re having a problem with conductivity to the Mobil Data Terminals and actually being able to send messages.”

The respondent continued to mention that currently Arrowhead Transit is waiting to hear from the State Department of Administration and the Attorney General’s Office regarding any possible legal action that the transit company can take with the vendor. Other transit companies, which the respondent has had discussions with are experiencing similar software problems.

The Transit Director described the main barrier to the ARTIC Program’s success as being incomplete development. His comment was:

“I think they (the vendor) spend as much time as they’re able to, at our office, at this point, because I don’t think their product is fully enough developed. I think when they get a

bit more of their product developed, then they will send somebody out to spend some time and debug it.”

B. STAFF MORALE AND TRAINING ISSUES:

The staff at Arrowhead Transit has experienced the ups and downs of expecting the system to help them in their jobs and then seeing it continue to fail to function as it should. As the Manager said, the constant problems have taken a toll on the staff's confidence in the ARTIC Program. In some cases, they often go back to the old way of doing things, by using pen and paper to keep records, etc.

In July 1997, initial training was conducted on the MDT's. However, due to the delays with the system, the staff has used them very little. According to the Transit Manager, this means more training will be required when the system is up and running.

C. CURRENT USE OF EQUIPMENT:

When asked if Arrowhead Transit is using any portion of the ARTIC System, the research participant indicated that in recent weeks a few drivers have started using the MDT's. They are using the terminals to log in and out of their shifts to become familiar with the equipment.

At this point, Virginia Dial-A-Ride is not participating in any aspect of the ARTIC Program. However, according to the transit respondent, they are still planning to be part of the ARTIC Program in the future.

**D. EXPECTATIONS FOR THE FUTURE OF ARTIC AT
ARROWHEAD TRANSIT:**

Despite the delays and numerous problems with integrating the ARTIC Program into Arrowhead Transit, the Director included in this study remained positive overall. The Director's comment, which summed up what he expected of ARTIC in the future was:

“Well, I’m still optimistic that we’re going to get this thing to work. I’m disappointed that it’s taking this long. I feel, I guess that we’re maybe into this a little too early. The technology really isn’t there...I think it’s going to be painful, as it continues to be, but I think it’ll work. I think it’s not going to be fully operational to the way we envision it, for the terms of this operational test. That’s the sense I’m getting right now. But I think we’re going to be able to do some of it.”

CONCLUSIONS

STATE PATROL & MN/DOT:

- Overall, respondents were very positive about ARTIC's progress.
- The aspect of the new system being used, which respondents seem to be the most positive about, is the cooperation and communication between the State Patrol and Mn/DOT.
- Those involved with ARTIC have more information and improved communication which has resulted in a feeling of more control over their jobs. This is important to them because most of what they deal with is uncontrollable, such as the weather.
- The employees that work closely with the new equipment and capabilities of ARTIC, such as Dispatchers, are the most enthusiastic about the program.
- The Mn/DOT Maintenance Workers generally find the communication with State Patrol to be a great advantage for them. However, they are not anxious to use the MDT's for routine messages at this point.
- Having the State Patrol take on dispatching for Mn/DOT is looked upon as a very positive move. Staff members consider this a way to know what other agencies are doing and to fully understand each other's jobs. It appears to have increased mutual respect between the State Patrol and Mn/DOT.
- Locating incidents has improved through ARTIC, again due to the communication and cooperation between Mn/DOT and the State Patrol including the use of GPS and AVL's.
- State Patrol respondents were reluctant to give actual numbers of incident calls because they felt it was difficult to define. However, an estimated two hundred calls per day was mentioned. Mn/DOT takes only a few calls per week now that ARTIC is in place. Many of the calls are from Maintenance Workers and are mostly related to inter-office issues.

- Road and weather information calls do not appear to be a problem now that the recorded information line is regularly updated by the State Patrol.
- The State Patrol Dispatchers appear to be positively impacted by ARTIC in areas such as self-confidence and pride in their jobs.
- The problems and/or frustrations expressed by respondents seem to be primarily related to lack of communication regarding the program's objectives and lack of adequate training.
- The quality of the equipment is generally looked upon as very good. Two problems mentioned regarding equipment were a periodic loss of the GPS signal in the State Trooper's vehicle and faulty brackets for MDT's in maintenance trucks.
- It is generally agreed that ARTIC is positively influencing the speed of dispatch.
- Needed staff hours should decrease, according to these respondents. One State Patrol Dispatcher was added; however, four to five part-time student Dispatchers were eliminated and Mn/DOT's office personnel take considerably fewer calls.
- Shared resources of both personnel and equipment are seen as positively influencing budgets.
- Although it is difficult to measure ARTIC's effect on survival rates, most respondents felt that ARTIC would prevent some crashes because of faster response time to problem areas on the roadways.
- Some respondents felt that government agencies have difficulty competing with private businesses for computer programmer's time, resulting in some delays.
- Despite expectations, Arrowhead Transit has been delayed in getting the ARTIC Program started due to software that is not fully developed.
- These delays and problems at Arrowhead Transit have affected the staff's confidence in ARTIC.

- Re-training will be needed for Arrowhead Transit's staff when the program is functioning correctly.
- Virginia Dial-A-Ride is not yet working with the ARTIC Program. However, they still expect to be part of the program in the future.

Appendix D

Post-Test Evaluation of Project Participants' Attitudes

**Advanced Rural Transportation Information and
Coordination Project (ARTIC)
Operational Test**

**POST-TEST EVALUATION OF
PROJECT PARTICIPANTS'
ATTITUDES**

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ARTIC POST #98114, November, 1998

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PROJECT OBJECTIVES

Mn/Dot is conducting an operational test of the Advanced Rural Transportation Information and Coordination (ARTIC) project to test whether the use of technology to enhance inter-agency coordination and information sharing can contribute to higher levels of operational effectiveness and efficiency.

SEH, Inc., assisted by CJ Olson Market Research Inc., has been retained by Mn/DOT to prepare an evaluation of the ARTIC project.

The primary objective of this qualitative research was to determine the attitudes of project participants toward the ARTIC system at the post-evaluation point of the operational test.

METHODOLOGY

Following definition of the project objectives, discussion guides and questionnaires were designed by Olson Research and these instruments were approved by the client. The interviews were arranged and scheduled by Dick Maddern of Minnesota Department of Transportation in Virginia, Minnesota. The following respondent groups were scheduled and interviews were conducted with each:

- State Patrol Radio Operators
- State Patrol Troopers
- State Patrol Management
- Transit Company Personnel
- Mn/DOT Electronic Technician
- Mn/DOT Management
- Technical Integration Company

All interviews were conducted by Lisa Kelly, Research Moderator for CJ Olson Market Research, Inc. The data collection was done at the Mn/DOT offices in Virginia, Minnesota on October 28 and 29, 1998. The one-on-one and group interviews were audio taped and the tapes were transcribed for analysis purposes.

RESPONDENT PROFILE

Ten interviews were conducted for this post-evaluation phase of the research. The following job titles were included:

- Mn/DOT or State Patrol Radio Communications Operators (2 respondents)
- Mn/DOT or State Patrol Radio Communications Supervisor (1 respondent)
- Arrowhead Transit Director (1 respondent)
- Arrowhead Transit Assistant Administrator (1 respondent)
- Mn/DOT Electronic Technician (1 respondent)
- Minnesota State Patrol Station Sergeants (2 respondents)
- Minnesota State Patrol District Lieutenants (2 respondents)
- Minnesota State Patrol District Captain (1 respondent)
- Mn/DOT Project Manager for ARTIC (1 respondent)
- Mn/DOT Virginia Area Supervisor (1 respondent)
- Thom Tech systems integrator (1 respondent)

DETAILED FINDINGS

SECTION SUMMARY:

A. Mn/DOT or State Patrol Radio Communication Operators and Troopers:

- 1. Current Procedures*
- 2. Information Received Through System*
- 3. Determining Locations of Incidents*
- 4. Equipment Performance*
- 5. Interaction Between Mn/DOT and State Patrol*
- 6. Impressions of ARTIC*
- 7. Training Issues*
- 8. Impact of ARTIC*
- 9. Suggested Improvements*

B. Mn/DOT and State Patrol Supervisors and Managers:

- 1. Information Received Through System*
- 2. Equipment Performance*
- 3. Determining Locations of Incidents*
- 4. Interaction Between Mn/DOT and State Patrol*
- 5. Management Issues*
- 6. Impressions of ARTIC*
- 7. Training Issues*
- 8. Impact of ARTIC*
- 9. Legal or Institutional Issues*
- 10. Suggested Improvements*

C. Arrowhead Transit Management:

- 1. Progress Report*
- 2. Current Challenges*
- 3. Benefits of the Experience*
- 4. Lessons Learned*
- 5. Future Plans*

D. Mn/DOT Electronic Technician:

- 1. Equipment Performance*
- 2. Impressions of ARTIC*

E. Systems Integrator:

- 1. Progress Report*
- 2. Benefits/Opportunities*
- 3. Interaction with Other Agencies*
- 4. Regional Influences*
- 5. Impressions of ARTIC*
- 6. Suggested Improvements*

Mn/DOT STATE PATROL RADIO COMMUNICATIONS OPERATORS & TROOPERS:

1. CURRENT PROCEDURES:

When respondents were asked to describe how calls were received in the communications center, the dispatchers reported that there had been no changes since the last evaluation. They expressed satisfaction in how the calls are handled since they have direct contact with Mn/DOT, as well as satisfaction in how much faster the process is now. When asked how many calls the communication center handled per day, one of the dispatchers estimated 80-100 on a slow day and 300-350 calls on a day of a heavy snowstorm.

The road/weather information calls are now handled by a recorded message which is up-dated as needed, seven days per week. This appears to be successful, however there was mention of some reluctance by a portion of the public to use the information line. Most respondents felt the usage would continue to improve with time.

2. INFORMATION RECEIVED THROUGH SYSTEM:

The dispatchers included in this study were asked how accurate they thought the information was that they received from the ARTIC System. Their initial response indicated that the information they received was only as good as the information the caller gave them. There was some discussion describing how often times, cellular phone callers didn't have accurate location or severity of incident information.

The discussion then turned to the mapping capabilities of ARTIC and automatic vehicle location (AVL) units in four of the State Troopers' squad cars. The dispatchers expressed some dissatisfaction with the 20-minute interval between signals to the satellite. They felt this was not adequate when tracking a Trooper driving along the highway. One such comment was:

"At 20-minute intervals it is not sufficient. A 20-minute interval is a long time if you're traveling 100 miles per hour to a critical incident. What we found is that it is certainly sufficient for a DOT truck traveling 35 miles per hour loaded down with several tons of sand, plowing snow. So I think it would be much more usable if the time frame was decreased substantially and I realize that we may not be able to go to real time, but we've got to go to something much closer than 20 minutes. "

The same respondent said that they do not usually use it for locating Troopers, but rather in other situations:

"I use AVL quite a bit, but I use it for directing helicopters, for finding lost hunters, for assisting the public who carry GPS units. I use it a lot more for search and rescue than I ever do for the unit that we actually have AVL units on..."

A desire to include snowmobile trails on the mapping system for DNR purposes was expressed. Rest areas and mile markers were also mentioned as possibly helpful additions to the maps.

Despite the reservations regarding the mapping system, the dispatchers seemed to appreciate having this available to them rather than having to manually take out hard copy state maps and spending a significant amount of time looking for a location.

3. DETERMINING LOCATIONS OF INCIDENTS:

According to the dispatchers interviewed, the length of time it took to locate a particular incident varied widely due to the very large area the district covers. One of the respondents involved in this Post-ARTIC mentioned that it could currently take anywhere from 30 minutes in more populated areas to 4-6 hours in rural areas.

The Troopers interviewed seemed to think that locating incidents was not a very frequent problem. They mentioned that sometimes there was a problem when different cellular callers reported an accident and it was not clear if it was the same incident or two separate incidents. In those cases, Troopers would search the highway to be sure there was not a second accident. These Troopers felt that there was rarely a situation where they couldn't locate a vehicle. One comment was that there were usually visible tracks on the side of the road where the vehicle left the highway.

The radio operators indicated there were situations where an officer had to call back to the dispatch center for additional location information, but often there was none available.

4. EQUIPMENT PERFORMANCE:

When the dispatchers were asked if they had problems with the new phone system, they both said that there were very few. They seemed very positive about the phone system's capabilities and said that it was a drastic improvement from the system they used in the past.

The State Patrol Troopers made several comments regarding their in-vehicle equipment. They mentioned ways in which they used their computers and the global positioning system (GPS) capability. Both of the Troopers said that they used the GPS coordinates for accident reports. It was also mentioned by one of the officers that he used his computer to send non-urgent messages to the dispatch center if the radio operators were busy handling other calls. Likewise, the in-vehicle computer was used in the following situation mentioned by a Trooper:

"Again, (regarding) a wide load move that I was on. I tried calling radio several times. I couldn't get through to them. Unbeknownst to me, the radio was down. So I went into the computer and I punched a message up to them, and I got through via the computer."

When asked about the reliability of the equipment itself, the Troopers reported having very few problems. They mentioned that there had been a few minor problems, which they expected considering the test period. One of the Troopers mentioned that occasionally his GPS unit would shut down for periods of time.

The dispatchers also seemed to expect a few minor problems with the equipment, but also mentioned that anything that went wrong was fixed immediately.

5. INTERACTION BETWEEN MN/DOT AND STATE PATROL:

Both the dispatchers and the Troopers included in this evaluation mentioned how much improved the relationship between Mn/DOT and the State Patrol is since ARTIC has been in place. The dispatchers appreciate being able to work directly with truck operators and supervisors when there are poor conditions on the road. This is considered a major improvement from the previous procedure, which involved Troopers calling State Patrol dispatch, who called Mn/DOT dispatch, who then called a Mn/DOT supervisor. Then the supervisor was required to go to the location in question before sending out a maintenance truck. The time involved for this process was prohibitive and sometimes contributed to additional accidents at that stretch of highway. Therefore, the Troopers also mentioned how much they favor being able to deal more directly with Mn/DOT and get assistance faster. They also mentioned the improved relationship with Mn/DOT, in general, including understanding each others' jobs better. One Trooper said:

"The fact that I know what their job is, which I didn't know before. I don't know the true job completely, but I know enough of it now that I realize what's going on as far as response time to things, or whether they'll take care of something. There's confidence that I know they're going to at least look into it, and I know that they do look into it. Before, you really didn't know. "

6. IMPRESSIONS OF ARTIC:

When respondents were asked how they felt ARTIC is working now, compared to what they initially expected, the dispatchers expressed great satisfaction. A major factor associated with ARTIC was the new communications center located at the combined Mn/DOT and State Patrol offices. The fact that now the offices are shared with the State Patrol and that they have a much larger, more pleasant room to work in is a great advantage for the dispatchers. Along with the physical working conditions, the technology was mentioned as an improvement.

In addition, the radio operators think that the ability of State Patrol Troopers to speak over the radio directly with a Mn/DOT driver is very advantageous for the whole system. One such comment was:

“When I call them (Mn/DOT drivers) and tell them I need a right-hand plow, they know what a right-hand plow is. And with the troopers it is similar, in that I can give them a call and simultaneously be airing it with the system that we have now which is a capability we didn’t have before. I can be simultaneously airing the data to the DOT and even if I’m not directly addressing them, they are copying it.”

Respondents were asked how ARTIC is improving what they do. Both the dispatchers and the Troopers mentioned that working with Mn/DOT has enabled them to be proactive, which they felt prevented some accidents and reduced the severity of others. One of the dispatchers said the workload is heavier now, but more efficient due to the improved communication with Mn/DOT and the technology available to them. The Troopers indicated that they appreciate having the technology, however, they would have wanted the opportunity for more experience during the test period. They did however express confidence that they could fulfill their responsibilities with or without ARTIC.

There seemed to be a general acceptance of ARTIC among the Troopers interviewed with the attitude that the technology was inevitable. One of the Troopers said:

“ARTIC to me is something of the future. It’s something that’s going to come. All I am is a guinea pig. I think the GPS systems are something that’s going to be in cars. Computers are going to be in cars.”

These research participants were asked how the people they work with have reacted to the ARTIC System. Most said that their co-workers are primarily curious and positive regarding the system. One Trooper said that he felt 90% of the staff are accepting and enthusiastic about ARTIC, while the other 10% are skeptical of any new technology. The dispatchers responded quite differently from each other, with one saying everyone had reacted positively about the project while the other said that she had heard some concern from other radio operators, as reflected in this quote:

“There is a lot of fear even amongst radio personnel, especially now that they are talking about turning this out statewide, that we’re going to be replaced by equipment. And these are folks we’ve got in-house, you know, who don’t understand that we’re smarter than that equipment in there and that equipment is only as good as the information that I give it. When I fail in my job, that equipment is going to fail. Anyone of us in that room could have shut down this project months ago, just by failing to do our jobs as we’ve always done them. And they have kind of ignored that aspect of it. They don’t give themselves credit for what they’ve done.”

7. TRAINING ISSUES:

Generally, the respondents described the formal training as minimal. In their view, the training was not adequate. However, they all seemed to feel they had the support of management and supervisors to learn any aspect of the equipment. One of the dispatchers was particularly negative about how the training was handled. This respondent said that they had spent their own time learning more functions of the equipment and that they did not get help from other dispatchers. The other dispatcher felt that there may have to be some retraining or some type of reference sheet developed for functions they seldom use.

The Troopers also mentioned that much of what they learned regarding their computers was on their own. One of them said that he asked for additional Windows training, which he received. There appeared to be more sharing of information between Troopers than there was between the Radio Communications Operators.

8. IMPACT OF ARTIC:

The following areas of discussion focused on the impact of ARTIC from the participants' point of view:

a. Impact on the speed of dispatching and scheduling:

Dispatchers felt that they were able to get information to Troopers faster than before. The Troopers mentioned that having an additional dispatch center enabled them to have two operators on at one time on a particularly busy day. This, they felt, sped dispatching. Another favorable comment from a Trooper was that the communication they had with Mn/DOT enabled the trucks to respond faster.

b. Impact on the driving public:

There seemed to be mixed reaction to this question, with some saying that the public probably was not affected in any way or were not aware of it. Others said they thought there were fewer and less severe crashes with the improved communications. One of the Troopers mentioned that the road maintenance during the summer months was being dealt with faster resulting in fewer pot holes, etc.

c. Impact on survival rates in highway accidents:

While the dispatchers in this study thought that ARTIC was preventing some accidents and reducing the severity of others, the Troopers were unwilling to make any correlation between the system and fewer highway deaths.

9. **SUGGESTED IMPROVEMENTS:**

During the course of the discussions with the State Patrol Troopers, several suggestions were made for ways in which the system and the procedures could be improved. They were:

- a. Add a part-time dispatcher to help alleviate situations where Troopers have to wait to speak with a dispatcher.
- b. Consider ways to route 911 cellular calls to local Sheriffs' offices where there are usually more dispatchers on duty to take calls.
- c. Instruct State Patrol dispatchers to give Troopers priority over other calls.
One Trooper said:

"It could help by having supervision tell our dispatchers to give the Troopers priority ... think there should be some prioritizing as to who they're going to relay to when they're working by themselves."

B Mn/DOT & STATE PATROL SUPERVISORS & MANAGERS:

1. INFORMATION RECEIVED THROUGH SYSTEM:

The Radio Communications Supervisor discussed, as did the dispatchers, the perceived advantage of having the AVL signal sent more frequently than every 20 minutes. Overall, this supervisor was very appreciative of the AVL and GPS capabilities of ARTIC. There was mention of how the GPS units have been installed in two aircraft, including the DNR airplane and the State Patrol airplane. This was thought by the respondent to be very crucial due to the nature of their work:

“These planes are flying around. They are on search and rescue. The float plane is going in and out of lakes all day long. We had it happen where up north on a frozen lake a warden plane did a flip over and nosed the plane into the ice. This was before ARTIC. Luckily, he got in on his radio and it was 20 below zero. What if he hadn’t gotten in on his radio? With ARTIC we’d know where he is. Without ARTIC we wouldn’t know where to look.”

2. EQUIPMENT PERFORMANCE:

When asked about how the new telephone system was performing, the supervisor and the managers said that there had only been a few minor problems that were easily resolved. There were several positive comments regarding the superiority of Positron, as opposed to the previous telephone system.

The respondents were asked about the reliability of the equipment, in general. The Radio Communications Supervisor reported only a few minor glitches that he expected during a test period. The State Patrol managers and supervisors mentioned a problem with the in-vehicle equipment draining the car’s battery. This problem was resolved without delay. The Mn/DOT manager and supervisor also recalled a few problems such as with the stands in the trucks that held the computers. These stands had to be replaced by equipment that could better withstand the vibrations of the vehicle. It was also mentioned that during the first six months of the test, the tracking system was not working for periods of time. This was dealt with by contacting Thom Tech directly, who was able to correct the problem immediately. This Mn/DOT group mentioned that the second half of the operational test had less trouble than the first half.

3. DETERMINING LOCATIONS OF INCIDENTS:

The supervisors and managers discussed how ARTIC had affected locating various incidents. The general opinion was that the GPS aided in different situations that arose. One of the State Patrol supervisors described an occasion where this capability was used:

“We used that just the night before last. There was an incident involving the Hibbing Police Department and St. Louis County’s Rescue Squad. Fourteen-year-old boy threatened suicide and ran out in the woods with a knife and some medication. It was after dark and they requested our helicopter with the FLIR (Forward Looking Infra Red), which is the infra-red looking device. The dispatcher was able to punch up a longitude and latitude of the location, give it to the helicopter when it left Cloquet so the helicopter knew exactly where to fly.”

The State Patrol respondents mentioned a desire to include milepost markers on the mapping system.

The Mn/DOT supervisor and manager were very confident in the dispatchers’ ability to gather the correct information from callers to get accurate locations. They did not see a need to use the latitude and longitude coordinates, saying that the drivers still primarily use landmarks and milepost markers.

4. INTERACTION BETWEEN MN/DOT AND THE STATE PATROL:

The research participants were extremely satisfied with the way Mn/DOT and the State Patrol are now interacting since ARTIC started. There were only positive comments regarding this area. Several people mentioned how they now know the people in the other organization personally. Some said they were on a first-name basis with each other. The Mn/DOT supervisor and manager discussed how much the relationship had improved. A typical response was:

“There’s no comparison really. Inputs or outputs, whatever you want to phrase them...It’s done whatever we request. There is no division. They may wear uniforms a little different color than ours, but the division isn’t there anymore about whose responsibility is it or what has to be done. It’s just somebody makes a request for a road obstruction, be it a 911 call or a trooper call or our own people calling. The chain of

events on how it gets communicated back to whoever it needs to be and how it gets resolved, there's no comparison."

The State Patrol supervisors and managers also appreciate the new relationship. One of the supervisors described how they benefit each other:

"The troops in the field are getting to know the Mn/DOT truck drivers and so forth, because they have communications with them now. I can tell you from experience, if a Mn/DOT driver saved me a 160 mile drive to check on a car in a ditch, I'd be very grateful to that driver. Driving 80 miles up there to find out there's a car in a ditch with nobody in it and it's not a hazard, then having to come back 80 miles, where somebody four miles away can save that time, I think is great."

The new communication between the two agencies was compared once again, to the old procedure where a Mn/DOT supervisor was called out to evaluate a request for sand on an icy road. All the people involved seemed to agree that this was very inefficient and only added to misunderstandings between Mn/DOT and the State Patrol.

The Radio Communications Supervisor also was impressed with the way the Mn/DOT MIS person supported the communications center with any possible needed repairs on equipment.

5. MANAGEMENT ISSUES:

The supervisors and managers were asked how satisfied they were with the way they were able to manage their staff. The Radio Communications Supervisor talked about how much improved the physical environment was in the new communications center. This was thought of as an improvement for the supervisor also, due to the more positive attitudes of the dispatchers. Despite the excitement over the new center, there continued to be a complaint on the part of the dispatchers for more staff, according to their supervisor. This request for more help for the radio communications operators was a recurring theme throughout the three evaluations.

The State Patrol supervisors and manager saw potential for the system to aid them in managing their troopers on the road. This would be possible when all the cars had computers and GPS tracking could be used to assign the closest trooper to an incident. The other capability they looked forward to using was checking outstanding warrants, vehicle registrations and drivers' licenses from their vehicles rather than calling the dispatch center for that information. This,

they felt, would lighten the dispatchers' workload and speed obtaining important information before a driver left the scene.

The Mn/DOT supervisor will have the ability to track where the trucks are this winter, which he feels will improve how he does his job. He mentioned that when he has the tracking on his computer, he will be able to make better scheduling decisions and will have documentation on when and where each truck was on a specific date. This will be helpful when handling public complaints and will also contribute to redesigning routes. A comment regarding this was:

"And as a manager it also helps you say, well, we had a hole in our operations that day. We didn't get a truck there. We had a four hour period when we didn't have one in there. ... So you get to look at that and say what happened? Well, we've got two trucks for that route, they were both down, and everybody else was on primary routes. But at least you know."

Another interesting issue that came up with these Mn/DOT managers was that they expected to have more communication with the truck drivers through the MDT:

"Actually, on the front end we envisioned that we would be doing a lot of communication with the truck through this mobile data display terminal. What we've discovered is we don't need to do that. The radio works well for our communications. We've found the best thing we can do, without any driver interaction at all, is just gather information from the truck and bring it into the center. So that's the path we're taking."

The Mn/DOT supervisor and manager mentioned that the truck operators did not approve of the location of the in-vehicle computer monitor. They saw it as obstructing their access to other controls in the truck. For this reason the computer equipment will be moved to alongside the driver's seat.

When asked how their staff reacted to ARTIC, the Radio Communications Supervisor said that the dispatchers have been very enthusiastic about the new communications center. However, they have also encountered a problem due to the fact that the dispatchers must share the same work stations from one shift to another. One person will set up the computer and other electronic equipment one way and the next dispatcher on duty will want to change things to accommodate their own preferences. This has caused some friction between staff members.

The State Patrol supervisors and manager said that some Troopers referred to the ARTIC equipment as “lieutenant in the trunk” because they see it as a way for their supervisors to monitor their activities. The lieutenants in the study made it clear, as did the Captain, that this was not the purpose of ARTIC and it will never be used to police their troopers.

6. IMPRESSIONS OF ARTIC:

Overall, the managers and supervisors were very impressed by the ARTIC System and were optimistic about what it would do for the two organizations in the future. When asked how ARTIC was improving what they do, the Radio Communications Supervisor expressed how much the technology had helped him to become up-to-date with state-of-the-art equipment. His comment was:

“I guess what ARTIC has done for me as a manager has really moved me forward with the knowledge of, ...I mean, I’m working with Windows NT, I have stuff that other districts don’t even know about, hardly even touched, so it has really moved me forward as a manager.”

The State Patrol Lieutenants and the Captain talked about how the system was not totally in place for them yet because the software that would enable them to get registration and other information from their cars was not being used, as mentioned in the previous section. Despite this expressed disappointment, they were confident that when more capabilities were functioning, it would increase their accountability and effectiveness.

The Mn/DOT supervisor and manager commented on a few ways that ARTIC was improving their jobs such as better communication with the truck operators and a closer relationship with the State Patrol, resulting in more efficient operations.

7. TRAINING ISSUES:

Training was an important topic to the respondents in this qualitative research. However, there appeared to be diverse points of view regarding the amount of training conducted and needed. As mentioned in an earlier section, the radio communications operators were not completely satisfied with the amount of training they received on the computer equipment. Their supervisor said that there was formal training for the dispatchers and that the State Patrol also conducted adequate training on different subjects. This supervisor did, however, say that he would like to have had more time to train his staff, but his workload

prevented him from doing so. To compensate somewhat for this, the supervisor said he had a lot of support from the MIS person at Mn/DOT and the ARTIC Project Manager.

The State Patrol manager and supervisor indicated that there did not appear to be any training issues or problems in their area. They mentioned that there was funding available to train staff when needed.

The Mn/DOT supervisor and manager discussed how most of the vehicle operators had not yet been trained on the use of the mobile data terminals, but they did not anticipate any problems.

8. IMPACT OF ARTIC:

How ARTIC is impacting the work of supervisors and managers is summarized in the following section.

a. Impact on staff hours and payroll:

The Radio Communications Supervisor felt that the increase in needed staff had been a result of the escalation of cellular 911 call frequency, rather than anything related to ARTIC. Likewise, the State Patrol lieutenants and the Captain said they did not see any impact on hours or payroll. The Mn/DOT group, however, thought that in their organization ARTIC had decreased staff hours, first of all due to the elimination of the DOT student dispatchers who used to handle evenings and weekends. Secondly, the Mn/DOT manager and supervisor said that improved communication with the State Patrol had helped them use their time more efficiently resulting in fewer overtime hours needed.

b. Impact on the driving public:

The State Patrol group thought that the general public had an increased sense of security due to ARTIC's capabilities. They also mentioned that the public is receiving improved service in faster response times to accidents, locating lost people and faster treatment of slippery roads due to the communication between the two organizations, Mn/DOT and the State Patrol. The Mn/DOT group did not seem to think that the general public was aware of ARTIC despite the fact that they are reaping the benefits through faster response to trouble spots on the highways.

The Project Manager discussed a concern that the general public not overestimate the capabilities of ARTIC his comment was:

"And we had one of the television stations out of Duluth come up here. And they were in awe of what we were doing. We got a good three minute spot on the local news. I was really, as the Project Manager, playing that down, because this reporter was in awe of what we were doing. He thought we were going to be able to do magic. I said, 'Hold it. We're still plowing snow with big orange trucks, okay?'"

c. Impact on survival rates of highway accidents:

The State Patrol respondents were reluctant to claim that survival rates have been impacted by ARTIC. They felt it was impossible to measure such an effect. The Mn/DOT respondents were more confident that the proactive activities practiced since the program has been put in place have prevented some accidents. A typical comment regarding this was:

"Instead of being reactive in a snowstorm, now we're being proactive. Before the road even gets slippery, we're treating it. We're in and out of there. Everybody's in bed sleeping yet. They don't even know we did anything yet, and it snows. Last year I probably got anywhere between 35 and 50 calls... 'I don't know what your doing there, but it never got slippery.' ... They don't realize that we're doing treatments prior to storms."

9. LEGAL OR INSTITUTIONAL ISSUES:

The supervisors and managers were asked what legal or institutional concerns or issues interfered with the way their work could be most efficiently done. The Radio Communications Supervisor mentioned that some people thought that Mn/DOT and the State Patrol could not work together from the same dispatch center because of the private information that came over the computer or radio regarding criminal records, etc. This problem has been avoided by training dispatchers to be aware of the type of information being communicated when there are visitors in the dispatch center.

The State Patrol lieutenants and captain said they thought that having the technology associated with ARTIC improved their ability to respond to legal

issues. They thought this would increase if all the trooper vehicles were equipped with MDT's which would result in documentation of troopers' activities. Along the same line, they said having faster medical response due to GPS capabilities would be important information for potential lawsuits.

Much like the State Patrol management, the Mn/DOT group also commented on how ARTIC helped them with potential legal problems through documentation of their activities.

10. SUGGESTED IMPROVEMENTS:

The following suggestions were made by the supervisors and managers to improve the system:

- a. Initiate the use of a computer aided dispatch (CAD) system in the communications center that documents incidents for future reference concerning such things as accident reports.
- b. Install MDT's in all trooper vehicles to help manage squads better.
- c. Work to get software in place to obtain warrant and other driver information from the squad.
- d. Collect more data as part of the Mn/DOT system, as related in the following quote:

"The stuff that's missing is what they're doing. Is the plow up? Is the plow down? Is the sander on? Is the sander off? ... Two hour conference call told us nobody is able to gather all this information yet, because the vendors that have to make that black box, they weren't ready. They're getting ready. They're starting to run real hard. We're going to be collecting at least on a couple of (the DOT) trucks plow up, plow down, wing up, wing down, sander on, sander off and highway surface temperature this year. Next year, more vendors should be jumping into this thing. Snow plow equipment vendors are new beginning to make their equipment compatible with electronic monitoring."

C. ARROWHEAD TRANSIT MANAGEMENT:

1. PROGRESS REPORT:

The management group from Arrowhead Transit discussed what had occurred since the mid-evaluation in May of 1998. According to the Director, there has been no progress since that time. The software was not yet functional despite the months of attempting to get it up and running. There were fifteen buses that were equipped with mobile data terminals, along with four Virginia Dial-A-Ride vehicles. The vehicle location capabilities were functioning, which enabled Arrowhead Transit to track those fifteen buses, although this function appeared to be working inconsistently. It was mentioned, however, that vehicle tracking has never been a critical portion for the transit company. Some experimenting has been done on having the drivers log in and out of their routes on the mobile data terminals.

The respondents also mentioned that they had completed entering the customer information into a database. However, it was useless at this point without the software functioning. They did not seem to have confidence in the database, saying they would not use it for their reports. In the future, they hope to have the ability to transfer the information on 870 customers into another database.

2. CURRENT CHALLENGES:

It was mentioned again that the vendor providing the software did not perform the requirements of their contract. They did not complete activities within the timeframe established. This comment was:

“They failed to meet those timelines. We gave them an extension. They failed to meet the extension timelines. And right now, it’s really out of our hands. It’s in the Attorney General’s office.”

The Director commented that another challenge facing them now is the effect this process will have on their staff the next time they attempt something similar. The Director personally invested a lot of time and effort convincing the staff that this type of system would benefit them. He also mentioned that he felt that he had lost some of his credibility with his staff because of the vendor’s failure to perform. The Assistant Administrator agreed that the staff had lost confidence in the system. However, she also felt that they could be convinced again if they saw something that was working and doing what they had expected.

3. BENEFITS OF THE EXPERIENCE:

The following benefits of the process were indicated:

- a. It was a very good learning experience.
- b. The formation of some partnerships with other organizations will carry through to the future. The other organizations mentioned were Mn/DOT, the State Patrol and Virginia Dial-A-Ride. The comment made was:

“We formed some partnerships that we hope will endure ... So I can't say it was all negative. The vision that we have, I think we want to continue with, and hopefully someday we'll get there. And I'm confident that we will, I just don't know when.”

4. LESSONS LEARNED:

The transit respondents mentioned the following lessons that they learned from this experience:

- a. The type of technology that is available and close to becoming available will improve their operation significantly.
- b. Caution should be taken before embarking on any similar endeavor in the future.
- c. The software and technology available is not as advanced as represented by the vendor and there are probably no transit companies that can step into this without the same difficulties.
- d. Any software that would be developed would have to be customized to meet the needs of a transit company.

5. FUTURE PLANS:

There was some hesitation on the part of the transit research participants to comment on future plans due to their involvement in litigation as indicated in the following quote:

“I think it’s going to depend on the legal remedy, which direction we go. I’d like to continue with the vision. It’s a matter of how long it’s going to take to get the legal remedy and more forward.”

D. Mn/DOT ELECTRONIC TECHNICIAN:

1. EQUIPMENT PERFORMANCE:

The Electronic Technician interviewed was responsible for supervising the electronic maintenance office in the Virginia area and also for maintaining the radio communications system for the State Patrol. When asked specifically about how the telephone system had been performing, the technician said that US West was responsible for taking care of any of these problems, however, there have been very few.

There was one situation which required a solution. The computer equipment on the DOT trucks was actually turned on when it appeared to be off. This drained the batteries on the trucks and this problem had to be resolved. The respondent mentioned that some problems in the system were expected in a test such as this.

Overall, the maintenance task for Mn/DOT has been greatly reduced since ARTIC has been put in place, according to the respondent. There had been very few problems with the equipment.

2. IMPRESSIONS OF ARTIC:

When asked how the people he works with reacted to ARTIC, the electronic technician said that the transition was very smooth. He mentioned that there were a few people who initially were skeptical of something new replacing the old system, but they seemed to have come around to also see the advantages. The system has simplified operations for the dispatchers in this respondent’s opinion.

In general, the electronic technician seemed very happy with how ARTIC is working. He said:

“I guess I was just reflecting on what it was like before the ARTIC system, and now it’s such a vast improvement now over what we had before. There’s space to work. People aren’t sharing offices or the supervisor isn’t sharing his office with a

dispatcher, that kind of thing.”

E. SYSTEMS INTEGRATOR:

1. PROGRESS REPORT:

The Project Manager from Thom Tech, Inc. was interviewed due to his involvement in the ARTIC project as the systems integrator for the automatic vehicle locator (AVL) system and the mobile data terminals (MDT's). First, this respondent was asked what his involvement had been since the mid-evaluation time. He mentioned that he had visited the Virginia offices 5-6 times since May of 1998, at which time he trained personnel on equipment, extended the Fleetman software program to Arrowhead Transit to give them some service and was involved in some trouble-shooting activities for the State Patrol. He specifically commented on a situation where the State Patrol Troopers with the MDT's in their vehicles often took their units into the office to work on something. The problem was that the battery power in the units were not adequate for the period of time they used the units away from their vehicles. To remedy this, Thom Tech made it possible for them to plug their units into electrical power in the office when they wanted.

2. BENEFITS/OPPORTUNITIES:

When the system integration respondent was asked how ARTIC had benefited his firm, he said that it prompted them to have an informational booth at the Minnesota State Fair where they were able to demonstrate the equipment used for ARTIC. This provided their firm with added credibility and the opportunity to teach many people about GPS. He also mentioned that their firm had received at least two projects as a result of their work with ARTIC.

Another, more general benefit mentioned was simply the experience they gained from working on a very successful program such as ARTIC. This also had provided their firm with very strong references.

Thom Tech gained a lot of knowledge regarding training personnel such as what common questions would be asked on similar projects.

3. INTERACTION WITH OTHER AGENCIES:

The Thom Tech participant was asked how satisfied he was with the communication and interaction between his firm and the other ARTIC team

members. His response was very positive. His experience with Mn/DOT, the State Patrol and Arrowhead Transit has been very productive and agreeable. The respondent praised the Mn/DOT Project Manager for ARTIC, saying:

“The only reason this project goes is because of Dick Maddern.”

The contractual agreements were also discussed. The respondent said that Thom Tech had six amendments to the original contract and there had been no problems getting these through the system. He worked directly with Dick Maddern on these. The difficulty seemed to come following the completion of work and receiving the 10% retaining fee in a timely manner.

4. REGIONAL INFLUENCES:

When asked what local conditions or influences had affected the way that the project was executed, the participant from Thom Tech mentioned that there were noticeable differences between working with metro clients and out-state clients. The people he worked with in Virginia typically:

- used less paperwork than metro clients.
- often agreed on things with a handshake.
- could approve work to start through telephone conversations.
- shared more information with each other, between agencies and job levels.
- worked more as a team.

5. IMPRESSIONS OF ARTIC:

It was the opinion of the respondent that this industry had not matured enough to expand it to more areas. He said that the various GPS providers were not integrated, which he felt was necessary. A comparison was made between this and the cellular telephone industry which is integrated together, but at one time was not, just as the GPS is not.

He also talked about how a management technique used by the Mn/DOT Project Manager was extremely successful. This technique involved developing the system and making it known to the staff. Then, the Mn/DOT project manager, Dick Maddern, gave people time to become curious about the technology on their own and ask questions on how it worked. At that time the system was explained to them and he offered to include them in the project. This was a very effective way for the staff to adjust to the new technology and procedures.

6. SUGGESTED IMPROVEMENTS:

In hindsight, the Thom Tech respondent offered the following suggestions for future reference:

- a. The system designed for the transit company was perhaps more than an 11-county transit system could use. A software package, like suggested by the software vendor, is actually better for a large city system. A more simple software package should have been adopted.
- b. The Project Manager at Mn/DOT could have possibly used a Project Assistant to help him with some of the work, although the project ran on time and met all deadlines.

COMPARISON OF FINDINGS FROM PRE, MID AND POST-EVALUATION

CJ Olson Market Research, Inc. conducted three phases of the evaluation of ARTIC: The Pre-Evaluation (April 1998), the Mid-Evaluation (May 1998) and this Post-Evaluation (October 1998). This final section takes a look at how issues have changed or remained the same through this process.

- **HOW CALLS ARE RECEIVED AND DISPATCHED:**

Respondents described the procedure they were required to follow before ARTIC was in place. If a trouble area was identified by the State Patrol, they would call their dispatcher, who would call the Mn/DOT dispatcher. This person would then contact the supervisor for Mn/DOT. The supervisor would have to drive out to the area to assess the situation and determine whether or not it was necessary to treat the road. If the supervisor believed the road should be treated, he would then call out one of the trucks. Obviously, this process could take a long time. While this was happening, there were times when the State Patrol watched other accidents occur in the same spot . This created an atmosphere of resentment and misunderstanding between the State Patrol and Mn/DOT.

As discussed in this report and the mid-evaluation report, the process has taken a drastic turn since ARTIC started. The process now involves the State Patrol calling their dispatcher to say there is a slippery area on the highway. While he is talking about this problem area over the radio, the Mn/DOT drivers who are out at that time can also hear about the situation. Sometimes one of them will volunteer to respond immediately if they are nearby. Otherwise, the State Patrol dispatcher contacts the Mn/DOT supervisor who activates a truck as soon as possible. This system of communication and activation is much faster than the previous procedure and has resulted in improved relationships between State Patrol Troopers and Mn/DOT truck operators.

- **PHONE SYSTEM BREAKDOWNS:**

The telephone system used before ARTIC provided minimal technology or capabilities. However, it also appeared to have few maintenance problems. The new system is referred to by the respondents as excellent and much more efficient than the pre-ARTIC system. There have been very few problems with the new Positron system, other than a few minor incidents.

- **LOCATING HIGHWAY INCIDENTS:**

Before ARTIC, the State Patrol and Mn/DOT reported it as a common problem to have difficulty locating a reported incident or accident. Once the communication between the two agencies improved, those working out on the road started to help each other. For example, Mn/DOT drivers now report incidents to the State Patrol if they come across something. The locations the Mn/DOT drivers are able to give are usually much more accurate than from cellular telephone callers. The AVL capability was also mentioned as helpful in locating accidents and the GPS is now being used on some search and rescue situations.

- **EXPECTATIONS OF ARTIC:**

In general, the ARTIC system has met or exceeded the respondents' expectations. They anticipated that it would save time for staff, add to efficiency and the equipment would run without many problems. There were a few unexpected turns also such as Mn/DOT drivers probably would not be able to communicate through the MDT's as originally thought. Also, the State Patrol Troopers expected to use their in-vehicle equipment more than they did for the test period. Lastly and probably the most unexpected turn of events was the failure of the software package for Arrowhead Transit.

- **IMPACT ON THE GENERAL PUBLIC:**

The opinions regarding how ARTIC will or does effect the general public did not change significantly from the Pre-Evaluation to the Post-Evaluation. Those interviewed expected that the public would receive better and faster service, however, they may not notice the change. This was the same general opinion of respondents at the end of the test period.

- **MANAGEMENT ISSUES:**

Prior to ARTIC, managers and supervisors discussed their staff-related difficulties. The State Patrol Radio Communications Supervisor talked about how unpleasant the old communications center was at the State Patrol office. The room was extremely small, the dispatchers were required to wear uniforms and the technology was very "low-tech". The contrast from this to the current communications center is great. Working conditions have been improved in the physical environment and also with the equipment they are using.

The Mn/DOT managers and supervisors described how difficult it was for their staff to continually handle complaints from the public. The situation was especially frustrating for the office staff because they could not contact the truck

operators to ask for their assistance. Now, the office staff has very few such calls as the communication has improved and so has the speed at which the problem areas are taken care of.

Throughout every phase of this evaluation there were numerous mentions of how helpful and capable the Project Manager for ARTIC, Dick Maddern, was. It appears that his enthusiasm and drive for the success of this project were instrumental to ARTIC's positive outcome.

- **RELATIONSHIP BETWEEN THE STATE PATROL, MN/DOT AND ARROWHEAD TRANSIT:**

Probably the greatest change that has occurred as a result of ARTIC is the relationship among the three agencies. Due to the delays with the software, Arrowhead Transit has not had the opportunity to work as closely with other organizations. However, the Arrowhead Transit management considers the partnerships they have built with Mn/DOT and the State Patrol to be extremely valuable.

The new communication, both in the office and out on the road, and understanding of each others' responsibilities have contributed to a very effective working relationship between Mn/DOT and the State Patrol. This not only has produced more efficiency and better service to the public, but it also appears to have had a positive effect on how satisfied people are with their jobs.

CONCLUSIONS

When reviewing the findings from the Post-Test Evaluation portion of the ARTIC Project, the following conclusions may be drawn:

1. The road and weather information line has been very successful and the general public appears to be using it more as time goes on. (A-1)
2. A 20-minute interval between signals for the AVL units in the State Patrol Troopers' cars does not satisfy the dispatchers when using the system. They do, however, feel that this interval is adequate for tracking Mn/DOT trucks, which travel at lower speeds. (A-2, B-1)
3. Troopers do not think that locating incidents on the highway is a significant problem for them. On the other hand, the radio communications operators feel this is a concern. (A-3)
4. Several respondents mentioned the need to add milepost markers to the mapping system. (A-2, B-3)
5. Mn/DOT management appears to be very confident in the State Patrol dispatchers' ability to obtain accurate location information from callers. (B-3)
6. The Positron telephone system used in the communications center has had very few problems and is meeting the needs of the dispatchers very well. (A-4, B-2)
7. State Patrol Troopers reported very few maintenance problems with their MDT's. (A-4)
8. When considering all the equipment used, there have been very few problems or break-downs. When something needed repairing, the technical support was in place enabling the problem to be resolved quickly. (A-4, B-2)
9. The combined efforts of Mn/DOT and the State Patrol have been a major success in the eyes of the respondents. The relationship between the two agencies was mentioned over and over again a very positive ARTIC result. Eliminating the previous procedure (of contacting Mn/DOT and their organization going through a series of calls) has decreased the response time to highway incidents dramatically. (A5 - B4)

10. The two agencies working closely together in their office environment has led to an increased understanding and appreciation of each other's responsibilities and has enhanced a team effort which is proving to be very successful. (A-5, B-4)
11. As troopers and truck operators are communicating and assisting each other on the roadways, the efficiency of their efforts is also becoming greater. (A-5, B-4)
12. There were some troopers who would have liked to test their equipment more than they did, to explore other capabilities and functions. (A-6)
13. Although both the radio communications operators and the troopers would have liked to have had more training, they felt that they could get help from their supervisors or Dick Maddern any time they needed their questions answered. (A-7, B-7)
14. Although some said they received no formal training on the ARTIC equipment, the supervisors stated the opposite. (B-7)
15. The primary benefits of the ARTIC System brought out in this evaluation were:
 - a. faster response time to accidents (A-5, A-8a, B-8, B-8b)
 - b. faster dispatching of emergency services (A-8a)
 - c. fewer and less severe traffic accidents (A-8B, A-8b)
 - d. decrease in staff hours for Mn/DOT (B-8a)
 - e. improved and more timely treatment of slippery roads (B-8b, A-5)
16. It is very important to the State Patrol to have the capability to obtain information regarding a particular driver from his in-vehicle computer rather than requesting this from the dispatcher. They feel they could get the information faster and would not have to tie up the dispatchers' time with the request. (B-5)
17. Documenting activities of both the State Patrol and Mn/DOT is thought of as a great advantage to assist them in any possible future legal concerns. (B-5)
18. The failure of the vendor providing software to Arrowhead Transit has been a very discouraging experience for the staff. This not only has affected the management at Arrowhead Transit, but also the drivers. (C-1, C-2)
19. Arrowhead Transit management is remaining cautiously optimistic as they wait for a legal remedy to their lack of progress. (C-5)

LESSONS LEARNED

As others seek information on the ARTIC experience, the following items may be helpful:

1. Instituting a road and weather information line where callers can receive such information from a recorded message, is very beneficial.
2. A 20-minute signal interval is perhaps not adequate for tracking law enforcement vehicles.
3. The Positron telephone system used in this communication centers is very effective and progressive.
4. In most organizations there is a certain small percentage of people who are skeptical of new technology. In the ARTIC test, the majority of the people accepted it.
5. There are some radio communications operators who will see new technology as a threat to their jobs because they fear the equipment will replace them. This misconception will need to be addressed in the early stages of a project.
6. Formal training is important for many staff members. It needs to be properly timed to take place when all equipment is available and functioning.
7. Communication needs to be encouraged among co-workers regarding the use of technology to assist in on-going training.
8. Information privacy issues need to be addressed when combining a dispatch center.
9. Transit systems need to fully examine software vendors to be sure that they are able to deliver what they propose.
10. When initiating a new system or new procedures, the staff should not feel they are being pushed into something they are not ready for. Allowing time for staff members to gain information about the technology's capabilities and develop a curiosity about it will make the transition smoother.
11. Staff should have access to technical support personnel who can readily assist them with problems or questions.

12. The Project Manager for an endeavor such as this should be very accessible to the staff as well, and should be always ready to answer questions or offer support.
13. The combined efforts of a department of transportation and a law enforcement agency is advantageous to both organizations. The increased communication and understanding leads to an increase in efficiency and effectiveness.
14. Improved communication and information enables a department of transportation to be proactive in treating roadways.