AMASCOT:

Automated Mileage and Stateline Crossing Operational Test

Final Report

Part 1 of 4: Evaluation Summary

May 1, 1996

Principal Investigator
Bill M. McCall

Principal Contributor
Michael L. Hancock

Center for Transportation Research and Education
Iowa State University

Wisconsin Department of Transportation

Center for Transportation Research and Education

Iowa Department of Transportation

Iowa State University

U.S. Department of Transportation

CONTENTS

LIST OF TABLES

BACKGROUND

The Automated Mileage and Stateline Crossing Operational Test (AMASCOT) demonstrated and evaluated the feasibility of automating the collection of mileage-by-jurisdiction data and electronic data interchange for International Fuel Tax Agreement (IFTA) and International Registration Plan (IRP) reporting. The test involved the states of Iowa, Minnesota, and Wisconsin and motor carriers from these three states. The test equipped 30 interstate commercial vehicles with prototype electronic mileage-by-jurisdiction data collection devices, collected mileage-by-jurisdiction data from the vehicles as they operated throughout the United States and Canada in their normal course of business, integrated these mileage data with fuel purchase data to generate the data necessary for IFTA reporting, and evaluated the ability of an electronic mileage data collection system and the data generated to meet IFTA and IRP requirements. The test also investigated the feasibility of transmitting IFTA and IRP reporting data electronically from the motor carrier to the base jurisdiction.

The catalyst for developing the project was created by Title IV of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA-9l). This legislation supported reducing the fuel tax and registration compliance burden for commercial vehicle operators by requiring states to join IFTA and IRP by September 30, 1996. These organizations simplify motor carrier compliance by eliminating the need for motor carriers to file fuel tax and mileage reports with each individual jurisdiction. IFTA and IRP allow motor carriers to file a composite report for all member jurisdictions to a single base state that meets the requirements for primary place of business.

The standardization of processes and data requirements created by membership in IFTA and IRP allows for automating data collection and filing processes. The requirement that all states join IFTA and IRP created the opportunity to introduce improved methods for states to administer and motor carriers to comply with IFTA and IRP, thus making a significant leap in IFTA and IRP administration and compliance possible.

Realizing the importance of this opportunity, the project partners developed AMASCOT to test and evaluate an innovative application of technology that would facilitate the nation’s productivity and growth while supporting states’ efforts in complying with the requirements of Title IV of ISTEA-91.

The project was proposed in response to a Federal Highway Administration (FHWA) solicitation for Intelligent Transportation Systems (ITS) projects in 1992 and approved for FHWA finding in 1993. Begun in January 1994, the project concludes with the issuance of this project evaluation report in March 1996.

Project Partnership
The AMASCOT project was conducted by a unique partnership of private, public, and academic transportation organizations that included the following:

Iowa Department of Transportation (Iowa DOT). The Iowa DOT was involved in the project as the lead state agency for contract administration and as a participant due to its responsibility for administering of IFTA and IRP programs.

Rockwell International Corporation (Rockwell). A well-known technology supplier to defense, aviation, communications, and transportation industries, Rockwell provided the project with the in-vehicle locational, computing and trip recording, and electronic data transfer capabilities.

Rand McNally-TDM, Inc. Rand McNally-TDM, Inc. is a well-known provider of routing and mileage software to the transportation industry. Rand McNally provided the project with custom route mileage software that converted the global positioning system (GPS) locational information collected by Rockwell into nearest actual locations (as matched to a map database) and identified taxable and nontaxable mileage segments.

Center for Transportation Research and Education (CTRE). Formerly the Iowa Transportation Center, CTRE at Iowa State University specializes in transportation research, technology transfer, education, and outreach for public transportation agencies and the private sector. CTRE provided project management, technology transfer and outreach, data processing, and evaluation coordination and conduct support to the AMASCOT.

Minnesota Department of Public Safety (MnDPS). MnDPS participated in AMASCOT as the Minnesota agency responsible for IFTA and IRP administration.

Wisconsin Department of Transportation (WDOT). WDOT participated in AMASCOT as the Wisconsin agency responsible for IFTA and IRP administration.

Western Highway Institute/ATA Foundation (WHI/ATAF). WHI/ATAF is a nonprofit motor carrier research and education organization affiliated with the American Trucking Associations. WHI/ATAF worked with the state trucking associations to identify and recruit motor carriers and led the evaluation efforts related to motor carrier operations.

Iowa Motor Truck Association (IMTA). IMTA is a membership organization that represents the interests of the motor carrier industry in Iowa to lawmakers, regulatory agencies, and the public. The IMTA provided assistance in involving motor carriers in the project for the operational test phase and evaluation efforts, served as a conduit of project-related information to and from Iowa motor carriers, and helped guide the project through the steering committee.

Minnesota Trucking Association (MTA). MTA represents the interests of its motor carrier members to lawmakers, regulatory agencies, and the Minnesota public. The MTA assisted the project in recruiting motor carriers, disseminating information about the project to motor carriers, and providing project guidance through the steering committee.

Wisconsin Motor Carriers Association (WMCA). WMCA is a membership organization that represents the interests of Wisconsin motor carriers to lawmakers, regulatory agencies, and the public. WMCA participated in the project by assisting in the recruitment of motor carriers, providing information exchange between the project and motor carriers, and furnishing project guidance through the steering committee.

Federal Highway Administration (FHWA). FHWA provided the project with contract funding, high-level project oversight, and evaluation guidance.

To provide project and evaluation guidance, a steering committee and an evaluation subcommittee were formed and chair persons selected. High-level project direction and policy decisions were made by these committees, and day-to-day activities were managed by CTRE regarding coordination with the lead state and the project subcontractors.

Project Goal and Objectives

The goal of the partners was to demonstrate and evaluate technology to automate the collection and filing of motor carrier mileage and gallonage data and reports for Commercial Vehicle Operations (CVO) fuel tax and registration apportionment.

Objectives developed to attain this goal include the following:

- Ensure the automated mileage and stateline data collection and submittal system accommodates state auditing guidelines.
- Develop procedures and software to electronically submit the fuel use and apportioned mileage report to the base-state jurisdiction.
- Test and evaluate the technology to determine requirements necessary to support state auditing guidelines and electronic submittal to base-state jurisdictions.
- Conduct an analysis of user acceptance and the benefits and costs of employing the technology for both motor carriers and states.

- Conduct a technology transfer program to include workshops, a newsletter, and presentations at professional and industry meetings.

In pursuit of the project goal and objectives, the AMASCOT partners utilized the following technologies and processes during the test:

- In-vehicle GPS coupled with a jurisdictional boundary database and stateline crossing algorithm to detect vehicle entrance into and exit from U.S. and Canadian jurisdictions
- In-vehicle data recording of significant vehicle events, route of travel, and a sequential mileage record of the vehicle's travels
- Modified mileage and routing software and locational database for post-data-collection conversion of GPS coordinates into nearest known location (city, highway, truck stop, etc.) and identification of taxable/nontaxable mileage segments
- Commercially-available database software and custom data file conversion programs to compile vehicle mileage by jurisdiction and fuel purchase information and generate acceptable IFTA quarterly report
- Electronic transmission of vehicle mileage by jurisdiction information, fuel purchase information, and IFTA quarterly reports

Other technologies and approaches could have been used to meet the project goals and objectives. The technologies and processes used were a result of the areas of expertise of the project partnership and were developed specifically to meet the test goals and objectives. As a result, the equipment and processes used during the test only generally represent those that might be developed and utilized if an actual marketplace develops.

Relevance to the National ITS Program Plan

The AMASCOT project falls under the CVO Administrative Processes service of the National ITS Program Plan. The CVO Administrative Processes service is intended to reduce the time and paperwork necessary for motor carriers to comply with and states to administer the regulatory processes for vehicle licensing, permitting, and fuel tax filing, and thus enhance the productivity of motor carriers and states. The AMASCOT project specifically focused on the administrative processes related to IFTA and IRP mileage record keeping and filing requirements.

AMASCOT succeeded in proving the concept of automated mileage and route data collection and electronic filing for complying with commercial vehicle fuel tax and registration apportionment requirements. This success provides jurisdictions, technology providers, and motor carriers the incentive to begin developing and implementing the necessary hardware, software, and procedures for automated mileage-by-jurisdiction data collection and electronic filing for compliance with IFTA and IRP. Further, the test provided critical insights into the type and significance of changes in business processes necessary for jurisdictions and private industry to implement such automated fuel tax mileage data collection and electronic filing.

Overview of Project Methodology

To demonstrate and evaluate the feasibility of automating both the collection of mileage data and the filing of the reports required for motor carrier registration and fuel tax apportionment, the basic test design was to install and operate prototype, automated mileage data collection equipment developed by Rockwell on 30 trucks—five trucks from each of six participating motor carriers, two carriers from each of Iowa, Minnesota, and Wisconsin.

The basic project methodology included these tasks:

- Prototype development, testing, and manufacturing
- Motor carrier recruitment
- Equipment installation
- Equipment and data processing beta test
- Data collection, processing, and archiving
- Evaluation of the prototype equipment and the project
- Technology transfer

Development, Testing, and Manufacturing of the Prototype Data Collection Device

Development of the prototype device was guided by IFTA and IRP requirements for automated data collection devices. Interpretation and clarification of these requirements was provided by the state agencies involved in the test.

To ensure the validity of the concept before moving forward with the operational test portion of the project, an early prototype was developed and a test conducted. The validity test was conducted in June 1994 on a route specified by IFTA and IRP auditors from the participating states. Both state auditors and motor carriers participated in the test, riding in the vehicle equipped with the early prototype system and gathering manual mileage data to compare to the data collected by the system. In addition to the data comparison, other tests were conducted, such as disabling the system antenna to note how the system handled the problem and if usable exception data were recorded. The prototype system met the validity test requirements and was approved for development for the operational test. More information on the validity test can be found in the AMASCOT Phase 1 Interim Report.

Integrating changes as suggested by the results of the validity test, Rockwell then manufactured the prototype data collection devices to be used in the operational test portion of the project. The Iowa DOT (contract manager) and CTRE (project manager) inspected and accepted delivery of the prototype data collection devices in August 1994.

Recruiting Motor Carrier Participants

Recruiting motor carriers focused on ensuring a large enough motor carrier and vehicle participation to provide adequate data, identifying carriers based within the participating states, and ensuring the recruited carriers covered a broad range of industry operating characteristics. The test design specified the test include six motor carriers, two from each state, and equip five vehicles from each motor carrier, for a total of 30 trucks.

Motor carrier recruitment was coordinated with the ATA-affiliated state trucking association of each participating state and received input from participating state IFTA and IRP administrators and auditors and Rockwell. Recruiting activities included identifying candidate carriers in each state, conducting a recruitment interview to exchange information about the project and the motor carriers' operations, and approval of recommended motor carriers by the steering committee.

Installing the Prototype Equipment

Equipping motor carriers' vehicles was undertaken following approval by the steering committee and agreement to participate by the recruited carriers. Installations were either performed in Cedar Rapids, Iowa, at a Rockwell provided installation center, or at the motor carriers' locations of business by Rockwell technicians. Due to the logistics of equipping operating motor carrier fleets without disrupting their operation, installation of the equipment took several months and led to a number of lessons learned (see the Evaluation Findings section of this document).

Beta Testing the Prototype Equipment and Data Processing

To ensure the prototype equipment and the data processing methods developed would be suitable for the operational test, the prototype equipment and the data processing methods were beta tested. The time between installation of the first prototype data collection units in vehicles and completion of installation of the equipment in all the vehicles was used for beta testing. Originally, this beta testing was expected to last approximately six to eight weeks. However, difficulties in coordinating the installations with vehicles operating across the country as well as some issues uncovered during the beta test stretched this period to several months.

During the beta test, data were collected and processed for all equipped vehicles. As more vehicles joined the equipped fleet, more data were collected and processed. The beta test was very successful in ensuring the usability of the prototype equipment and data processing methods before collection of official evaluation data. Several issues were uncovered and corrected during the beta testing, leading to a fairly uneventful collection of data during the official 90-day evaluation data collection period. For more information on these issues, see Part 2, Evaluation Report on the Truck System and Electronic Data Interchange.

Data Collection, Processing, and Record Keeping

Data collection, processing, and record keeping efforts focused on retrieving the data from the vehicles, processing them with fuel information to produce the data and reports required for IFTA filing, and maintaining the records required for IFTA auditability. The source data and the resulting reports would be evaluated by state auditors for acceptability under the current IFTA requirements. To provide enough data to enable multiple evaluation analyses, data collection was specified to include a minimum of 90 days of data collection from each five-truck fleet.

The prototype equipment utilized GPS and on-board logic to identify an equipped vehicle's starts, stops, and exits from one jurisdiction into another and record the vehicle's mileage and position at such events. For a more detailed description of the on board data collection system, see the Phase I Interim Report and Part 2, Evaluation Report on the Truck System and Electronic Data Interchange, of this document.

The data collected on board the vehicle were communicated from the vehicle to Rockwell via satellite communication once per day. Once per week, Rockwell combined the daily data packets for each truck into a continuous ASCII data file for each truck. Rockwell then communicated the data via modem to CTRE for processing. Processing of the mileage data by CTRE included converting latitude/longitude data into location place names and highway designators, importing the data into commercial database software, processing the data to accumulate mileage by jurisdiction, and integrating the mileage data with fuel purchase data to generate reports that could meet IFTA requirements. The source data used to generate the IFTA reporting information were kept in an electronic archive to ensure availability of the data for audit as required by IFTA. A more detailed description of the data processing methods can be found in Part 2, Evaluation Report on the Truck System and Electronic Data Interchange.

Evaluation of the Prototype Equipment and the Project

Evaluation of the equipment focused on whether the automated data collection system could generate data that could meet IFTA and IRP requirements, the feasibility of electronically communicating the report data to a base jurisdiction, the impacts such a system might have on states and motor carriers in terms of costs and benefits and changes to current processes, and the institutional issues related to implementation of automated data collection and electronic filing. The project partners formed an Evaluation Subcommittee that oversaw the evaluation effort and evaluation task forces that helped in the detailed guidance and conduct of the evaluation efforts.

The evaluation of the automated mileage data and their suitability for IFTA and IRP reporting was conducted primarily by the participating IFTA and IRP auditors from each state. These auditors evaluated the prototype system and the mileage and route data it generated using IFTA and IRP guidelines for electronic data collection and accepted audit techniques.

The technical performance of the prototype data collection equipment, the data processing methods, and the feasibility of electronic data transfer were also evaluated. Rockwell and CTRE conducted these efforts.

The state evaluation efforts focused on documenting the possible impacts of automated data collection on the participating states' processes, possible costs and benefits, general receptivity, and possible institutional issues. This portion of the evaluation was completed by CTRE with assistance from the participating state agencies.

The evaluation of motor carrier costs, benefits, and likelihood of implementation was conducted by WHI/ATAF with guidance from the Evaluation Subcommittee. These efforts focused on identifying the applicability of automated mileage data to motor carrier operations, the likelihood of motor carrier adoption of automated mileage data collection technology, and motor carrier implementation issues.

Technology Transfer

Technology transfer efforts during the project focused on informing fuel tax and registration administrators and auditors and motor carriers of the project. Technology transfer efforts included publishing a project newsletter, distributing project reports, and making presentations to state fuel tax and registration administrators and auditors, motor carriers, and other public and private audiences interested ITS-CVO applications.

Project Schedule

To give a frame of reference to the course of the project, Table 1.1 lists a number of significant project events.

Table 1.1
Schedule of Project Events

Event	Start	End
AMASCOT Project	**January 10, 1994**	**March 31, 1996**
Proof of Concept	January 1994	June 1994
Kick-Off Meeting	March 1994	
Evaluation Plan	January 1994	March 1994
Phase 1 Validity Test	March 1994	June 1994
Phase 1 Interim Report	August 1994	
Recruit Motor Carriers	April 1994	October 1994
Install Equipment	August 1994	April 1995
Beta-test Equipment and Processes	December 1994	April 1995
Official Data Collection	May 1995	July 1995
Draft Evaluation Reports	January 1996	
Final Evaluation Reports	**April 1996**	

The participating motor carriers and their operating characteristics were:

Roehl Transport Inc. is a large for-hire truckload carrier based in Marshfield, Wisconsin. Roehl operates approximately 900 units in flat-bed and van transportation, with approximately 450 of those units operating on interstates in the contiguous 48 states. Roehl uses computer-aided functions extensively in its operations and has equipped its fleet with in-vehicle tracking and communications systems.

Skinner Transfer is a smaller for-hire truckload carrier operating 135 units out of Reedsburg, Wisconsin. Skinner provides both flat-bed and van transportation in the contiguous 48 states with substantial mileage east of the Mississippi River. Although Skinner uses computer-aided functions in its administrative operations, the company has no current plans for employing on-board tracking and/or communications systems.

Johnsrud Transport, Inc. is a medium-sized for-hire special commodities carrier typically operating 80 to 90 food-grade tank truck units. Johnsrud is based in Des

Moines, Iowa, and operates in the contiguous 48 states, although service in the extreme northeast U.S. is not currently heavy. Johnsrud utilizes computers in most functional areas but does not utilize in-vehicle tracking or communications equipment and has no immediate plans to integrate such equipment.

Caledonia Haulers, Inc. is a small for-hire special commodities carrier based in Caledonia, Minnesota. Caledonia operates 40 food-grade tank truck units throughout the U.S. but with heavy emphasis on service in the Midwest. Caledonia's operations did not utilize in-vehicle communications or tracking during the course of AMASCOT; however, computerized dispatch and maintenance functions were in use.

CENEX, Inc., based in St. Paul, Minnesota, is a large private carrier operating 240 tractors and 1,000 trailers in delivery of various agricultural services including the transport of hazardous materials. CENEX operates from the Midwest south to Texas, west to Washington, and north into Canada. Computer-aided functions are utilized throughout the company with portable cellular telephones the current means of in-vehicle communications.

Ruan Transport Corporation, with headquarters in Des Moines, Iowa, operates 6,000 tractors and 4,000 trailers in numerous fleets serving the contiguous 48 states through a network of 174 terminals. The particular Ruan fleet participating in the test operates out of a terminal in Milford, Iowa, and provides primarily a truckload service with some less-than-truckload (LTL) operations. Ruan utilizes computer-aided functions as well as in-vehicle tracking and communications systems extensively in its operations.

Hyman Freightways, Inc. is a regional LTL common carrier with its headquarters terminal located in Roseville, Minnesota. Hyman was the candidate carrier interviewed as a representative of the LTL transportation sector. Its trucks were not equipped with the Rockwell recording device due to a pre-judgment concerning probable irrelevance. While the company had no actual evaluation involvement, their mileage recording and reporting procedures were analyzed and documented by CTRE as a contribution to the broader project emphasis which also recorded existing fuel-use reporting practices. Hyman operates 430 tractors, 725 semi-trailers, 1,016 double trailers, and 12 straight trucks in 17 states spanning Colorado to Ohio and Canada to Texas. The company incorporates computer-aided functions but does not utilize in-vehicle tracking or communications.

EVALUATION FINDINGS

The evaluation summary encompasses the three major areas of evaluation—truck system and electronic data interchange (EDI); state agency costs, benefits, and acceptance; and motor carrier acceptance and benefits—and technology transfer efforts and lessons learned. These sections provide an overview of the evaluation efforts and highlight the major evaluation findings. More detailed information on the AMASCOT evaluation can be found in the individual reports for the three major evaluation areas.

Summary of the Truck System and EDI Evaluation Findings

Following is a summary of the evaluation of the automated-mileage-by-jurisdiction data collection system and electronic data transfer for IFTA and IRP filing. The truck system and EDI evaluation achieved the following goals:

- Determined the modifications to IFTA and IRP procedures necessary to accommodate electronic mileage data collection.
- Evaluated the feasibility of using currently available communications and database software for electronically submitting IFTA and IRP reports to base states.
- Determined the acceptability of the data provided by the truck system.

Detailed discussion of the truck system and EDI evaluation results can be found in Part 2, the Evaluation Report on the Truck System and EDI.

For this summary, discussion of the evaluation of the truck system and EDI is categorized into three primary areas: 1) evaluation of the technical performance of the prototype truck system data collection equipment; 2) evaluation of the feasibility of integrating such a system into motor carrier and state business practices; and 3) evaluation of the acceptability of the data generated by the automated system for IFTA and IRP compliance.

To meet the data needs of IFTA and IRP, the automated data collection system developed for AMASCOT needed to be able to accurately record vehicle route of travel and mileage traveled in each jurisdiction along the route of travel and generate data that was suitable for IFTA and IRP reporting and auditing. The evaluation of the truck system and EDI is based on the analysis of nearly one million miles of data collected and processed using the prototype automated electronic mileage data collection system and processes developed to use the collected data as a basis for generating reports and records that meet IFTA and IRP requirements.

Truck System and Costs

The technologies used in the AMASCOT truck system were GPS, the jurisdiction detection algorithm/database, and the mileage and route data collection/storage algorithm. These technologies established the foundation for automatic detection and collection of miles traveled in each jurisdiction by a vehicle.

In Phase I of the project, the prototype data collection device was developed and tested. The device consisted of a consumer off-the-shelf (COTS) computer board, a GPS receiver, a sophisticated algorithm for detecting a jurisdictional boundary crossing, and a compact database defining jurisdictional boundaries in the United States and Canada. Jurisdictional boundaries in Mexico were not included since U.S. based motor carriers are not allowed to operate their power units in Mexico beyond a very small free range of trade along the border. This prototype system was validity tested to determine the feasibility of continuing forward with the operational test portion of the project. For more details on the Phase I system and the validity test, see the Phase I Interim Report dated August 1995.

In Phase II of the project, the Phase I hardware was modified to a design that would more appropriately allow extended use on board a heavy duty vehicle. In addition, improvements and corrections to the Phase I jurisdictional boundary crossing detection algorithm and jurisdictional boundary crossing database were made as indicated by test results. To expedite the test, COTS equipment was used as much as possible. This equipment consisted of a COTS single-board computer (SBC) integrated into standard Rockwell Pro 2000 and Link 2000 satellite communications gear. The COTS SBC hosted the Phase I automatic jurisdiction boundary crossing detection algorithm, jurisdiction boundary database, and the data collection function. The Pro/Link 2000 equipment provided a convenient means to retrieve the data from each test vehicle via satellite communications, thus eliminating the need to make physical contact with the vehicles to collect data.

The truck system recorded data, called Driver Trip Reports (DTR), contained a history of starts, stops, route samples, border crossings, and system exceptions. System exceptions include such things as loss of position information, loss of odometer, and unexpected power losses. These recorded exceptions allow for automatic system monitoring of the DTR information collected. DTR files also contain a unique sequence number, driver ID, carrier ID, and vehicle ID.

The prototype truck system was operated in a number of vehicles from January 1995 through April 1995 and in the actual 90-day, 30-vehicle data collection period from May 1995 through July 1995. Table 1.2, on the following page, summarizes the operational details of this experience.

Table 1.2
Summary of Truck System Operation

Company	Events			Miles			Crossings		
	Pre-Test	Test	Subtotal	Pre-Test	Test	Subtotal	Pre-Test	Test	Subtotal
Caledonia		9,072	9,072		143,119	143,119		645.00	645.00
Cenex	8,836	12,553	21,389	143,000	129,957	272,957	473.00	534.00	1,007
Johnsrud	2,078	10,060	12,138	44,314	115,211	159,525	92.00	460.00	552.00
Roehl	9,335	9,854	19,097	144,602	142,412	287,014	669.00	627.00	1,293
Ruan	3,438	8,060	11,498	49,752	123,579	173,331	221.00	547.00	768.00
Skinner	4,576	13,687	18,263	72,297	302,563	374,860	357.00	536.00	893.00
Total			**91,457**			**1,410,805**			**5,158**

Evaluation of the prototype data collection system resulted in the following findings:

- Accurate, repeatable determinations of jurisdictional border crossings are available through an electronic system. Of the 3,349 border crossings logged during the official data collection period, border crossing detection was within 75 feet.

- System operation anomalies in the prototype system were minimal. In over 1.4 million miles of data collected (pre-test and test), the prototype system experienced just four types of instances in which jurisdictional border crossings were not detected. These four instances included (1) a missing data point in the jurisdictional boundary database; (2) a GPS data smoothing filter that resulted in the position error being too small; (3) a unit experienced intermittent power that resulted in missed border crossings; and (4) the error budgeted for Selective Availability (the signal degradation purposely introduced into GPS by the United States Department of Defense) was set small enough that a border crossing could be missed in rare instances. Of these instances, (1) and (2) were corrected before the 90-day data collection period, (3) was an equipment failure related to improper installation, and (4) would be eliminated as an issue in a production device by setting the Selective Availability error budget to a more appropriate value.

In general, the technical evaluation concluded that GPS could be used to accurately and consistently detect jurisdictional border crossings made by a moving vehicle. The issue of whether or not the travel data collected by the prototype system would be sufficient for IFTA and IRP is addressed in the evaluation of data acceptability.

Costs for motor carrier implementation of an automated mileage and route data collection system similar to that used in AMASCOT were estimated by motor carrier experts. These experts included the AMASCOT technology provider, representatives from leading motor carrier business software developers, and motor carriers.

Using these cost estimates, three types of motor carrier operating and implementation scenarios were hypothesized. In general, these three hypothesized motor carriers included:

(1) A **smaller carrier not already utilizing GPS and satellite communications** for vehicle tracking; carrier has **basic office automation for business functions** (IFTA/IRP, payroll, etc.).

    Without GPS and communications already in place, carrier needs GPS and associated equipment to collect data, some means for retrieving the data from the vehicles, and major business system software upgrades to incorporate the electronic data.

(2) A **medium-sized carrier that is utilizing GPS and cellular communications for vehicle tracking**; carrier has **well developed office automation** for fleet management and business functions, **including EDI**.

    With GPS and communications already in place, the carrier can piggyback the electronic data collection system onto current vehicle GPS/communications equipment to collect and communicate mileage data. Carrier needs only minor business system software upgrades to incorporate the electronic data. Cellular communications costs for data transmission will be a variable cost.

(3) A **large carrier using GPS and both satellite and cellular communications for fleet management**; carrier has **advanced office automation system** for business and fleet management functions, **including EDI**.

With GPS and communications already in use by this carrier, the carrier can add the electronic data collection system to current vehicle GPS/communications equipment to collect and communicate mileage data. Carrier needs very minor business system software upgrades to incorporate the electronic data. Data communications costs will be a variable cost.

The general cost estimates developed by equipment and software providers and motor carriers and the cost examples for hypothesized carriers support the following conclusion:

- Equipment will be affordable. Cost estimates for the on-board equipment and other supporting hardware and software indicate that carriers that employ satellite communications and vehicle location tracking systems could add automated electronic mileage-by-jurisdiction data collection and integrate the data into their business systems for as little as $400 per vehicle.

Cost estimates for the hypothesized motor carriers are summarized in Table 1.3.

Table 1.3

Cost Estimates for Hypothesized Motor Carriers

Cost Category	**Small Carrier**	**Medium Carrier**	**Larger Carrier**
30 Trucks	**200 Trucks**	**1,200 Trucks**	
In-Vehicle Recorder	$600 - 800 /truck	$400 - 500 /truck	$400 - 500 /truck
Data Extraction			
Vehicle Equipment Terminal Equipment	$300 - 400 /truck $800 RF Modem $2,000 Computer	Cellular costs	Satellite/cellular costs[1]
Data Processing Upgrades	$5,000	$1,000	Staff time
Report Communications			
Modem Software	$100 $100	Already equipped for EDI	Already equipped for EDI
Data Archiving/Auditing			
Data Storage Costs Conversion Software	$0 May be a net gain $1,000	$0 May be a net gain $1,000	$0 May be a net gain $1,000
Total	$36,000 - 45,000	$82,000 - 102,000	$481,000 - 601,000
Total per Truck	**$1,200 - 1,500**	**$410 - 510 + communications costs**	**$401 - 501 + staff time and communications costs**

[1] Communications costs for cellular and/or satellite data transmission were not estimated due to their wide variability.

Feasibility of Integration

The evaluation of the feasibility of integration investigated the resources required for and issues encountered in utilizing the electronic mileage and route data for generating IFTA and IRP compatible records and reports. In general, this portion of AMASCOT consisted of retrieving the data from the participating vehicles and performing the data processing necessary to integrate the data with fuel purchase information, generate vehicle mileage and fuel purchase summaries and mock IFTA reports, and maintain vehicle records acceptable for IFTA and IRP auditing.

In addition, electronic transfer of data was tested. In fact, the entire data collection and processing path was entirely electronic for one motor carrier that was able to provide fuel purchase data in an electronic format. A test of EDI between AMASCOT and the Iowa DOT was planned but was not completed because the necessary state programming resources were not available.

Key questions related to the feasibility of integration included:

- Could current software readily accept the data with only minor modifications?
- Could the data be used to generate acceptable IFTA/IRP reports?
- Is an electronic data path from vehicle to carrier to state feasible?

Findings related to these questions include:

- Commercially available database software can be used to integrate the electronic mileage-by-jurisdiction data with fuel purchase data and generate the necessary fleet reports for IFTA and IRP.
- An entirely electronic data path from vehicle to processing was successfully demonstrated, including fuel purchase information. Testing of the AMASCOT system clearly demonstrated that mileage data could be collected electronically, communicated electronically, and integrated with electronic fuel purchase data to meet IFTA requirements.
- States that can easily integrate database format files into their systems can accept electronic transfer of IFTA and IRP reports with relatively minor changes to their data processing software. Commercially available database applications and motor carrier software packages can export data in a database file format which can be integrated into both commercial and custom software through relatively straightforward data mapping routines. However, while these changes are relatively straightforward, states dependent upon internal programming staff may not have staff time or funding available to make these changes.

- The biggest challenges for states may be in achieving standards and facilities for electronic data transfer, some method for electronic payment to accompany electronic IFTA and IRP filings, and marshalling the resources to make the necessary modifications to their software.

- Upgrading commercially available motor carrier software to integrate electronic mileage data will be relatively inexpensive. In a meeting with leading motor carrier software providers and motor carriers, estimates for modifying commercially available motor carrier software to integrate the electronic mileage-by-jurisdiction information ranged from $1,000 to $5,000, with most participants expecting the cost to be at the low end of this range.

Acceptability of Data for IFTA and IRP Compliance

The acceptability of the data for IFTA and IRP compliance was evaluated by IFTA and IRP auditors from Iowa, Minnesota, and Wisconsin. The data collected on board the vehicles were integrated with fuel purchase information and processed to produce filing reports that followed IFTA requirements. For the evaluation, the test data were first examined by the state auditors for their potential to meet IFTA and IRP requirements. Then, the test generated IFTA reports were audited by the state auditors using the electronically collected data as the mileage and route records for the reports.

After close examination of the test data, the state auditors concluded that the AMASCOT system was able to do the following:

- Determine jurisdictional border crossing points and record accurate odometer readings at those points.

- Accurately accumulate distance, in total and by jurisdiction, including distance on routes designated as non-taxable for purposes of this test.

- Provide information about other truck activity, including trip starting and stopping points, periods of no movement, engine shutdowns, etc.

- Assign a recognizable place name to each latitude-longitude location reading kept by the system.

The reports and data were audited using several audit techniques commonly used by state IFTA and IRP auditors. These included comparing the test mileage data to do the following:

(1) Odometer/hubometer miles as recorded by drivers.

(2) Miles calculated by state auditors using current computer atlas software (such as Rand- McNally Milemaker or PCMiler) over the route of travel as recorded by drivers.

(3) Miles calculated using computer atlas software over the route of travel as indicated in the drivers' United States Department of Transportation (U.S.DOT) log books.

(4) Miles calculated using computer alias software over the route of travel as indicated by locational information recorded by the AMASCOT system.

After auditing the test generated reports and the corresponding electronic mileage data for the test vehicles, the state auditors concluded that:

- AMASCOT system demonstrated that GPS, in combination with other technologies, is capable of being used to accurately record and accumulate miles for fuel tax and licensing reporting purposes.
- AMASCOT system fulfills the basic intent of IFTA and IRP mileage record-keeping requirements. Minor adjustments, as outlined in Part 2, page 46, will allow such a system to meet all requirements.
- Such technology is capable of providing an automatic, completely electronic alternative method to the current practice of drivers keeping mileage records by hand on an Individual Vehicle Driver Record (IVDR). The documents reviewed indicate the potential to increase the accuracy of mileage data and to provide both time and cost savings for jurisdictional processing and audit functions.
- Mileage data generated by the test system demonstrated the potential to increase the accuracy of mileage-by-jurisdiction data. In fact, the auditors felt that the jurisdictional distribution of mileage was more accurate using the data collected by the automated electronic mileage data collection system, since available time and routing information indicated that border crossing readings were being taken at or very near the point and time of actual border crossing.

Truck System and Electronic Data Interchange Evaluation Conclusions

The truck system and EDI evaluation has shown that automated data collection is feasible and can meet IFTA and IRP requirements, that an electronic data path is feasible, and that motor carrier implementation costs will be relatively affordable. Independent of the findings of the evaluations of state and motor carrier costs, benefits, and acceptance, these findings clearly demonstrate the technical and practical feasibility of electronically collecting mileage-by-jurisdiction data and integrating these data into both current systems and more advanced systems able to accommodate end-to-end electronic data paths for IFTA and IRP data collection, processing, and reporting to a base jurisdiction.

With the viability of the concept proven, states and motor carriers can move ahead to solve the related issues of EDI standards, EDI facilities, and electronic funds transfer and clear the way for implementation of similar technologies and processes for streamlining IFTA and IRP administration and compliance for both states and motor carriers.

Summary of State Costs, Benefits, and Acceptance Evaluation Findings

The evaluation of state costs, benefits, and acceptance accomplished the following evaluation goals:

- Document current processes and costs of IFTA and IRP processing and auditing administration and identify possible impacts of automated data collection and electronic filing on these processes and costs.
- Determine participating states' acceptance of the automated method and their willingness to change the method of processing.
- Document legal and institutional issues related to automated data collection and electronic filing for IFTA and IRP.

The state evaluation used a case study approach for each of the three participating states—Iowa, Minnesota, and Wisconsin. This methodology allowed the evaluation to accommodate the differences among states. Each state case study examined the following areas:

- processes for IFTA processing
- processes for IFTA auditing
- current costs for IFTA functions as identified by states
- potential benefits and changes in current processes resulting from automated, electronic mileage data collection and filing
- perceptions of state processing and auditing personnel regarding potential benefits and their likelihood
- possible barriers to state implementation.

The state evaluation focused on IFTA processes and costs because IRP filing is less frequent than IFTA (therefore a smaller part of state work), uses the same mileage data, and is often audited in conjunction with IFTA filings. Benefits identified for IFTA processing and auditing are also applicable to IRP, though to a lesser extent in processing due to the IRP requirement for only a single mileage report annually versus the IFTA requirement for fuel and mileage reporting quarterly.

In the case studies, two basic methods were used to investigate these areas: 1) site visits and interviews with state processing and audit personnel and 2) questionnaires distributed to both processing and audit personnel.

The evaluation findings are summarized in general for all three states. For more information on the state evaluation, see Part 3, Evaluation Report on State Agency, Benefits, Costs, and Acceptance.

Potential Benefits and Cost Savings for IFTA Processing and Auditing Administration

The examination of processes, costs, and benefits was not expected to result in a traditional cost-benefit analysis due to differences in state costing methods, varying availability of cost data, and a reluctance by states to estimate the effects of automated data collection and electronic filing on their costs for IFTA administration. Rather, the cost data available allowed a tabulation of the current state costs as identified by the participating states and identification of the areas of the process that could be positively affected by automated, electronic mileage data collection and electronic filing.

Processing Benefits. Currently, mileage data are recorded manually by the driver and turned in to the carrier for reporting purposes. The data are then entered on a manual form by the motor carrier staff, mailed into the state agency, and re-keyed into the state processing system by the state processing personnel. With automatic mileage data collection and electronic fuel tax reporting, fuel tax returns could be processed electronically. Motor carriers or their service providers could collect electronic data from the vehicle, use these data to generate IFTA quarterly reports, and submit these reports to the base state via EDI. For Iowa, Minnesota, and Wisconsin, automated, electronic mileage data collection and electronic filing offers the following benefits for IFTA processing:

- **Reduced labor costs for opening, sorting, and delivering mailed-in, manual returns.**
- **Reduced data entry** due to electronic filing.
- **Reduced problems related to hand-written filings.** Most carriers compile the necessary IFTA data, make the necessary calculations for IFTA, and then hand-write the IFTA return. These hand-written returns often create legibility problems for states. Electronic returns would reduce the number of hand-written returns and the associated legibility problems.
- **Reduced base state follow-up due to IFTA filing errors.** The use of electronic data and filing reduces the opportunities for motor carriers to make mistakes in

their IFTA filing. Reduced errors lessens the need for the base state to follow-up with carriers for corrected filings.

- **Reduced labor for verification and data entry of payments through electronic funds transfer (EFT).** Along with receiving returns electronically, funds due could also be received electronically. EFT would eliminate the need for processing personnel to verify the payment, enter it on the system for deposit, and reconcile reports and payments manually.
- **Reduced labor and mail costs associated with preparing mailings for manual returns.** Currently, the base state sends each IFTA registered carrier manual return forms every quarter. These mailings could be eliminated for those carriers who would be filing electronically if the IFTA rates are made available to carriers electronically,
- **Reduced labor and storage space/materials costs related to retaining and using data.** Electronic data would reduce time required for storage and retrieval of filing data and reduce the physical space and materials (paper, file folders, etc.) necessary.
- **Reallocation of staff where additional help is needed.** Reductions in the staff time required to complete IFTA report processing will allow shifting of resources to other areas such as assisting companies reporting for the first time or to other areas of motor carrier regulatory administration.

Auditing Benefits. Potential IFTA/IRP auditing benefits for the participating states from electronic mileage data collection were identified as the following:

- **Time savings (resulting in more audits) due to improved data accessibility.** During the actual audit, auditors spend a significant amount of time searching through paper documentation at the carrier's site and then entering the data into auditing software (usually a spreadsheet program and a route mileage program). Electronic information would reduce these manual steps and be more easily queried to facilitate faster and easier audits. By reducing the time needed for each audit, the states could audit many more carriers per year.
- **More in-house audits due to improved data portability.** The feasibility of in-house audits is increased substantially by electronic data. The mileage and fuel purchase data requested by auditors could be supplied in electronic format much more easily than current paper records can be, thus enabling in-house audits for larger motor carriers. More in-house audits would result in:

- more audits (less time spent traveling creates more time for audits)
- less travel expense

- **Better targeting of resources.** Electronic data would allow auditors to more easily request data samples for “pre-audits.” Audits of these limited electronic data samples could be combined with phone interviews and other information to assess whether a motor carrier needs more auditing attention. With reduced time in accessing and using electronic data, these “pre-audits” could reach more carriers. Such “pre-audits” could indicate potential trouble areas in a motor carrier’s process more quickly than a manual limited review.

State Agency Perceived Benefits and Receptivity

To identify the benefits expected by processing and auditing staff and gauge their receptivity for electronic mileage data collection and electronic filing, short questionnaires were distributed to the Iowa DOT IFTA processing and auditing staffs. The questionnaires were designed to provide a general measure of the staff’s knowledge and attitudes toward the AMASCOT project, their perceptions of the benefits of electronic mileage data collection and electronic filing and the likelihood of those benefits, and their receptivity toward implementation of electronic mileage data collection and electronic filing.

Because the sample size was small and concerns over survey length kept the questionnaires short, the questionnaires were not intended to support statistical analysis, but instead to provide indications of the general perceptions and receptivity of the target group toward automated electronic data collection and electronic filing for IFTA and IRP. Following is a summary of results from both the processing and auditing perspective.

Perceived Benefits. As part of the state evaluation, state IFTA/IRP processing and auditing staffs were asked to indicate possible benefits from electronic mileage data collection and electronic filing and the most likely impacts of the indicated benefits on their work.

Processing staff expect that automated mileage data collection and electronic filing would result in:

- increased reporting accuracy
- reduced data entry
- more efficient data storage and retrieval
- less time spent resolving inaccuracies and more reliance on their IFTA processing software to determine inaccuracies

- use of time savings to recheck the accuracy of their own work, complete additional tasks of their own, help others with their tasks, or assume additional responsibilities

While these processing benefits are possible for the participating state agencies, the impact or value of these benefits is difficult to estimate in any meaningful way. These benefits are dependent on the number of motor carriers who implement electronic data collection and filing, which is difficult to predict in a potentially emerging marketplace. In addition, costs identified by the states indicate that IFTA processing costs less than $125,000 per year. Consequently, electronic data collection and filing would have to reduce processing costs by a very high percentage to result in large monetary savings.

However, these agencies are currently operating with reduced staff resources, resulting in considerable difficulty in maintaining the desired levels of service. As a result, the benefits to these states are not likely to be in the form of direct money cost-savings, but in the form of staff time that can be reallocated to maintaining other necessary motor carrier services or enhancing IFTA/IRP and other motor carrier services as needed. In short, electronic mileage data collection and filing could make the states' motor carrier agencies more productive and better able to accommodate current and future demands on staff.

Auditing staff expect that automated mileage data collection and electronic filing would result in:

- ability to audit the electronic data using specially developed audit software
- improved ease of querying information
- decrease in time required to perform audits
- improved data accessibility resulting in greater audit efficiency
- increased reporting accuracy
- time saved would be utilized to conduct more audits, review their own work more thoroughly to ensure accuracy, help others with unfinished tasks, or take on additional responsibilities

If these benefits are actually realized, auditors project cost savings from less manual data entry and higher reporting accuracy. Some cost savings were also foreseen with decreased audit time. Auditors expected very little cost savings from decreased travel and expected no cost savings from decreased mailings to motor carriers.

Receptivity to Electronic Mileage Data Collection and Electronic Filing. The state evaluation also asked state IFTA/IRP processing and auditing staff to indicate their receptiveness to implementation of electronic mileage date collection and electronic filing and their expectations about which benefits would accrue from implementation of such a system.

Processing staff were generally:

- receptive to automatic mileage data collection for IFTA reporting
- receptive to electronic filing of IFTA reports
- optimistic that all identified benefits were very likely to occur

However, there was an underlying current of apprehension about job security, particularly among workers from Wisconsin, a state currently facing severe budget limitations and the attendant cost cutting issues.

Auditing staff were highly:

- receptive to the electronic fuel tax data collection and reporting device
- optimistic that the device would be acceptable among the auditing community
- optimistic about the benefits to be realized with electronic mileage data collection and filing, believing that such a system will improve accuracy, provide a cost savings to states and motor carriers, and provide the opportunity to conduct more audits

State Legal and Institutional Issues

The evaluation objectives included identification of legal and institutional issues encountered during the project or likely to be faced if states want to implement automated electronic mileage data collection and filing. No legal issues were uncovered during the test or the evaluation, and contracting issues were limited solely to the contract with the technology provider. A number of institutional issues were uncovered as well. Contracting and institutional issues are discussed in the following sections.

Analysis of the three participating states' processes and staff perceptions uncovered several institutional issues. These issues are not unique to the study states, and some or all are likely to exist in every state. These issues include:

- **Lack of EDI standards for transmitting IFTA and IRP reporting data from motor carriers or their agents to states.** Currently, there is no standard for submitting electronic data to states for IFTA and IRP reporting. None of the states involved in the project were routinely accepting data from motor carriers in an electronic format. Without such a standard, states, motor carriers, and technology providers are reluctant to move forward with EDI at risk of having their efforts discarded when standards are developed.

- **Lack of electronic method of payment to facilitate electronic filing of IFTA and IRP data**. IFTA and IRP require that payment accompany the filing document. As a result, electronic data transfer of IFTA and IRP reporting data would require some means to enable payment at the time the data are accepted by a state. State agencies that participated in the test have limited or no experience with methods for electronic funds transfer (EFT), the most efficient method to allow motor carriers or their agents to provide means of payment with their electronic submissions.
- **Lack of facilities to accept electronic data.** While all the participating state agencies were interested in EDI for IFTA and IRP filing, none of them has facilities in place to accept electronic data from outside sources. Until states implement some means of easily receiving and integrating electronic data from outside sources into their data processing systems, EDI for IFTA and IRP cannot be executed.
- **Staff resistance to electronic filing due to concerns over job security.** One human concern states may encounter when automating portions of the IFTA and IRP filing process is staff resistance, mostly due to concerns over job security.

Fortunately, these issues have very real and achievable solutions, many of which are already being put in place through other efforts. In the case of EDI standards, states are working through the IFTA and IRP organizations to develop the data standards necessary for EDI between states and between motor carriers or their agents and states. In addition, the states participating in AMASCOT as well as others are currently involved in other operational tests (e.g., electronic one-stop credentialing projects) that are also working to address the issues of EDI between states and motor carriers as well as electronic payment and development of the infrastructure facilities and processes to support EDI.

State Evaluation Conclusions

Clearly, the implementation of electronic mileage data collection and electronic filing for IFTA and IRP compliance promises benefits to states' IFTA/IRP processing and auditing processes. Analysis of state agency IFTA processing and audit processes identified a number of potential benefits due to electronic mileage data collection and electronic filing, and many of these potential benefits were also perceived as likely by IFTA processing and auditing staff.

States can benefit from automated electronic mileage data collection and electronic filing for IFTA and IRP compliance through reduced staff inputs for data entry, ensuring the integrity of the data received, reduced data storage requirements, and increased data accessibility and portability. The extent of these benefits will vary by state but will mainly be influenced by the rate of implementation of such systems by motor carriers.

State auditing and processing supervisors agreed that the impact of electronic mileage data collection and filing on their systems is dependent on the level of implementation by Iowa-based motor carriers and that large impacts will not be realized until implementation has filtered down to carriers with fewer than ten trucks. However, these auditing and processing supervisors also indicated that benefits accrued from implementation of electronic mileage data collection and filing by larger motor carriers (more than 50 trucks) and equipment leasing and service firms would be significant enough to be worthwhile.

However, states face a number of institutional issues in implementing automated electronic mileage data collection and electronic filing for IFTA and IRP. Fortunately, these issues have achievable solutions and many are being addressed through other efforts as well. The most significant turning point will be when the IFTA and IRP communities acknowledge acceptance of these technologies for IFTA and IRP compliance. Such acceptance will allow implementation of these technologies by states and motor carriers that perceive an appropriate level of benefit.

Summary of Motor Carrier Benefits and Acceptance Evaluation Findings

The evaluation of motor carrier acceptance and benefits was designed to provide insight into current motor carrier processes for fuel tax and registration mileage reporting, the acceptability of an AMASCOT-like system, the possible motor carrier benefits, and the likelihood of motor carrier implementation of electronic mileage data collection and filing. The motor carrier acceptance and benefits evaluation focused on:

- possible benefits of automated mileage and route data collection and EDI for IFTA/IRP reporting
- estimated impact of automated data collection and EDI for IFTA/IRP reporting on current costs of compliance
- suitability of an automated data collection system for motor carrier implementation
- feasibility of and issues related to implementation by motor carriers

The motor carrier evaluation was conducted through post-test interviews, which were supported by preparatory activities. These activities included a worksheet to help motor carriers estimate the costs associated with current processes for IFTA compliance and assistance in interpreting the AMASCOT mileage and route records and comparing them to corresponding driver trip records.

Key Motor Carrier Evaluation Findings

Analysis of the motor carrier evaluation interviews and supporting information resulted in the following evaluation findings.

Motor Carrier Acceptability. The following areas relate to motor carrier acceptability:

- **Accuracy and reliability are the key attributes motor carriers identified as necessary for mileage and route data recorders.** Rapid, convenient repairability was also a frequently mentioned expectation of motor carriers.
- **Excellent correlation between the AMASCOT mileage and route data and driver recorded mileage and route data.** While only four of the six carriers indicated they had examined the travel data reports produced by AMASCOT, three of these four reported finding excellent mileage data correlation (ratings of 4.5, 5, and 5, on a 1-5 scale with 1 equaling unacceptable).
- **Good correlation between the IFTA-style reports produced by AMASCOT and motor carriers' IFTA reporting.** The only correlation problems identified by motor carriers were related to differences in data cut-off dates between the AMASCOT processing and the motor carriers' own processing.
- **EDI for transfer of IFTA and IRP reports to the states is not a priority for motor carriers.** Of the six participating motor carriers, two utilize EDI routinely and indicated it is a low priority for IFTA and IRP reporting since the benefits are negligible (states would accrue the benefits from EDI reporting in reduced data entry, data errors, and mail handling).

Motor Carrier Issues. The following areas relate to motor carrier issues:

- **Motor carriers expressed concern that the time and location detail included in the mileage and route data could compromise their privacy.** Motor carriers were concerned that regulatory agencies might use the data outside the intended context of fuel tax and registration mileage compliance.
- **Motor carriers expressed concerns over how to manage access to their electronic records during an audit.** While motor carriers agreed with the concept of being able to audit the electronic data using software methods, they voiced strong concerns over how the data might be accessed. Motor carriers indicated a preference for uploading or supplying on diskette the data requested

for audit rather than attempting to "limit access" within their corporate computer system.

Motor Carrier Costs/Benefits. The following areas relate to motor carrier costs/benefits:

- **Nearly all of the participating carriers agreed that an automated mileage and route data collection system had the potential to reduce the costs of IFTA and IRP compliance.** Possible costs savings identified were associated with reduced data entry, reduced data errors and associated reconciliation, and reduced paperwork.

- **Automated mileage and route data collection could reduce IFTA and IRP reporting costs by as much as 50 percent for the participating carriers, but must have additional uses and benefits to result in widespread motor carrier implementation.** Participating motor carriers indicated that automated mileage data collection has the potential to reduce IFTA and IRP reporting costs by 33 to 50 percent. These carriers also indicated, however, that an automated mileage data collection system like that used in AMASCOT would be considered for implementation only if it is accompanied by additional functionality and corresponding benefits.

Motor Carrier Evaluation Conclusions

The AMASCOT demonstrated that technology is capable of automatically collecting mileage and route data for IFTA and IRP compliance. Participating motor carriers found excellent correlation between the AMASCOT data and mileage and route data collected by their drivers. These carriers also agreed that these data could easily be used to generate IFTA and IRP reports.

With automated data collection proven feasible, motor carriers participating in AMASCOT agreed that significant benefits could be available through automated mileage and route data collection for IFTA and IRP compliance. Primarily, benefits could be accrued through reduced data entry, reduced data errors and associated reconciliation, reduced paperwork, and electronic record keeping. A majority of these carriers identified significant potential cost savings from automated mileage and route data collection. These potential savings were estimated to be from 33 to 50 percent of current IFTA and IRP administration costs.

However, motor carriers also identified privacy issues associated with electronic mileage and route data, particularly related to limiting use of and access to their data. Fortunately, motor carriers offered possible solutions to these issues, suggesting that these issues will not be insurmountable.

Lastly, automated mileage and route data collection is most likely to be implemented by larger motor carriers with more technologically advanced business information systems. This agrees with the conclusions of the evaluation work on costs of implementation. These motor carriers will pioneer the use of automated mileage and route data collection for IFTA and IRP compliance as well as for other business functions, ultimately demonstrating its economic viability and paving the way for more widespread implementation.

More detailed information regarding the motor carrier evaluation can be found in the AMASCOT Evaluation Report on Motor Carrier Acceptance and Benefits.

Evaluation Summary of Technology Transfer Efforts

Technology transfer efforts for the AMASCOT project included a project newsletter, presentations at professional meetings, presentations in support of other research efforts, and dissemination of project reports and other information as requested. This report focuses on the efforts related to the newsletters and presentations.

Newsletter

The AMASCOT newsletter consisted of four, four-to-six page issues published quarterly. The newsletter was distributed to all project partners, the FHWA regional offices, all 50 American Trucking Associations affiliated state trucking associations, and other interested parties as requested. To help facilitate newsletter dissemination, each issue included a small address form and subscription request that allowed readers to request their inclusion on the mailing list.

Success of the newsletter for disseminating project information was good. Over 700 copies of each issue of the newsletter were distributed for each of four issues. Each issue generated a modest number of requests for inclusion on the newsletter mailing list.

Problems related to the newsletter were generally limited to timely cooperation by project partners in providing information for publication. With the first priority being successful completion of the project, publication of the newsletter was often delayed while waiting for crucial information from the partners.

Overall, the newsletter was successful, but some means of ensuring partner support for providing information for publication was needed. For future projects incorporating a newsletter or other periodic publication, delineation of newsletter responsibilities could be outlined specifically as deliverables in the project contracts.

Presentations

A number of presentations for the AMASCOT project were made by the project partners at professional meetings of state fuel tax and registration administrators and auditors, motor carriers, and others. These efforts included presentations at:

- IFTA annual meeting
- IFTA Audit Subcommittee meeting
- Highway Safety Forum on Technological Innovations in Vehicle and Highway Safety

In addition to the presentations at professional meetings, efforts were also made to provide AMASCOT information to other ITS-CVO research efforts, particularly state institutional issues studies. Presentations on AMASCOT were made in support of these research efforts:

- North Dakota and South Dakota ITS-CVO institutional issues study
- Massachusetts ITS-CVO institutional issues study
- Connecticut ITS-CVO institutional issues study

The presentations were a very effective method of sharing information about AMASCOT and generating interest among states and motor carriers in AMASCOT and ITS-CVO. Considerable requests for information about AMASCOT were generated following each presentations. In addition, requests for presentations to other groups were made after the project was completed but could not be accommodated since project funds were no longer available.

Technology Transfer Conclusions

Technology transfer efforts for the AMASCOT were successful, resulting in substantial interest in the electronic mileage data collection and filing by state agencies, motor carriers, and technology and service providers. Issues related to technology transfer include difficulties with partner participation in the newsletter and identification of a need for funding for post-project presentations, both of which are easily addressed. Partner participation issues could be relieved by including newsletter participation as part of contract deliverables. Funding for post-project presentations could be addressed by identifying funds for use in technology transfer after project completion.

EVALUATION CONCLUSIONS

The AMASCOT has proven the feasibility of automated mileage data collection and electronic filing for streamlining state and motor carrier processes for administration of fuel tax (IFTA) and registration (IRP) apportionment. The combination of GPS with other technologies is capable of accurately identifying and recording jurisdictional border crossings and mileage traveled by a vehicle, and these data can meet IFTA and IRP requirements.

The AMASCOT has also shown that both states and motor carriers expect to reap benefits from an automated mileage and route data collection system and EDI. For motor carriers, the cost-to-benefit ratio is dependent on the motor carriers' level of business information automation and the extent to which implementing automated mileage and route data collection would be an extension of current fleet management practices. For states, the cost-to-benefit ratio is mostly dependent on the rate of implementation of automated mileage and route data collection and EDI for IFTA and IRP reporting by motor carriers. As more motor carriers implement such systems, states reap greater benefits without additional costs.

Next Steps for Implementation

Clearly, AMASCOT has demonstrated that the feasibility and potential benefits of automated mileage and route data collection and electronic reporting for IFTA and IRP compliance should interest states and motor carriers in implementation of such systems. In fact, three technology providers (Rockwell, Highway Master, and Qualcomm) have announced plans to develop and market AMASCOT-like mileage and route data collection systems. Such competition in a new marketplace should quickly bring down the costs of motor carrier implementation, further encouraging widespread motor carrier implementation.

States need to move forward to support these private sector investments, encourage implementation, and reap benefits of their own. The next steps for achieving widespread implementation include:

- Formal acceptance of automated mileage and route data collection systems by states. The IFTA and IRP agreements enjoin states to accept electronic data collection methods that meet IFTA and IRP requirements. However, to encourage implementation by motor carriers, states need to formally recognize the validity of these systems and work with interested motor carriers and technology providers to promote implementation.
- Establish state capability for EDI and electronic payment between motor carriers and states. For states to achieve significant benefits, EDI and electronic payment are necessary to remove the paperwork in IFTA and IRP reporting. Since states are not generally equipped for EDI and electronic payment between their agencies and motor carriers, a good deal of work will need to be done to put EDI and electronic payment systems in place.

These next steps are straightforward. States only need to make a commitment to achieving them, and both motor carriers and states will reap the benefits of moving commercial vehicle regulatory administration into the information age.

AMASCOT:

Automated Mileage and Stateline Crossing Operational Test

Final Report

Part 2 of 4: Truck System and Electronic Data Interchange Evaluation

May 1, 1996

Principal Investigator
Bill M. McCall

Principal Contributor
Michael L. Hancock

Center for Transportation Research and Education
Iowa State University

Wisconsin Department of Transportation

Center for Transportation Research and Education

Iowa Department of Transportation

IOWA STATE UNIVERSITY

U.S. Department of Transportation

CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

The Automated Mileage and Stateline Crossing Operational Test (AMASCOT) tested the feasibility of automating the collection of mileage-by-jurisdiction data and electronic data interchange for International Fuel Tax Agreement (IFTA) and International Registration Plan (IRP) reporting. The test involved the states of Iowa, Minnesota, and Wisconsin and motor carriers from these three states. The test equipped 30 interstate commercial vehicles with prototype electronic mileage-by-jurisdiction data collection devices, collected mileage-by-jurisdiction data from the vehicles as they operated throughout the United States and Canada in their normal course of business, integrated these mileage data with fuel purchase data to generate the data necessary for IFTA reporting, and evaluated the ability of an electronic mileage data collection system and the data generated to meet IFTA and IRP requirements. The test also investigated the feasibility of transmitting IFTA and IRP reporting data electronically from the motor carrier to the base jurisdiction.

This Part 2 of this AMASCOT Report documents the evaluation of the automated mileage-by-jurisdiction data collection system and electronic data transfer for IFTA and IRP filing. The evaluation goals included:

- Determine the modifications to IFTA and IRP procedures necessary to accommodate electronic mileage data collection.
- Evaluate the feasibility of using currently available communications and database software for electronically submitting IFTA and IRP reports to base states.
- Determine the acceptability of the data provided by the truck system.

This part 2 is a combination of work from several sources, including Rockwell's *Phase II Report of the Driver Trip Report System*, the CTRE reports on *General Motor Carrier System Implementation Options and Cost Estimates* and *Evaluation of the Feasibility of Automated Electronic Mileage Data Processing and Electronic Data Interchange to Support IFTA and IRP Compliance*, and the *Evaluation Subcommittee Report on the Acceptability of Automated Electronic Mileage Data Collection for IFTA and IRP Compliance.* A summary of the Part 2 findings is presented, followed by the subsections with more detailed discussions of the truck system, the data processing and electronic data interchange efforts, and the acceptability of an automated electronic data collection system for IFTA and IRP compliance.

SUMMARY OF FINDINGS

Overall, the AMASCOT project met its goal of demonstrating the feasibility of automated electronic collection of mileage-by-jurisdiction data and its potential for use in IFTA and IRP compliance. Analysis of nearly one million miles of data collected and processed using the prototype automated electronic mileage data collection system has shown:

Truck System

- Accurate, repeatable determinations of jurisdictional border crossings are available through an electronic system. Of the 3,349 border crossings logged during the official data collection period, border crossing detection was repeatable within ±75 feet.
- System operation anomalies in the prototype system were minimal. In over 1.4 million miles of data collection (pre-test and test), the prototype system experienced just four types of instances in which jurisdictional border crossings were not detected. Of these instances, two were corrected before the 90-day data collection period, one was an equipment failure related to improper installation, and the last would be eliminated as an issue in a production device.
- Equipment will be affordable. Cost estimates for the on-board equipment and other supporting hardware and software indicate that carriers that implement satellite communications and vehicle location tracking systems could add automated electronic mileage-by-jurisdiction data collection for as little as $500 per vehicle.

Data Processing and Electronic Data Transfer

- Commercially available database software can be used to integrate the electronic mileage-by-jurisdiction data with fuel purchase data and generate the necessary fleet reports for IFTA and IRP.
- States that can easily integrate database format files into their systems can accept electronic transfer of IFTA and IRP reports with straightforward modifications to their software. Commercially available database applications and motor carrier software packages can export data in an easily integratable database file format which can be integrated into both commercial and custom software through relatively simple data mapping routines. However, cash-strapped and understaffed state agencies may have difficulty appropriating the resources necessary to effect these changes. Other than this issue of the lack of resources, the biggest challenges for states may be achieving standards and

facilities for electronic data transfer and some method for electronic payment to accompany electronic IFTA and IRP filings.

- Upgrading commercially available motor carrier software to integrate electronic mileage data will be relatively inexpensive. In a meeting with leading motor carrier software providers and motor carriers, estimates for modifying commercially available motor carrier software to integrate the electronic mileage-by-jurisdiction information ranged from $1,000 to $5,000, with most participants expecting the cost to be at the low end of this range.

Acceptability of Data for IFTA and IRP Compliance

- Test system fulfilled the basic intent of IFTA and IRP mileage record-keeping requirements, and relatively minor adjustments will allow such a system to meet all requirements.
- Automated, electronic mileage data collection method was demonstrated to be a viable alternative to the current practice of hand-written individual vehicle records.
- Mileage data generated by the test system demonstrated the potential to increase the accuracy of mileage-by-jurisdiction data.

Independent of the findings of the evaluations of state and motor carrier costs, benefits, and acceptance, these findings clearly demonstrate the technical and practical feasibility of electronically collecting mileage-by-jurisdiction data and integrating these data into both current systems and more advanced systems able to accommodate end-to-end electronic data paths for IFTA and IRP data collection, processing, and reporting to a base jurisdiction. With the viability of the concept proven, states and motor carriers can move ahead to solve the issues of EDI standards, EDI facilities, and electronic funds transfer and clear the way for implementation of similar technologies and processes for streamlining IFTA and IRP administration and compliance for both states and motor carriers.

ROCKWELL PHASE II REPORT OF THE DRIVER TRIP REPORT (DTR) SYSTEM

This section is a summary of the Phase II results of the Automated Mileage and Stateline Crossing Operational Test (AMASCOT) DTR data collection system. Phase II of the test consisted of altering the Phase I hardware configuration to a design that would more appropriately allow extended use on-board a class 8 tractor. This design would provide a convenient means to collect and correlate the Driver Trip Report (DTR) data received.

For this portion of the test, six truck fleets, two fleets from each of the participating states of Iowa, Wisconsin, and Minnesota, were solicited to be active participants. Each fleet allowed equipment to be installed on five vehicles for the duration of the test.

To expedite the test, consumer off-the-shelf (COTS) equipment was used as much as possible. This equipment consisted of standard Rockwell Pro 2000 and Link 2000 satellite communications gear outfitted with a COTS single board computer (SBC). The Pro/Link 2000 equipment provided a convenient means to retrieve the data from the vehicle without having to make physical contact with the vehicle. The COTS SBC hosted the Phase I automatic jurisdiction line crossing detection algorithm, jurisdiction line database (SLDB), and the mileage collection function.

The Phase II system demonstrated the practical application of an on-board computer to accurately detect and collect information necessary to allow the automatic means to determine miles a vehicle will travel in a given polygonal jurisdiction. The technologies evaluated in Phase II of the AMASCOT program were the Global Positioning System (GPS), jurisdiction detection algorithm/database, and route collection/storage algorithm. These technologies established the foundation for automatic detection and collection of miles traveled in each jurisdiction by a vehicle.

System Description

In Phase II, the DTR system was installed on 30 test vehicles, five each from the six participating fleets. The information collected by each DTR system was compiled and placed in a summary file. To simplify the removal of the data from each of the fleet vehicles, the DTR system was integrated into a Rockwell Pro 2000 satellite communication system. Figure 2.1 shows the system diagram of both the on-board and fleet management system of the Phase II test. The data received at the fleet management station were then post-processed for submittal to CTRE for evaluation and preparation of mock IFTA reports.

On-Board Equipment

The on-board equipment consisted of a Rockwell Pro2000 satellite communications transceiver with an integrated Single Board Computer (SBC), keyboard display unit (KDU), antenna, antenna cable, odometer sensor cable, and power cable. The Pro2000 equipment is standard off-the-shelf equipment with minor modifications to the hardware to accommodate hosting the SBC within the same mechanical housing. The standard Pro2000 configuration provided a 24-hour continental US coverage messaging system via satellite link. By incorporating the SBC within the Pro2000 equipment, a convenient

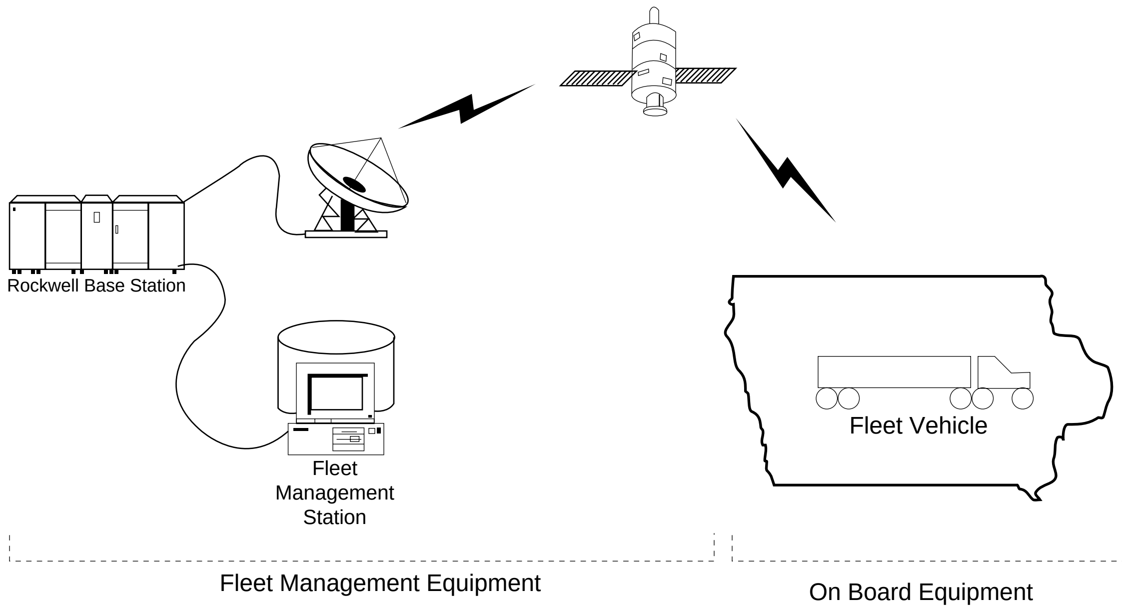

Figure 2.1 Phase II System

means to retrieve the data from the various fleets was achieved. The on-board equipment collected all the pertinent information from the vehicle and provided a satellite extraction link to transfer the data from the vehicle to the fleet management station on a timely basis.

Pro2000 Satellite Communications Transceiver. The Pro2000 transceiver provided a means for 24-hour continental US communications. The standard transceiver consists of a power supply, logic board, RF synthesizer, and GPS module. The Pro2000 KDU, antenna, antenna cable, power cable, and transceiver mounting kits were not modified. For Phase II of the AMASCOT program, the standard transceiver was modified to accept the COTS SBC. A block diagram of the transceiver is shown in Figure 2.2.

Data transmission in the Pro2000 system occurs in a store-and-forward fashion. Once a DTR data record is completed, the SBC then begins a communication process to the logic board in the Pro2000 transceiver. Part of this process is to insure that the Pro2000 is in communication with the satellite. After this check has occurred, the DTR data record is transmitted, via the satellite link, to the fleet management equipment. If an acknowledgment from the logic board that the satellite has received the message is not received by the SBC, the SBC will retry transmission of the data record. Retries will occur until a

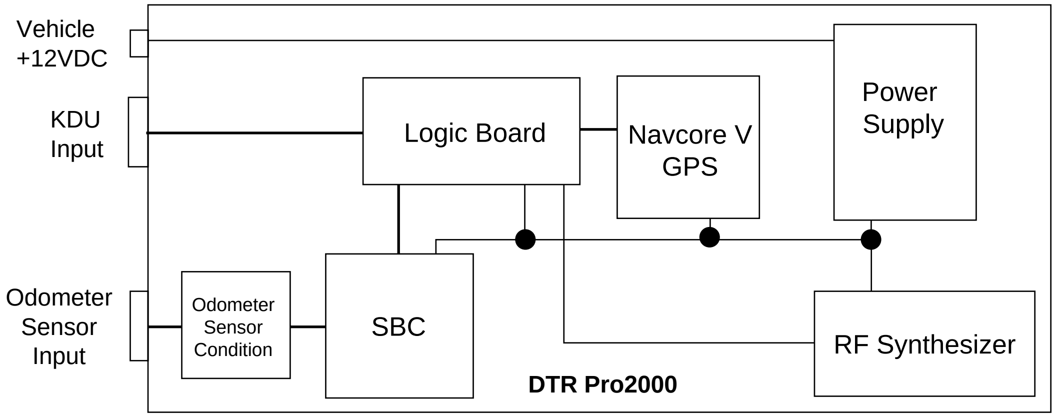

Figure 2.2 Pro2000 Block Diagram

successful transmission of the information over the satellite to the fleet management system has occurred.

Power Supply. The power supply board accepts standard 12-volt vehicle power. The voltage is then conditioned and used to develop the primary operating voltages required by all functions in the transceiver. The power supply function is standard on all Pro2000 equipment and required no modification.

RF Synthesizer. The RF synthesizer module functions as the modulator/demodulator of the satellite signal. The RF synthesizer function is standard on all Pro2000 equipment and required no modification.

Logic Board. The logic board provides the central control and intelligence to the transceiver. Peripheral devices such as the KDU, GPS, and SBC connect through the processor board to move data to/from the satellite link. The logic board acts as a data pipeline to peripheral devices, coordinating activity between them and the satellite communication path.

Navcore V. Integrated into the standard Pro2000 transceiver is a Rockwell Navcore V global positioning module. The Navcore V is a self-contained receiver that decodes the satellite transmissions from a constellation of 24 GPS satellites. The Navcore V formats the decoded satellite information and provides location in latitude and longitude and time in Greenwich Mean Time (GMT) once a second. The basic design of the Pro2000 incorporates the use of the Navcore V module to provide an automatic vehicle location function.

To allow for easy incorporation of the DTR system into the standard Pro2000, the information from the Navcore V module was sent to the SBC via a logical pipeline within the logic board between the Navcore V and the SBC. The information contained latitude, longitude, and time as required by the jurisdiction line crossing algorithm to accurately sense and record a border crossing.

Single Board Computer (SBC). The SBC mounted inside the Pro2000 managed all of the DTR functions. This includes odometer collection, jurisdiction line crossing detection, route sampling, and exception logging. The SBC logs all information to a nonvolatile storage area for later transmission over the Pro2000 satellite system. When enough information is collected to fill a data record, the SBC will initiate transmission of the record to the fleet management system.

The SBC has one megabyte of RAM and two solid state disk drives. The one megabyte of memory is used by the application for general computing memory. One of the solid state disk drives is dedicated to the DTR application software while the other holds the DTR records. An EPROM is used for the DTR application while a battery-backed SRAM is used for the DTR record storage.

Odometer data are obtained by counting pulses generated by the vehicle odometer. The vehicle odometer pulses are signal conditioned prior to use by the SBC to prevent false pulses from occurring.

To maintain accurate collection of mileage traveled, the odometer circuit is calibrated to each tractor. Three pieces of information were required from each tractor: the tire manufacturer, the tire size, and the gear ratio. Using the tire size and manufacturer, the number of revolutions of the tire per mile can be obtained directly from a Veeder-Root Hubometer Application Chart. This value is multiplied by the gear ratio and further multiplied by the number of pulses produced by the odometer sensor in a single revolution (typically 16). This process is identical to that used to calibrate the mechanical odometer on a tractor, except that in this system, the odometer is calibrated by software rather than through mechanical methods.

Keyboard Display Unit (KDU). The KDU is the interface for the vehicle owner to the satellite system. The keyboard is of standard QWERTY configuration. A segregated numeric keypad is also incorporated. Special defined function keys allow for hot key access to specific functions provided by the keypad.

The KDU provided a visual access to data contained on the SBC. The KDU communicated to the SBC via a logical pipeline created on the logic board of the Pro2000 transceiver. The KDU is standard on all Pro2000 equipment and required no modification.

Antenna. The antenna is a dual purpose device that not only receives the GPS signals but also is an active electronic element that provides filtering and amplification of the satellite communication signal. Its shape resembles that of an upside down salad bowl approximately six inches in diameter.

The antenna is mounted in a location on the truck power unit that provides the maximum exposure of the antenna elements to the sky to ensure maximum satellite coverage. The antenna is standard on all Pro2000 equipment and required no modification.

On-Board Equipment Software. The on-board equipment software includes the jurisdiction line crossing algorithm and the jurisdiction line crossing database. This software works together to determine the jurisdiction the vehicle is located in and whether a jurisdiction line crossing is impending.

Jurisdiction Line Crossing Algorithm. The jurisdiction line crossing algorithm accepts position, time, and odometer and utilizes them in conjunction with the jurisdiction line database to determine if a jurisdiction line has been crossed. If it determines that a jurisdiction line has been crossed, it records the new and old jurisdiction, the quality of the position, the location of the crossing, the time of the crossing, and the odometer mileage at the crossing to vehicle DTR record.

The jurisdiction line crossing algorithm uses the current position, surrounded by a circle of ambiguity to determine if a crossing has occurred. The circle of ambiguity is a measurement of the possible system position errors. The circle of ambiguity is dynamic. The radius of the circle depends on a variety of factors which include the quality of the position as received by the Navcore V module, the accuracy of the crossing point in the jurisdiction line database, and the speed of the vehicle. The radius of the circle at any given moment defines the total system error in determining a jurisdiction line crossing.

As the vehicle approaches a jurisdiction line, the circle of ambiguity touches the jurisdiction line stored in the jurisdiction line database. At that time, the algorithm notes that a crossing may be imminent and begins storing the closest probable crossing point. The closest probable crossing point is determined by computing the distance from the current position to the jurisdiction line. If the current position is closer to the jurisdiction line than the previous, the previous position is overwritten by the current position as the most probable crossing point. This continues until the circle of ambiguity is no longer touching the jurisdiction line. At that point, if the new position is in a different jurisdiction, then a crossing event is recorded with the position and time from the stored most probable crossing point. If the new jurisdiction is the same as the old jurisdiction, no crossing event is generated. Figure 2.3 depicts a diagram of both a crossing event and no crossing event.

The crossing event depicted in Figure 2.3 shows six positions of a vehicle starting in Iowa and passing into Illinois. A dashed circle depicts the circle of ambiguity. At posi-

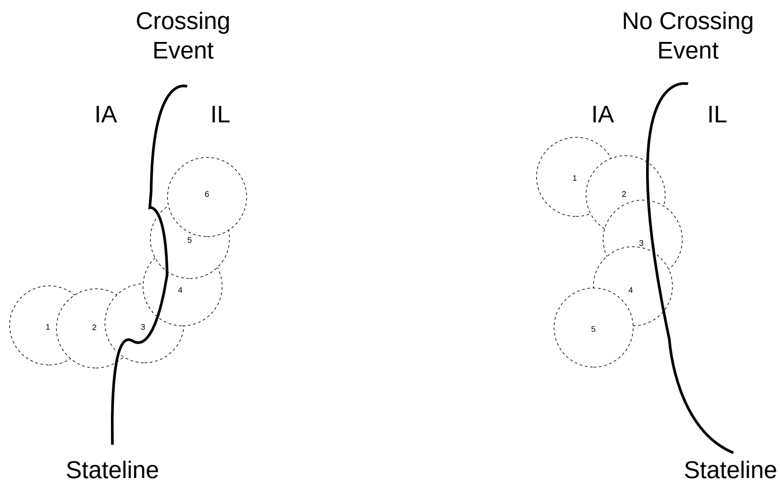

Figure 2.3 Diagram of a Crossing and No Crossing Event

tion 2, the circle of ambiguity touches the jurisdiction line, thus the algorithm saves position 2 as a probable crossing point. At position 3, the circle of ambiguity is still touching the jurisdiction line but is closer in position than that of 2 so position 3 is retained. At position 4, the circle of ambiguity is still touching the jurisdiction line, but it is farther from the jurisdiction line than position 3 so position 3 remains the most probable crossing point. At position 6, the circle of ambiguity no longer touches the jurisdiction line. At this moment, the new jurisdiction is determined and found to be different than the old jurisdiction. Therefore, a jurisdiction line crossing event is indicated with position point 3 logged as the crossing point.

The no crossing event depicted in Figure 2.3 shows 5 positions of a vehicle starting in Iowa, passing very close to the jurisdiction line, and remaining in Iowa. At position 2, the circle of ambiguity just touches the jurisdiction line, thus the algorithm saves position 2 as the most probable crossing point. At position 3, the circle of ambiguity is still touching the jurisdiction line; however, position 3 is closer to the jurisdiction line than that of position 2 so position 3 is saved as the most probable crossing point. At position 4, the circle of ambiguity is still touching the jurisdiction line; however, position 4 is farther away than position 3 so position 3 remains the most probable crossing point. At position 5, the circle of ambiguity no longer touches the jurisdiction line. At this moment, the new jurisdiction is determined and found to be the same as the old jurisdiction; therefore, no jurisdiction line crossing event is recorded.

Jurisdiction Line Database. The jurisdiction line database contains a digital list of all segments which define each of the 48 contiguous states, Alaska, the Canadian provinces, and the Mexican border. It also contains all known discrete border crossings. This database is used by the jurisdiction line crossing algorithm to identify the current position relative to borders of the included jurisdictions.

The jurisdiction line database consists of straight line segments and non straight line segments. Straight line segments endpoints are politically defined by state and federal legislatures and are stored in the database with an accuracy of zero meters. Non straight line segments are defined by rivers, mountain ridges, and other meandering geographic features. Known border crossing locations for non straight line segments are stored in the database with an accuracy of 100 meters.

Known border crossings on non straight line segments are compiled from currently available United States Atlases from multiple sources and compared for accuracy. USGS 1:24,000 and USGS 1:100,000 paper and electronic maps were used to capture the actual locations of the crossings. Known border crossings on non straight line segments are captured from the USGS 1:24,000 maps when available.

The jurisdiction line database also includes supplemental points to limit inaccuracies incurred by the construction of new jurisdiction line crossings. Supplemental points are also included to ensure that false jurisdiction line crossings are not detected on roads which travel very close to the jurisdiction line but do not cross it. Supplemental points are stored in the database with 250 meter accuracy.

The data points which define political jurisdiction lines, known crossing points, and supplemental points are entered as latitudes and longitudes in a binary database in a proprietary format.

Fleet Management Equipment

The fleet management equipment includes the fleet management station (FMS), the Rockwell Base Station (RBS), and the satellite land earth station (LES). The FMS is a Windows-based PC running a special version of the Rockwell EXEC2000 for Windows software package. The FMS manages all of the communication and report generation for the entire fleet of 30 vehicles. The RBS provides communication account management and is responsible for all message traffic routing to and from the LES. The LES handles the over-the-air segment of all message traffic to and from fleet vehicles.

Fleet Management Station (FMS). The FMS provides a convenient interface for monitoring the fleet and generating individual fleet vehicle reports. The FMS is comprised of a Windows-based PC running a special version of the Rockwell EXEC2000 for windows package. The FMS handles message traffic through a dial-up phone connection to the

RBS. Periodically, the FMS will connect to the RBS and drain the information gathered in the fleet account assigned for the AMASCOT fleet vehicles.

The package is modified to filter for the fleet vehicle DTR records and file them into a defined directory on the PC disk drive. Once filed on the PC disk drive, options are provided to sort the group of records. These records can be broken down by individual fleet vehicle, concatenated for a specific vehicle to provide a summary over a period of time, and have a properly formatted file header for use by third party software developed to generate fuel tax reports.

Rockwell Base Station (RBS). The RBS is the centralized data switch for all customers utilizing the Rockwell Pro2000 equipment. Individual fleet management computer systems communicate through the Rockwell RBS to their respective fleet vehicles. The RBS also performs general accounting for all data traffic to generate billing information for data sent over the system.

For the AMASCOT test, a single customer account was set up for the entire test fleet. Billing information was not required to validate the system.

Individual Automated Driver Trip Report (DTR) Records

DTR records are created on the solid state disk as the vehicle moves about. They contain a history of starts, stops, route samples, border crossings, and system exceptions. System exceptions include such things as loss of position information, loss of odometer, and unexpected power loses. These recorded exceptions allow for automatic system monitoring of the DTR information collected. DTR files also contain a unique sequence number, driver ID, carrier ID, and vehicle ID. Each DTR file has a unique file name which includes a 4-digit sequence number.

DTR records are limited in size by the maximum trip log size parameter. When a DTR file is full, it is closed and a new trip log file is created. If the maximum number of saved DTRs has been exceeded, the oldest DTR is deleted. The number of saved DTRs is defined by the maximum number of DTRs parameter. Once a DTR file has been closed it is transmitted over the air.

DTR files are in text format with each line defining an event. Each line begins with a 2-character event code which defines the format of the remaining fields in the line. Event codes, along with each field (as indicated by the < > symbols) relevant to the event, are defined below.

LS <sequence number>

Trip log - sequence number: The sequence number for this trip log. Each trip log has a unique sequence number. This number is also reflected in the file name used to store the data on the solid state disk.

LD <driver ID>

Trip log - driver ID: An alpha-numeric string defining the driver of this vehicle. This string is copied from the parameter file during trip log file creation.

LV <vehicle ID>

Trip log - vehicle ID: An alpha-numeric string defining this vehicle. This string is copied from the parameter file during trip log file creation.

LC <carrier ID>

Trip log - carrier ID: An alpha-numeric string defining the carrier that operates this vehicle. This string is copied from the parameter file during trip log file creation.

TC <odometer> <initial jurisdiction> <initial jurisdiction> <quality> <position> <time> <date>

Trip event - cold start: The system has detected a cold start and is reporting the initial jurisdiction. This occurs each time power is applied to the system or the position has been bad for more than 200 seconds. It will also be reported if successive position reports indicate that more than 200 seconds have elapsed.

TB <odometer> <jurisdiction from> <jurisdiction to> <quality> <position> <time> <date>

Trip event - border crossing: The system has detected a border crossing and reports the jurisdiction left and the jurisdiction entered. The location and quality correspond to the actual crossing, not the current location.

TS <odometer> <quality> <position> <time> <date>

Trip event - start trip: The system has detected vehicle movement and a trip has begun. A start occurs when the vehicle has averaged more than 5 MPH for the duration of the trip start time parameter.

TP <odometer> <quality> <position> <time> <date>

Trip event - stop trip: The system has detected that the vehicle has been stopped for at least the stop time parameter and the trip has been stopped.

TL <odometer> <quality> <position> <time> <date>

Trip event - sample of vehicle location: The system has taken a snapshot of the current location and odometer. This occurs only if the sample enable parameter is turned on.

EP <odometer> <quality> <position> <time> <date>

System exception - unexpected power down: The system has powered down unexpectedly and power has been restored. This exception may be triggered by removing power from the system while the vehicle is moving. It may also occur if power is removed and the vehicle has recently stopped but the stop timer has not expired.

EL <odometer> <last quality> <last position> <last time> <last date>

System exception - location outage: The system has detected that the \RCKWL\A position report from the Pro2000 transceiver has not been received for more than 5 minutes. This indicates a communication link failure but trip starts, stops, and samples are still recorded.

ES <odometer> <last quality> <last position> <last time> <last date>

System exception - status outage: The system has detected that the \RCKWL\J status report from the Pro2000 transceiver has not been received for more than 5 minutes. This indicates a communication link failure but does not affect trip log recording.

ET <odometer> <last quality> <last position> <last time> <last date>

S*ystem exception - transceiver reboot:* The system has detected that the Pro2000 has rebooted unexpectedly and has completed built in self-test. This indicates a transceiver anomaly but does not affect trip log recording.

EX <odometer> <last quality> <last position> <last time> <last date>

System exception - transmit packet time-out: The system has detected that a packet has taken more than 500 milliseconds to transfer to the Pro2000. The condition is typically cleared once recognized. This indicates an AFT system anomaly but does not affect trip log recording.

EG <odometer> <last quality> <last position> <last time> <last date>

System exception - GPS outage: The system has detected that the \RCKWL\A position report has been bad (quality worse than 500m) for more than the GPS outage time parameter.

EC <odometer> <last quality> <last position> <last time> <last date>

System exception - transceiver link failure: The system has detected that the serial link to the Pro2000 has been interrupted for more than 5 minutes and the AFT system is attempting to reset the link. This typically indicates a cable failure or serial communication device failure.

EO <last odometer> <quality> <position> <time> <date>

System exception - odometer outage: The system has detected that the odometer is not changing but the current position is changing. Distance is straight line approximated between successive position reports. This condition must persist for more than the odometer outage distance parameter.

EF <odometer> <quality> <position> <time> <date>

System exception - system failure: The system has catastrophically failed and requires service. This exception may occur under a variety of conditions including hardware failures and critical system time-outs.

ED <old odometer|new odometer> <quality> <position> <time> <date>

System exception - odometer calibration: The odometer has been changed via the keyboard or over the air. Two ED records will be logged which show the old odometer and the new odometer.

RG <odometer> <quality> <position> <time> <date>

System recovery - GPS recovered: The system has detected that the \RCKWL\A position report has returned to quality of less than 500m.

RC <odometer> <quality> <position> <time> <date>

System exception - transceiver link recovered: The system has detected that the serial link to the Pro2000 has been re-established after an outage.

RO <odometer> <quality> <position> <time> <date>

System recovery - odometer recovered: The system has detected that the odometer has begun to show movement once again.

RS <odometer> <quality> <position> <time> <date>

System recovery - status recovered: The system has detected that the \RCKWL\J status report has returned.

RF <odometer> <quality> <position> <time> <date>

System recovery - system failure recovery: The system has been manually reset via the keyboard or over the air.

The definition of each of the field types used in trip log event records are listed below. All fields are presented in standard ASCII text format.

<sequence number>

Numeric 4-character string with leading zeros.

<driver ID> <vehicle ID> <carrier ID>

Alpha-numeric 32-character maximum string with white space replaced by underscore.

<start date> <end date> <date> <last date>

Numeric 8-character string of format mm/dd/yy in GMT.

<odometer> <old odometer> <new odometer>

Numeric 8-character string of format dddddd.d in miles and tenths.

<initial jurisdiction> <jurisdiction from> <jurisdiction to>

Alpha 2-character string using standard postal abbreviations for states and provinces.

<quality> <last quality>

Numeric 1-character value with 0 = invalid, 1 = 5000m to 2500m, 2 = 2500m to 500m, 3 = 500m to 5m.

<position> <last position>

Two alpha numeric 12-character strings of format ddd”mm’ss.sh in degrees, minutes, seconds, tenths of seconds, and heading.

<time> <last time>

8 character numeric string of format hh:mm:ss in GMT.

An example of a complete DTR file is shown below. It includes a sequence number, driver identification, vehicle identification, and carrier identification in the header. The following event records include trip location samples, starts, stops, a GPS recovery, and a system cold start. The location and time fields can be invalid for any record type. Invalid location is always marked by a quality field of 0. Invalid time is always presented as 01/01/93.

LS 0138

LD Chip_Larson

LV 80001491

LC Midland_Transportation

TL 197269.5 3 042"01’39.8N 091"40’22.0W 22:47:59 10/24/94

TL 197274.2 3 041"58’10.0N 091"40’22.1W 22:52:59 10/24/94

TL 197278.2 3 041"55’21.0N 091"40’35.3W 22:57:59 10/24/94

TL 197279.4 3 041"54’53.2N 091"41’00.7W 23:02:59 10/24/94

TP 197279.5 3 041"54’54.0N 091"41’00.7W 23:04:37 10/24/94

TS 197279.5 3 041"54’54.6N 091"40’59.9W 23:05:49 10/24/94

TP 197279.5 3 041"54’55.0N 091"40’58.8W 23:07:26 10/24/94

TS 197279.5 3 041"54’56.1N 091"40’58.9W 23:13:04 10/24/94

TP 197279.6 3 041"54’54.9N 091"41’00.4W 23:14:28 10/24/94

TS 197279.6 0 000"00’00.0N 000"00’00.0E 00:00:00 01/01/93

TP 197279.6 0 000"00’00.0N 000"00’00.0E 00:00:00 01/01/93

RG 197279.6 3 041"54’54.1N 091"41’01.0W 10:59:40 10/25/94

TC 197279.6 IA IA 3 041"54’54.1N 091"41’01.0W 10:59:40 10/25/94

TS 197279.7 3 041"54’54.3N 091"41’01.3W 11:13:39 10/25/94

TP 197279.9 3 041"54’52.8N 091"41’04.4W 11:15:42 10/25/94

TS 197279.9 3 041"54’52.2N 091"41’04.0W 11:17:41 10/25/94

TL 197282.8 3 041"56’13.6N 091"40’09.1W 11:22:56 10/25/94

TL 197288.0 3 042"00’07.4N 091"39’58.5W 11:27:56 10/25/94

TL	197291.7	3	042"02’05.9N	091"38’59.1W	11:32:55	10/25/94
TP	197292.2	3	042"02’00.2N	091"38’34.3W	11:36:24	10/25/94
TS	197292.2	3	042"01’58.6N	091"38’34.9W	12:15:40	10/25/94
TL	197293.5	3	042"01’41.2N	091"37’42.0W	12:20:55	10/25/94
TL	197295.6	3	042"01’59.3N	091"35’32.1W	12:25:55	10/25/94
TL	197297.9	3	042"02’08.9N	091"32’55.8W	12:30:55	10/25/94

Compiled DTR Records

The fleet management stations (FMS) takes multiple DTR files from a vehicle and concatenates them to create a single DTR file for a selected report period. Events within the individual DTR records are preserved. The header information of each individual DTR record is used to create the complete report. The header includes the sequence number (LS record), the driver ID (LD record), the vehicle ID (LV record), and the carrier ID (LC record). The trip log file headers used to create the report are checked for consistency, but all are not included in the concatenated report. Once the report is complete, the FMS inserts report dates (LR record) to identify the time span of the information included in the report. The format of the report date is shown below. Field definitions can be found in the previous section.

LR <start date> <end date>

Trip log - report dates: Starting and ending dates, inclusive of the trip log data contained in the file.

Operational Data Flow

Figure 2.4 illustrates the sources for all data used during the AMASCOT DTR test. For a more detailed understanding of the “Rockwell Vehicle Trip Log” and how the information is obtained, refer to Figure 2.1.

This diagram is provided to give a general understanding of the flow of information necessary to create a miles-by-jurisdiction tax report. A fully operational system would appear very similar. Electronic fuel purchase data would be transferred to a centrally located data processing center. The fixed vehicle data from those boundary systems that do not provide electronic DTRs would also be sent to the central data processing center.

The central data processing center could be either a truck fleet’s own tax preparation department or could be a contracted tax preparation company. In an operational system, the amount of paperwise information is significantly reduced. Electronic storage of the

DTR information would be at the fleet site unless the economic benefit of having a third party manage the information dictated otherwise.

Submission of the final tax report would also be an automated process. A simple modem connection could be in place to transfer the information automatically on a timely schedule.

To assist the fleet manager in verification/coordination of the data, third party software would be developed to provide summary information. This information could range from pictorial to textual dependent upon the level of detail required to validate the vehicle data.

Verification of information by the different taxing authorities would be less cumbersome. Electronic transfer of information could take place in favor of time-consuming travel to the various record-keeping locations.

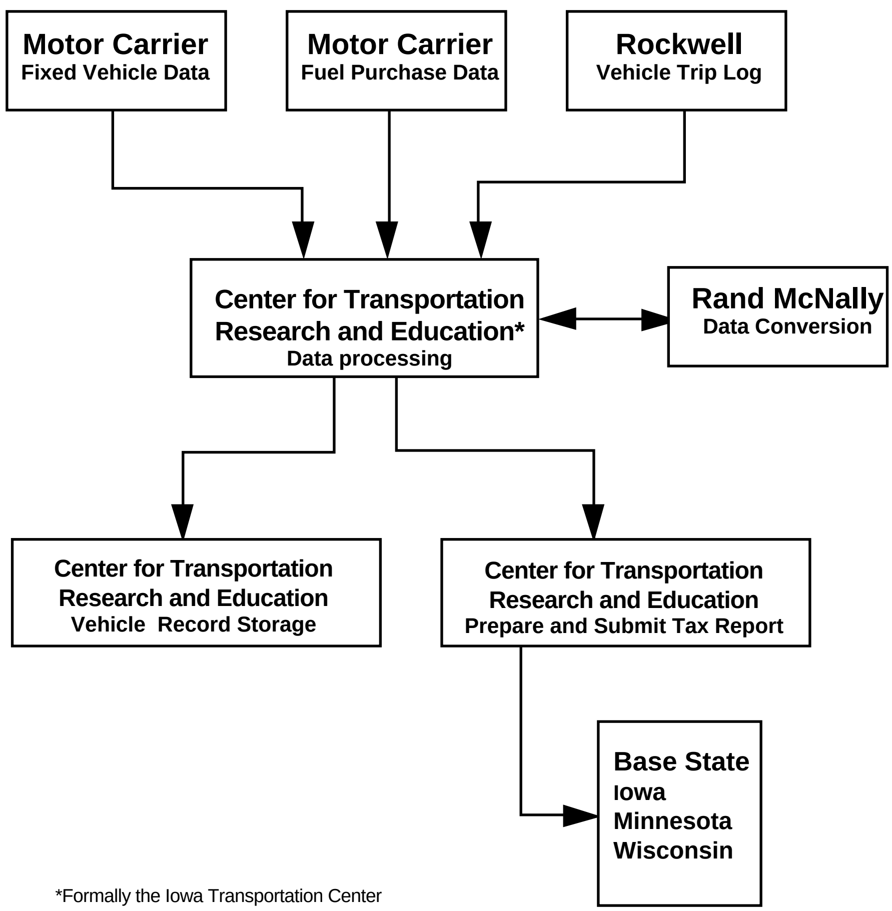

Figure 2.4 Data Flow Diagram

Test Results
Phase I of the AMASCOT DTR system was limited to evaluation of the system with a confined database consisting of the jurisdiction lines of Wisconsin, Illinois, and Iowa in the immediate vicinity of Dubuque, Iowa. This portion of the program successfully demonstrated that the technology could provide an automated means of collecting DTRs.

The purpose of Phase II of the AMASCOT DTR test was to demonstrate the capability of the automated DTR system with a database expanded to cover the continental United States. Trucks from six fleets provided a random route sample of data. This portion of the test provided the insight necessary to conclude that the system could be implemented on a broad scale.

Summary of Collected Data
Figure 2.5 is a map showing the distribution of the boundary crossings that were recorded by the 30 trucks participating in this project. There are over 5,000 points on the map created by the trucks which covered over 1,400,000 miles during the time that the Rockwell units were installed. Mileage was obtained in all 48 contiguous states as well as six of the Canadian provinces. Due to the scale of the map, not all recorded points are visible.

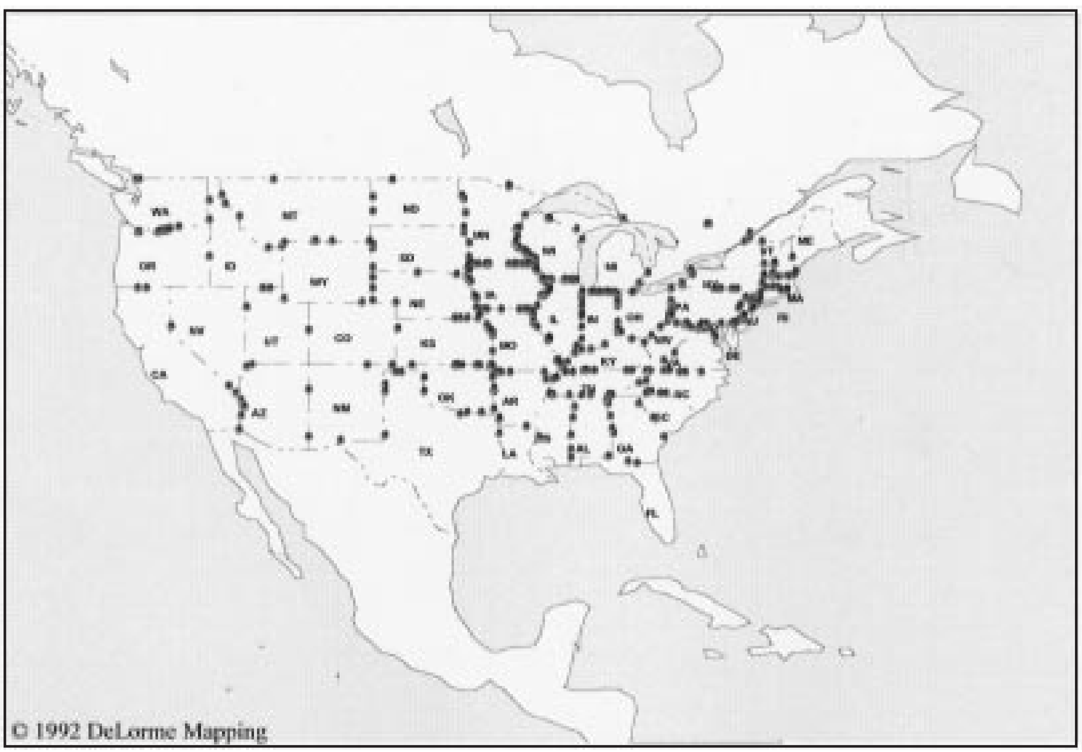

Figure 2.5 Boundary Crossing Distribution

In addition to the boundary crossings, over 90,000 events were collected resulting in over 1.3 megabytes of recorded data. Table 2.1 is a summary of all collected data since initial installations were performed on the fleet vehicles in January 1995. Table 2.2 is a summary of the data collected limited to the 90-day test period of May 1995 through July 1995.

Table 2.1 Total Data Collection Period by Company

Company	Events	Miles	Crossings
Caledonia	9,072	143,119	645.00
Cenex	21,389	272,957	1,007
Johnsrud	12,138	159,525	552.00
Roehl	19,097	287,014	1,293
Ruan	11,498	173,331	768.00
Skinner	18,263	374,860	893
TOTAL	91,457	1,410,805	5,158

Table 2.2 90-Day Test Period by Company

Company	Events	Miles	Crossings
Caledonia	9,072	143,119	645.00
Cenex	12,553	129,957	534.00
Johnsrud	10,060	115,211	460.00
Roehl	9,854	142,412	627.00
Ruan	8,060	123,579	547.00
Skinner	13,687	302,563	536
TOTAL	63,286	956,839	3,349

Jurisdiction Line Crossing Detail Data

Figure 2.6 and Figure 2.7 provide an indication of the repeatability of the boundary sensing algorithm in conjunction with the GPS. Figure 2.6 shows the location of Figure 2.7 with respect to St. Paul, Madison, and Des Moines. Figure 2.7 shows I-90 crossing the Mississippi River boundary between Wisconsin and Minnesota blown up to a scale that shows all the individual points.

There are over 50 points in the cluster that cover different vehicles over the data collection time period. The average distance to the boundary is about 200 feet. The boundary illustrated in the map is from the DeLorme Mapping Company database, which is a different source than the Rockwell database which accounts for the absolute error of the average location. The east/west scatter or repeatability of crossing sensing is less than ±75 feet.

The lone point upstream is separated from the main cluster by about 1500 feet but is only 50 feet from the boundary. This point demonstrates a unit whose position as reported from the Navcore V has degraded accuracy. In this particular circumstance, the accuracy caused the position deviation from the actual crossing point to what is termed a supplemental point in the jurisdiction line database. Supplemental points are used to enhance the jurisdiction boundaries as defined in the database where political lines are not present. Since the point is parallel with the boundary, the sense point for odometer reading will be as close to the proper reading as the other points. This indicates that the use of Navcore V with a properly constructed boundary sensing algorithm and boundary database can provide accuracy and repeatability greater than 10 times that which is required for computing the total jurisdictional miles. Examination of several other high density boundary crossing points shows the same characteristic scatter parallel with the boundary with the same magnitude of accuracy and repeatability. The parallel scatter is due to the fact that the crossing algorithm senses the boundary line segment and not the crossing point.

System Operation Anomalies

During the test there were four instances of jurisdiction lines crossings that were not detected by the on-board equipment. The first instance of a missed border crossing was due to an error in the database. The second instance of missed border crossing was due to a software filter incorporated in the standard Pro2000 transceiver. The third instance of the missed crossing was due to an apparent installation related failure of the on-board equipment. The fourth instance was due to an incorrect software parameter that defined the error inherent in GPS. Both the error in the database and the software position filter were corrected prior to start of the 90-day test. The installation error can be corrected with an appropriate check-out procedure. The software parameter discrepancy would not be present in a production system.

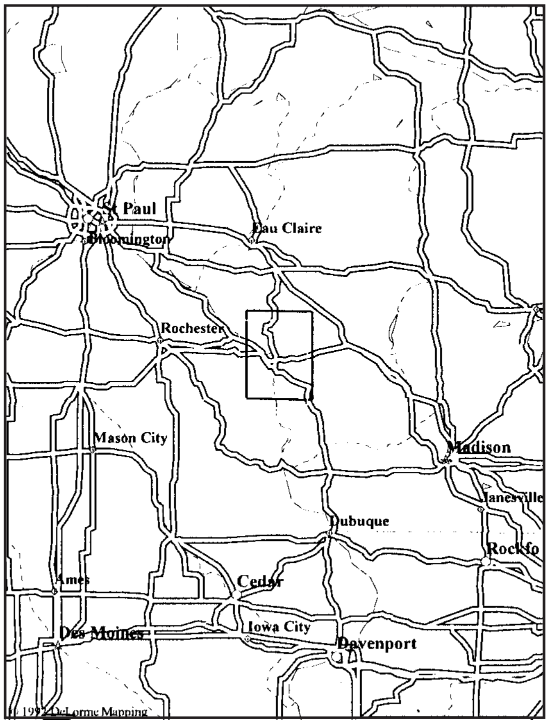

Figure 2.6 Border Crossing Overview

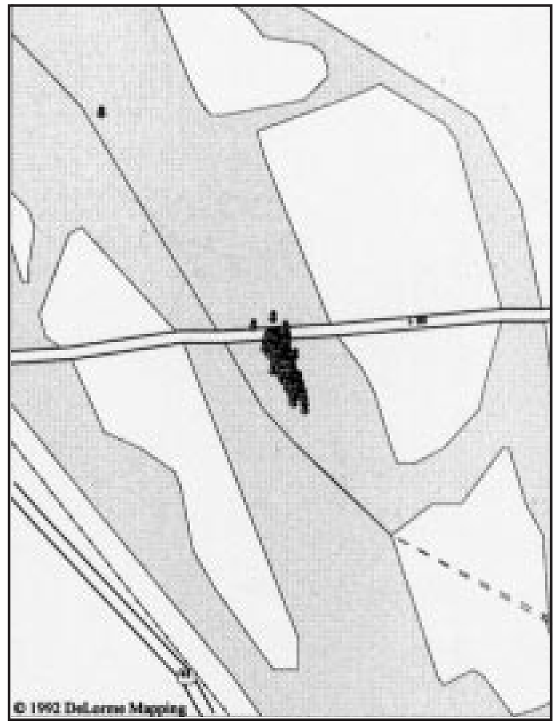

Figure 2.7 Border Crossing Detail

During the development of the Phase II database, a computerized test algorithm was developed to validate closure on each of the polygons that defined the states and provinces. Part of the test procedure called for human interpretation of the test results. The test result information was extensive and, as a result, an oversight of a reported error in the database occurred. This error was detected shortly after installation when initial data were received from the fleet vehicles. The database error was corrected in all fleet vehicles prior to execution of the 90-day test period.

The on-board equipment consisted of Rockwell Pro2000 satellite communications equipment. The standard Pro2000 equipment incorporates a smoothing filter in the logical pipeline that receives the Navcore V position information. The position information received from this logical pipeline was passed to the jurisdiction line crossing algorithm. The filter effectively smoothed the position error budget received from the Navcore V. A consequence was that the error budget allocated by the algorithm was insufficient. With the error budget being reported as smaller than it actually was, the circle of ambiguity was defined to be too small. This resulted in a condition where the first of two subsequent position reports would occur before a border detection and the second position report would occur after the border. Because the circle of ambiguity was smaller than the distance traveled by the vehicle in the time between the two position reports, the circle never touched the border, and thus the algorithm never detected the crossing event. The prototype system will not recover from a missed border crossing until it is reset by a cold start. This error was detected shortly after installation when initial data were received from the fleet vehicles. To correct this error, a logical pipeline from the Navcore V to the jurisdiction line crossing algorithm that did not incorporate the position filter was used. The position smoothing error was corrected prior to execution of the 90-day test.

The system anomaly related to an apparent installation related failure of the on-board equipment resulted when a truck that started in Joslin, New Hampshire, showed up in New York and then Pennsylvania with no indication of a border crossing until the Pennsylvania/Ohio border. Review of the data prior to Joslin, New Hampshire, and after the Pennsylvania/Ohio border indicated that the system was performing normally. In the interim pieces of data, there are records indicating cold starts (TC), transceiver reboot (ET), GPS recovered (RG), and unexpected power down (EP). This sequence of events indicated that the unit had intermittent power. The cause of the intermittent power was unknown but could be due to a loose power connection, intermittent ground, a shorted wire, or a loose connector. While data were lost, the system gave adequate indication that it was not performing correctly.

The incorrect software parameter was discovered during the trip of a truck that traveled on I-65 from the Tennessee/Alabama border down to Plateau, Alabama, and back north. The Alabama/Tennessee border was missed and the truck reported normal events but did not sense another border crossing until the Illinois/Wisconsin border after a cold start in Illinois. Review of the operating parameters indicated that the error budget for the Selective Availability (system accuracy degradation) of the GPS was set at 50 meters for all the systems. With the position degradation set this low, there is an opportunity for the circle of ambiguity to be defined small enough such that the first of two subsequent position reports would occur before a border detection, with the second position report occurring after the border. A missed border crossing is possible since this could, in rare instances, cause the circle of ambiguity not to sense a border crossing. The prototype system will not recover from a missed border crossing until it is reset by a cold start. While data were lost in this instance, in a production system, the error budget would be adjusted properly to prevent this fault from happening.

Conclusions

The database, as constructed, provided a means of defining all boundaries within the continental U.S. and Canada. The database is of compact form (less than 70 Kbytes) and can be expanded to incorporate other geographic regions as required. The database design is adequate even in the event new roads are constructed which cross jurisdiction boundaries. Supplemental boundary points defined in the database provide sufficient means to detect these new crossings.

The jurisdiction line crossing algorithm performed as expected on a large scale as was proven during the small scale test of Phase I. The algorithm demonstrated the capability to detect a crossing event with accuracy greater than ten times that generally expected from manual DTRs.

The Navcore V receiver operated nominally. There were no operational characteristics of the Navcore V or the GPS which adversely affected the capability to detect a crossing event.

The accuracy of the data are dependent upon the accuracy of the positioning system receiver and the database that the positioning system receiver is operating against. This, in conjunction with the algorithm used to detect the jurisdiction line crossing occurrence, demonstrated the capability of the system to accurately log a crossing event.

The test successfully demonstrated that a GPS based system can automatically collect mileage traveled by jurisdiction for electronic submittal to the IFTA and IRP based jurisdictions.

GENERAL MOTOR CARRIER SYSTEM IMPLEMENTATION OPTIONS AND COST ESTIMATES

This section identifies a general range of motor carrier implementation options and cost estimates likely for use of an automated mileage-by-jurisdiction collection device similar to that used for the AMASCOT test. These implementation options and costs were identified in a working meeting of motor carriers, leading motor carrier software vendors, and Rockwell representatives. The meeting was conducted with the following goals in mind:

1) Identify options for implementation of an automated mileage-by-jurisdiction recording device.

2) Identify general range of costs associated with the identified implementation options.

3) Identify other issues associated with implementation.

The cost estimates contained in this document are extremely conservative, with all representatives agreeing that costs for the on-board equipment and the software will most likely reflect the low end of the estimates and decrease significantly as competition is introduced.

To help in identifying implementation options, the process was broken down into subgroups of the entire system necessary to utilize automated mileage-by-jurisdiction data collection and reporting. These included:

- **In-vehicle data collection.** This includes only the equipment necessary to collect and temporarily store the mileage-by-jurisdiction information on-board the vehicle.
- **Data extraction.** This includes the hardware/method necessary to transfer the data collected on board the vehicle to a system for processing and filing.
- **Data processing.** This includes the hardware and software necessary to integrate the automated mileage data with fuel data to generate the necessary IFTA reports and to maintain the necessary records for IFTA auditability.
- **Report communication and payment.** This includes the hardware and software means for delivering the report and any necessary payment to the base jurisdiction.
- **Data archiving and auditing.** This includes the hardware and software means to maintain the necessary records and provide support for both internal and external audit.

The likely general implementation options and cost estimates for each of these areas are discussed in the following sections. Motor carrier costs for implementation can vary widely due to differences in motor carrier operations, level of sophistication, motor carrier size, and other characteristics. As a result of this variability, estimation of the costs of implementation of an automated mileage data collection system for an “average” motor carrier was not possible. To provide some reference for implementation costs, however, several example implementations and corresponding estimates of implementation costs are given.

In-Vehicle Data Collection Options and Cost Estimates

Discussion of the in-vehicle data collection options and costs assumes that implementation technologies will be similar to those used by Rockwell—a GPS receiver working with a jurisdiction line database and odometer to record mileage data by jurisdiction. This does not include the equipment necessary to get the data from the truck to another system and it does not include communications of any kind. In other words, this is the basic data collection system.

There are two likely options for implementation of an in-vehicle data collection device as described above:

1) Stand-alone for vehicles not needing/not equipped with GPS tracking and communications.

2) Integrated with GPS tracking and communications.

These options have different application and cost considerations which are discussed in this section.

Stand-Alone Data Collection Device

Equipping motor carrier vehicles with a stand-alone data collection device would be the implementation option available to those carriers who do not need the additional location reporting and communication capabilities of a satellite tracking system but would like to gain the benefits of automated mileage-by-jurisdiction data collection.

Such a system would consist of the GPS receiver, antenna, and mileage-by-jurisdiction computer module. This system would collect mileage-by-jurisdiction information but would require one of the direct data extract options (discussed later in the section on data extraction options) to move the data from the truck to the motor carrier's or service agency's processing system.

Cost Estimate:

Stand-alone system	\$600–800 per truck

Data Collection Device Integrated with GPS Tracking and Communications

Many motor carriers are already utilizing GPS tracking of vehicles with communications capabilities such as satellite data and messaging or cellular voice, messaging, and data. Vehicles already equipped with GPS tracking and communications would require less hardware to implement automated mileage-by-jurisdiction data collection. These vehicles would already have the GPS antenna and GPS card that could feed the automated mileage data function, which would reduce hardware needs and costs for implementing automated mileage data collection.

In addition, the on-board communications capabilities could serve as the data extraction method, thus eliminating the costs of in-vehicle data extraction hardware. However, over-the-air data extraction has its own costs, which are discussed in the section on data extraction options.

An automated mileage-by-jurisdiction data collection system that could be integrated with GPS location tracking and communications would consist of a mileage-by-jurisdiction data collection card or module that would integrate with the GPS and communication capabilities of the locational and data/messaging system. Such a card or module could use the GPS information being generated by the locational system and take advantage of the communications capabilities for data extraction.

Cost Estimate:

Integrated with existing GPS and communications	$400–500 per truck

Data Extraction Options and Cost Estimates

With the ability to automatically collect mileage-by-jurisdiction data on-board the vehicle comes the need to be able to extract the data conveniently and cost effectively. The options for extracting data include:

- long-range, over-the-air communication such as satellite or cellular links
- memory card
- hand-held device
- cable data link
- short-range RF data communication

These options can be grouped into those that allow mobile data extraction from any practical location at any time, such as satellite or land-based communications, and those that allow fixed data extraction only when the vehicle is at a properly equipped location, such as a memory card, hand-held device, cable link, and short-range RF data communication.

Mobile Data Extraction

Mobile data extraction options include satellite or land-based data communications. These options would be available when an automated mileage-by-jurisdiction data collection device is integrated with an on-board GPS location and communications system.

The costs of mobile data extraction are essentially related to the transmission time required for the data. During the AMASCOT project, the Rockwell prototype equipment generated approximately 1.4 kilobytes (1.4 K) of data per vehicle per day without compression of any kind. Discussion among the meeting participants regarding data compression arrived at an estimate of 400 bytes of data per vehicle per day after compression.

Communication costs differ for satellite and land-based data communications. Discussion of rates for data transmission arrived at the following approximate costs for data transmission:

Cost Estimates:

Satellite:	Day	\$1.65/K
	Night	\$0.75/K
Land-based:	Any time	\$0.48/minute (approx. 1K per minute). Full minutes only.

Using the above rates and the estimate of 400 bytes of data per vehicle per day, satellite data transmission would cost approximately \$0.30 per vehicle per day and land-based data transmission would cost approximately \$0.48 per vehicle per day (if a full minute of transmission is purchased and no other data are sent).

However, several issues could lower or eliminate the additional costs of data transmission. For motor carriers who would utilize land-based data transmission, the costs would be reduced substantially if other data were sent during the remainder of the one-minute minimum charge or if communications providers began offering partial-minute rates. Based on the percentage of one minute necessary to transmit the estimated 400 bytes, the data transmission costs could be reduced to approximately \$0.19 per vehicle per day.

For motor carriers who would be using satellite data transmission, the costs of data transmission for mileage-by-jurisdiction data could fall within their current data transmission quota and therefore incur no additional costs. Currently, motor carriers negotiate a rate for satellite communication that includes a base quota of data transmission in the rate, and data transmission above this quota incurs additional costs. Many motor carriers do not routinely use their entire base quota, leaving a reserve that might be used for transmission of mileage-by-jurisdiction data. Based on the estimate of 400 bytes of data per vehicle per day, motor carriers at the meeting concurred that this additional data might be accommodated without exceeding the base transmission quota, thus generating no additional data transmission costs for motor carriers able to do this.

Fixed Location Data Extraction

Because the mileage-by-jurisdiction data gathered on-board the vehicle are not extremely time sensitive, data extraction options that require the vehicle to be in a particular location (or one of several locations) such as a motor carrier’s terminal are viable options for motor carriers as well. Options that are currently available and in use on vehicles today are discussed below.

Memory Card. The memory card option would consist of an in-vehicle read/write device for each vehicle, a memory card (or cards) for each vehicle, and a card reader at each data extract location. The mileage-by-jurisdiction data would be stored on-board the vehicle in memory, then downloaded to the memory card when convenient, such as once a week or when the vehicle returns to the terminal.

The in-vehicle cost estimates for a memory card data extract system include the cost of a read/write device and a single memory card. The fixed location costs would be for the number of card readers/writers necessary at the fixed location.

Cost Estimates:

In-vehicle read/write device and memory card	$300–400	per vehicle
Fixed location read/write device	$300	per location
Additional memory card	$75	per card

While the memory card data extract option could be utilized in a mobile application by purchasing multiple memory cards for each vehicle and rotating them between being carried on the truck and being processed, the high cost of memory cards and the potential for loss is not justified when considering the low time sensitivity of the data.

Hand-Held Device. The hand-held device option would consist of data port or link on the vehicle, a hand-held device that could extract the data from numerous vehicles, and a data port or link to load the data into the processing system. The hand-held device would be used to download data from the vehicles when they are available at the fixed location.

The cost estimates for the hand-held device data extract method include the data port/link device on the vehicle, the hand-held device, and the data port/link at a fixed location.

Cost Estimates:

Vehicle data port/link	$300–400 per vehicle
Hand-held extract device	$500–600 each at entry level
Fixed data port/link	$300–400 per location

Cable Data Link. The cable data link option would consist of an output port on the vehicle and cable links at a fixed location. When the vehicle is available at the fixed location, the cable link would be connected to the truck and the data would be downloaded.

Cost estimates for the cable link include the port on the vehicle and the infrastructure at the fixed location.

Cost Estimate:

Cable data link and infrastructure	$300–400 per vehicle

Short-Range Radio Frequency (RF). Short-range RF data extraction consists of an RF-activated device on each vehicle and an RF modem linked with a computer at each location where data extraction is needed. An equipped vehicle would arrive at the location, the RF reader would establish contact with the truck, and the reader would automatically extract the data. This RF reader might be placed at the entrance to the terminal, the fuel pumps, or some other common area where all trucks will pass by while they are at the terminal.

Cost estimates shown below for the short-range RF system include the on-board, RF-activated device for each vehicle and an RF modem at each necessary location:

Cost Estimates:

RF-activated on-board device	$300–400 per vehicle
RF data communications network	less than $800 per RF modem

Data Processing Options and Cost Estimates

Once the mileage-by-jurisdiction information is extracted from the vehicle, motor carriers or their service providers will need to be able to integrate the data into the systems they use for fuel use and mileage-by-jurisdiction reporting. Discussion of options and costs for integrating the automated data into motor carriers' and service providers' systems for IFTA and IRP assumes that these processes are currently computerized with the exception of mileage data collection and entry. Options and costs for potential users who are not currently computerized were not covered in the meeting discussion.

For motor carriers and service providers already using computerized processes for fuel use and mileage-by-jurisdiction reporting, options and costs for implementation are fairly simple:

1) <u>In-House or Custom Software.</u> If they are currently using in-house developed software or other custom software, they will need to make the necessary changes to integrate the electronic mileage-by-jurisdiction data into their system. Cost estimates were not made for integration of in-house developed or other custom software because these costs will vary widely among carriers and service providers.

2) <u>Commercial Software.</u> If they are currently using commercially available software, the software vendor will need to provide an upgrade that can make use of the electronic mileage-by-jurisdiction data.

As for hardware needs, no additional hardware needs were foreseen for the processing of the data. Because motor carriers and service providers with existing computerized fuel use and mileage-by-jurisdiction reporting systems are already utilizing fuel and mileage data, the hardware necessary to process fuel use and mileage reports using electronic mileage-by-jurisdiction data should not change significantly.

Because hardware needs were deemed to need little or no modification to accommodate electronic data, cost estimates for integration of the electronic data into the current processing system only includes costs for upgrading commercially available software used by motor carriers and service providers.

Cost Estimate:

Commercial software upgrade	$1,000–5,000 per site

Report Communication Options and Cost Estimates

Generally, motor carriers submit the necessary fuel use and mileage reports to the proper regulatory agencies in paper copy via mail. One of the obvious benefits of automated data collection is the reduction of data entry and associated errors for motor carriers. States could reap their own reduction in data entry and associated errors if fuel and mileage reports could be filed via EDI with electronic funds payment.

A mailbox arrangement for EDI was identified as the preferred method of EDI with the states. Motor carriers and software vendors agreed that this method was commonly used by shippers and would be familiar to motor carriers and software developers. Motor carriers and software developers did not discuss a preference for a payment method to use with EDI; thus, this section does not include payment options or their associated costs.

Discussion of report communication options and costs concluded that there would be very little cost for motor carriers to engage in EDI with states. Software vendors at the meeting stated that the EDI capability for interfacing with states could be included with the software upgrade for integrating the data, thus adding no additional processing software costs to ensure the files are in the correct format. Other potential costs for motor carriers include a modem and communication software, both of which can be purchased for less than $200 total. However, most motor carriers wanting to used automated data collection are most likely already equipped for EDI; thus, they would have a modem and communications software.

Cost estimates for report communication include modem and communications software costs for those motor carriers not already equipped for EDI:

Cost Estimates:

14.4 kb modem	$100 per location
Communication software	$100 per location

Data Archiving and Auditing Options and Cost Estimates

Data archiving and auditing options and costs center on hardware needs for data storage and retrieval and software needs for data display and summary for internal and external auditing. Hardware needs for data storage and retrieval were deemed a non-issue. Motor carriers and software developers pointed out that computerized motor carriers are already storing electronic data of the mileage information for internal business needs and IFTA and IRP reporting. As a result, little additional need for data storage is foreseen. With the necessary data storage capacity likely already in place and the cost of additional data storage being very low and getting lower, data storage costs should not be an issue.

Data display and summary for auditing, however, generated extensive discussion regarding what the state auditors' needs for data display and summary might be. Software vendors indicated that they currently have the capability to integrate map database software with GPS reports and could provide a visual display if necessary. Auditing needs, however, are fairly straightforward under IFTA and IRP requirements; thus, a textual representation of mileage-by-jurisdiction and route-of-travel data like that used during the AMASCOT test would be sufficient to meet external auditing requirements. More sophisticated visual displays and summary capabilities might be useful for motor carriers and state auditors but would not be a requirement for auditing of the electronic data.

As a result, needs for external auditing will need to be met by locational database software that can interpret the GPS coordinates and generate a textual file of the data, including the event codes. Cost estimates for this software were not made at the meeting, but similar routing software can be purchased for approximately $1,000.

Cost estimates:

Data archiving storage capacity	No appreciable additional cost
GPS data interpretation software	$1,000

Example Implementation Scenarios and Cost Estimates

Following are three implementation scenarios that illustrate possible implementations and estimated implementation costs for three types of motor carriers: 1) a relatively small motor carrier with very little automation; 2) a moderately automated, medium-sized carrier; and 3) a large, highly automated carrier. While these scenarios generally represent three possibilities for motor carrier implementation options and corresponding cost estimates, they are only intended to illustrate the possible range of implementations and costs.

Each scenario includes a general description of the motor carrier (e.g., number of trucks, level of computerization, etc.), an explanation of the implementation options chosen, and a table estimating the general costs of implementation of automated mileage data collection by such a motor carrier.

Small, minimally automated motor carrier

This small, for-hire truckload carrier has 30 dry van trucks hauling food and other grocery goods in interstate operation. The trucks return to a central terminal approximately once a week. The carrier has computerized support for accounts receivable, payroll, fuel tax and registration administration, etc., through commercially available software and a DOS PC network. The carrier does not, however, have any vehicle tracking, communications, trip recorders, or other on-board fleet management equipment.

Implementation Description. Implementation includes the following:

> **In-Vehicle Data Collection Device.** Because this motor carrier is not using vehicle tracking technology incorporating GPS, the carrier's fleet will need to be equipped with the stand-alone version of a mileage data collection device. Approximate cost for the stand-alone data collection device $600–800 per truck.
>
> **Data Extraction.** With a fleet that returns to a central terminal approximately once per week, this motor carrier might choose one of the fixed-location data extraction methods, particularly since this carrier does not already have in-vehicle communications equipment. Of the fixed-location data extraction methods, an RF-modem system would provide the necessary data extraction without needing additional staff resources or multiple portable data storage/extraction devices. Using the RF-system, each vehicle would be queried for mileage data and the data downloaded to the motor carrier's computer system each time the vehicle returned to the central terminal.
>
> This method would require an on-board data storage device for each vehicle ($300–400/vehicle), an RF-modem ($800) for the central terminal, and a shared or dedicated computer to control the RF-download system and accept the retrieved data ($2,000 if a dedicated PC needs to be purchased).
>
> **Data Processing.** Since this motor carrier uses a commercially available software package, integration of the data into the carrier's business information system could be accomplished through a software upgrade. Because the carrier is not already integrating locational data (GPS data) into his business information system, the upgrade to integrate the mileage data gathered via GPS would likely be more expensive than if the carrier were already using similar GPS data for other business functions and were just adding another type of GPS data and functionality.
>
> Keeping this in mind, the cost for the software upgrade is likely be closer to $5,000 than $1,000. For the purposes of this cost approximation, a cost of $5,000 will be used.

Report Communication. Assuming that states would operate some sort of public access dial-up system, this motor carrier would need a modem ($100) to communicate with the state system. Because the amount of electronic data required for a report is relatively small, costs of data communication would be small as well. Communication software ($100) may also be required if the commercial software package being used does not have EDI capabilities.

Data Archiving and Auditing. Data archiving is not expected to accrue significant additional costs for the motor carrier. The carrier is already keying similar data into its business information system, and any minimal costs associated with the need for additional storage memory would be more than offset by the reduction in costs associated with paper records and their storage.

For the data to be auditable, however, the latitude and longitude coordinates recorded by the data collection system must be interpreted into readable place names and/or highway designators. Thus, the data collection system will need to include software to perform this function, the integrated business software will need to perform this function, or other software will need to be utilized. Even if the motor carrier is using routing/map database software, the ability to convert the lat/long information of GPS data are not currently available; thus, the motor carrier will need to upgrade or purchase a new software package.

Current costs for map database/routing software similar to that which would be needed for this location interpretation can be purchased for approximately $1,000. However, costs can vary widely in both the cost of the software itself and transaction fees associated with the use of the software. For the purpose of this cost estimate, however, a cost of $1,000 will be used.

Medium-sized, moderately automated carrier

This medium-sized, for-hire truckload carrier operates 200 dry van trucks generally hauling time-sensitive freight such as auto parts supporting JIT automobile manufacture and assembly. The carrier has computerized support for accounts receivable, payroll, fuel tax and registration administration, etc., through commercially available software and a DOS PC network. The carrier utilizes vehicle tracking (via GPS) and communications to assist in fleet management and meet the en route information needs of its customers. The carrier largely operates regionally; thus, cellular communications meet the communications coverage needed by this carrier.

Implementation Description. Implementation includes the following:

In-Vehicle Data Collection Device. Because this motor carrier already utilizes vehicle tracking technology incorporating GPS, integration of a mileage data collection device can take advantage of the existing GPS receiver and antenna, thus significantly reducing the cost of implementing the in-vehicle data collection device. Approximate cost for the mileage data collection device as an add-on to vehicle tracking system is $400–500 per truck.

Data Extraction. Since this carrier utilizes in-vehicle cellular communications equipment, the carrier might choose to utilize this link to communicate mileage data from the vehicles back to the processing location. Using a cellular communication link, each vehicle could automatically transmit mileage data in conjunction with other communications or at periodic intervals (such as weekly). This method may incur additional communication costs for transmitting the data. Because these costs might vary based on the motor carrier's bargaining power with the communications provider and on whether or not the mileage data can be piggybacked with other messaging transmissions, estimation of these data transmission costs is beyond the scope of this example.

Data Processing. Like the smaller motor carrier, this medium-sized carrier uses a commercially available software package. However, this carrier is utilizing vehicle tracking systems, and thus is already integrating GPS data into its business information system. As a result, integration of the data into the carrier's business information system could easily be accomplished through minimal software modification. Due to the ease of modifying software already designed to integrate GPS data, a cost of $1,000 (the low end of the range) will be used.

Report Communication. Using the same assumption that states would operate some sort of public dial-up system, this motor carrier would also need a modem to communicate with the state system. However, this carrier is already providing information to its customers via electronic data interchange, and thus has the modem and communications software necessary to interface with the base state. No additional costs would be incurred.

Data Archiving and Auditing. Data archiving is not expected to accrue significant additional costs for the motor carrier. The carrier is already keying similar data into its business information system, and any minimal costs associated with the need for additional storage memory would be more than offset by the reduction in costs associated with paper records and their storage.

For the data to be auditable, however, the latitude and longitude coordinates recorded by the data collection system must be interpreted into readable place names and/or highway designators. Thus, the data collection system will need to include software to perform this function, the integrated business software will need to perform this function, or other software will need to be utilized. Although this motor carrier is using routing/map database software, the ability to convert the lat/long information of GPS data are not currently available; thus, the motor carrier will need to upgrade or purchase a new software package.

Current costs for map database/routing software similar to that which would be needed for this location interpretation can be purchased for approximately $1,000. However, costs can vary widely in both the cost of the software itself and transaction fees associated with the use of the software. For this cost approximation, however, a cost of $1,000 will be used.

Large, highly automated carrier

This large, for-hire truckload carrier operates 1,200 dry van trucks generally hauling an assortment of freight, including household supplies, time-sensitive manufactured goods and newsprint, and paper products. The carrier has computerized support for accounts receivable, payroll, fuel tax and registration administration, and other business functions through custom software supplied by its own data processing department. The carrier also uses EDI for sharing information with its customers.

The carrier utilizes vehicle tracking (via GPS) and communications to assist in fleet management and meet the en route information needs of its customers. The carrier operates nationally, and thus has both satellite and cellular communications to ensure communications coverage whenever needed.

Implementation Description. Implementation includes the following:

In-Vehicle Data Collection Device. Because this motor carrier already utilizes vehicle tracking technology incorporating GPS, integration of a mileage data collection device can take advantage of the existing GPS receiver and antenna, thus significantly reducing the cost of implementing the in-vehicle data collection device. Approximate cost for the mileage data collection device as an add-on to vehicle tracking system is $400–500 per truck.

Data Extraction. Since this carrier utilizes both in-vehicle satellite and cellular communications equipment, the carrier might choose to utilize the most efficient of these links to communicate mileage data from the vehicles back to the processing location. Using one of these communication links, each vehicle could automatically transmit mileage data in conjunction with other communications or at periodic intervals (such as weekly). This method may incur additional communication costs for transmitting the data. Because these costs might vary based on the motor carrier's bargaining power with the communications provider and whether or not the mileage data can be piggybacked with other messaging transmissions, estimation of these data transmission costs is beyond the scope of this example.

Data Processing. Unlike the other two carriers, this large carrier has its own data processing staff and develops its own applications. In addition, the carrier is already integrating GPS information into its business information system. As a result, integration of the electronic mileage data into the carrier's business information system could more easily be accomplished through minimal modification of its custom software by data processing staff. Costs for these modifications are not estimated due to variability in the amount and difficulty of modification needed and differences in motor carrier costs.

Report Communication. Using the same assumption that states would operate some sort of public dial-up system, this motor carrier would also need a modem to communicate with the state system. However, this carrier is already providing information to its customers via electronic data interchange, and thus has the modem and communications software necessary to interface with the base state. No additional costs would be incurred.

Data Archiving and Auditing. Data archiving is not expected to accrue significant additional costs for the motor carrier. The carrier is already keying similar data into its business information system, and any minimal costs associated with the need for additional storage memory would be more than offset by the reduction in costs associated with paper records and their storage.

For the data to be auditable, however, the latitude and longitude coordinates recorded by the data collection system must be interpreted into readable place names and/or highway designators. Thus, the data collection system will need to include software to perform this function, the integrated business software will need to perform this function, or other software will need to be utilized. While this carrier is using routing/map database software, the ability to convert the lat/long information of GPS data are not currently available; thus, the motor carrier will need to upgrade or purchase a new software package.

Current costs for map database/routing software similar to that which would be needed for this location interpretation can be purchased for approximately $1,000. However, costs can vary widely in both the cost of the software itself and transaction fees associated with the use of the software. For this cost approximation, however, a cost of $1,000 will be used.

The following table summarizes the range of estimated costs for the example carriers. The table includes total costs and a per-vehicle cost share for each.

Table 2.3 Summary of Motor Carrier Implementation Costs Examples

Cost Category	Small carrier 30 trucks	Medium carrier 200 trucks	Large Carrier 1,200 trucks
In-vehicle recorder	$600–800 /truck	$400–500 /truck	$400–500 /truck
Data extraction			
Vehicle equipment	$300–400 /truck	Cellular costs	Satellite/cellular costs
Terminal equipment	RF modem $800 Computer $2,000		
Data processing	$5,000	$1,000	Staff time
Report communication			
Modem	$100	Already equipped for EDI	
Software	$100	Already equipped for EDI	
Data archiving/auditing			
Data storage costs	$0 May be a net gain	$0 May be a net gain	$0 May be a net gain
Conversion software	$1,000	$1,000	$1,000
Total	$36,000 - 45,000	$82,000 - 102,000	$481,000 - $601,000
Total per truck	**$1,200–1,500**	**$410–510 + communication costs**	**$401–501 + staff time and communication costs**

Concluding Observations

Implementation of automated electronic mileage data collection systems by any size carrier is possible, but costs for implementing such technology will vary widely based on motor carriers' business needs and current level of computerization. Those motor carriers already utilizing vehicle location tracking systems and other computerized business functions have the basic infrastructure in place to support AMASCOT-like technology and therefore will experience much lower start-up costs than those carriers without these advanced systems. As a result, implementation of automated electronic mileage data collection will likely be spearheaded by those carriers with a relatively high level of business automation, particularly those who are already integrating vehicle location tracking systems into their business.

EVALUATION OF THE FEASIBILITY OF AUTOMATED ELECTRONIC MILEAGE DATA PROCESSING AND ELECTRONIC DATA INTERCHANGE TO SUPPORT IFTA AND IRP COMPLIANCE

This section details the process used to prepare mock IFTA reports using the AMASCOT data and discusses the feasibility of electronic data transfer for filing IFTA and IRP reports. The procedures developed during AMASCOT and the software used were designed to meet the requirements of the project. However, by no means is the automation of IFTA or IRP report generation limited to this method and the employed software systems.

Developing an end-to-end computer package to generate an IFTA report from “raw” Rockwell trip logs was not the primary objective of this project; rather, the purpose was to demonstrate that the data generated by an automatic electronic mileage data collection system could be used to generate an IFTA report that meets all requirements for data content and auditability. In addition, the project would provide a test bed for examining the feasibility of electronic data transfer between motor carriers or their agents and base states. Toward those ends, the procedures defined in this report were developed and electronic data transfer investigated. Although the developed procedures are specifically applicable to preparation of an IFTA report, they can also be used as a basis for procedures to generate an IRP report.

IFTA Report Preparation

Using Global Positioning System (GPS) technology, the on-board data collection system used in AMASCOT was capable of generating vehicle trip logs which included odometer readings and locations of a vehicle at occurrences of defined events during its trip. These trip logs record the locations of an equipped truck in terms of its latitude and longitude positions. To enable human readability of the trip log data and identify vehicle travel on nontaxable road segments, the trip logs collected from the participating trucks were processed through a workstation equipped with custom map and route mileage software developed by Rand-McNally. This software interpreted the latitude/longitude locations recorded by the on-board system into readable place names such as highway designators or city names and identified the start and end points of any travel on nontaxable roadways.

To facilitate the generation of IFTA reports, researchers at CTRE developed a computerized routine utilizing commercially available database software and a low-level DOS programming language. The basic goal was to design a system that accepts the converted trip logs and purchased fuel information of a truck as input and generates a fleet IFTA report as its output. In addition to generating IFTA reports, the designed system is capable of producing fuel and mileage summary reports for each participating truck. The present version of this computerized IFTA report generating system is developed to fulfill the objectives of the project. The system's flexibility, however, allows it to be enhanced to accommodate the base states' requirements. For example, computer code could be added to this system to generate an exception report identifying data points where the on-board data collection system failed to record a truck's jurisdiction line crossing or experienced other anomalies.

The database software used was PARADOX 5.0 for Windows. PARADOX is a powerful relational database with its own computer language called ObjectPAL. ObjectPAL is based on an object-oriented programming technique which can be used to develop a customized application in the PARADOX environment. File conversion and other procedures were coded in QBASIC language. QBASIC was chosen because it is a common computer language that is included in DOS; however, any other low-level computer languages such as FORTRAN or C could also be used for this purpose.

The IFTA report generating system begins with the processing of raw electronic mileage and jurisdiction line crossing data, collected by the on-board system, through the Rand-McNally workstation. The converted trip logs and the purchased fuel information are then read into the computer programs to generate the IFTA reports. The prepared IFTA reports are regularly or electronically mailed to motor carriers' base states to be audited. Figure 2.8 shows the data flow diagram of the designed IFTA report generating system. The following sections detail this processing system.

Step 1 - Convert the Rockwell Latitude-Longitude Trip Logs

The thirty trucks from six different motor carriers involved in this project were all equipped with the on-board automated mileage and jurisdiction-line-crossing systems. On a frequent basis (e.g., weekly) the collected data are uploaded by Rockwell to CTRE's electronic bulletin board system (CTREBBS). These raw trip data logs include the locations of a truck in terms of its latitude and longitude positions, event codes, and electronic odometer data. These data records are processed through the Rand-McNally workstation to interpret the latitude/longitude locations recorded by the on-board system into readable place names such as highway designators or city names and identify the start and end points of any travel on nontaxable roadways.

The output from the Rand-McNally workstation is a data file that matches the format of the raw electronic log data but replaces the latitude/longitude data with readable place names and inserts data lines for travel determined to be on nontaxable roadways. A

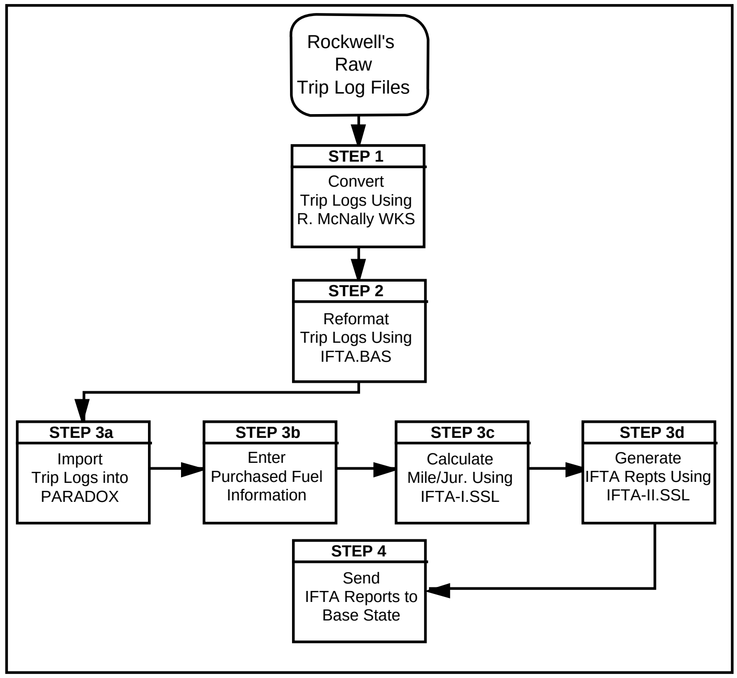

Figure 2.8 Data Flow Diagram of IFTA Report Generating System

portion of an actual trip log before and after data conversion is shown in Table 2.4. By comparing the before and after versions of this trip log, the inclusion of nontaxable routes in the converted Rand-McNally trip log is noticeable.

An example of trip log records is shown in Table 2.4. A complete explanation of the trip log format and codes is provided in this Part 2 document in the *Rockwell Phase II Report of the Driver Trip Report System*. An examination of Table 2.4 makes obvious the problem that the vehicle positions in lat/long locations as in the raw trip logs would not be readable by motor carriers or state auditors. Readable location records were obtained during the test using a custom map and route mileage database developed by Rand-McNally. This software was able to interpret a vehicle's latitude and longitude positions as recorded in the electronic trip log and translate these to the nearest place name locations of the vehicle, such as city or town names or highway designations.

This custom map and route mileage software was also designed to identify vehicle travel on highway segments designated as nontaxable. To test this capability for the AMASCOT project, the following highway segments were designated as nontaxable:

1) All of Interstate 80 in the state of Iowa

2) U.S. Highway 151 in Iowa around the following junctions:

Springville, Iowa

Fairview, Iowa

Anamosa, Iowa

Anamosa Jct., Iowa

The converted trip log file is identical in format to the raw trip log file with the lat/long readings replaced by location place names (highway location, city, etc.) and records inserted for beginning and ending points for any travel segments on nontaxable roads. The records for starting and ending of nontaxable miles have the following format and corresponding codes:

TN <odometer> <quality> <position> <time> <date>

Trip event - begin nontaxable segment: The conversion software has detected travel on a segment designated as nontaxable and reports the odometer and location of the vehicle at the beginning point of the nontaxable travel.

TT <odometer> <quality> <position> <time> <date>

Trip event - end nontaxable segment: The conversion software has detected end of travel on a segment designated as nontaxable and reports the odometer and location of the vehicle at the ending point of the nontaxable travel.

For example:

TN 114639.7 3 DAVENPORT_TRK_PLZ,IA 00:00:00 01/01/93

TT 114684.2 3 SE_OF_ELK_RUN_HTS,IA 00:00:00 01/01/93

Table 2.4 allows direct comparison of raw trip log data and converted trip log data, including identification of a nontaxable travel segment. These translated or converted trip logs, along with the purchased fuel information, are considered the main ingredients for preparation of IFTA and IRP reports.

Table 2.4 A Sample Trip Log—Before and After Data Conversion

Rockwell Trip Log—"before"	Converted R. McNally Trip Log—"after"
TL 283658.3 3 042"36'12.0N 088"44'00.3W 08:08:27 01/17/95	TL 283658.3 3 I43/U14,WI 08:08:27 01/17/95
TP 283672.8 3 042"31'38.6N 088"58'49.1W 08:29:52 01/17/95	TP 283672.8 3 NE_OF_I43/I90,WI 08:29:52 01/17/95
TS 283672.8 3 042"31'39.8N 088"58'48.7W 08:41:42 01/17/95	TS 283672.8 3 NE_OF_I43/I90,WI 08:41:42 01/17/95
TB 283675.3 WI IL 1 042"29'57.0N 088"59'31.4W 08:45:49 01/17/95	TB 283675.3 WI IL 1 I90/U51,IL 08:45:49 01/17/95
TL 283728.5 3 041"51'21.7N 089"12'56.6W 09:42:37 01/17/95	TL 283728.5 3 ASHTON,IL 09:42:37 01/17/95
TL 283786.0 3 041"36'13.7N 090"11'33.0W 10:42:33 01/17/95	TL 283786.0 3 SW_OF_HILLSDALE,IL 10:42:33 01/17/95
TB 283799.0 IL IA 1 041"34'46.4N 090"21'50.9W 10:56:19 01/17/95	TB 283799.0 IL IA 1 I80/IA_IL_BORDER,IA 10:56:19 01/17/95
	TN 283799.0 1 I80/IA_IL_BORDER,IA 00:00:00 01/01/93
TP 283805.6 3 041"35'51.7N 090"28'46.6W 11:09:36 01/17/95	TP 283805.6 3SW_OF_AEGO,IA 11:09:36 01/17/95
	TT 283805.6 SW_OF_AEGO,IA 00:00:00 01/01/93
TS 283805.6 3 041"35'48.9N 090"28'47.2W 11:58:37 01/17/95	TS 283805.6 3 SW_OF_AEGO,IA 11:58:37 01/17/95

Step 2 - Reformat the Converted Trip Logs

The fields in the trip log files are delimited (divided) by blanks (white spaces). Depending on the data being recorded, there can also be a different number of fields in each data record. For example, a record designating the vehicle for which the data applies begins with the code LV and has one field, whereas a record containing jurisdiction line crossing event data begins with the TB code and has eight fields. These data records are not of any recognized standard format (i.e. tab delimited, comma delimited, etc.) and cannot be imported directly into the database. To solve this issue, the formats of the data records have to be changed to a recognizable standard format before they can be imported into the PARADOX database.

To reformat the trip logs into an acceptable data format, the files are loaded into a computer program named "ifta.bas." In general, this program creates a comma-delimited data file with the same number of data fields in each record. Specifically, the ifta.bas program delimits each field in quotations, separates the fields with commas, and assigns an appropriate number of blank fields to any records with less than eight fields. This reformatted data file is named "convert.txt" and represents the trip log data for one truck for one week (the sampling period during the test). A sample of a reformatted trip log is shown in Table 2.5. The listings of the ifta.bas computer program are included in Appendix A.

Table 2.5 Sample of Reformatted Rand McNally Trip Log

“LC”,0,””,””,”Trucking_Company”

“LR”,0,”01/15/95",”01/22/95"

“TL”,0,””,””,””,283786.0,””,””,”3",”SW_OF_HILLSDALEIL”,”10:42:33",”01/17/95"

“TB”,0,””,””,””,283799.0,”IL”,”IA”,”1",”I80/IA_IL_BORDERIA”,”10:56:19",”01/17/95"

Step 3 - Load Fuel and Mileage Data into Database and Generate IFTA Reports

The third step is the main step in the designed IFTA report generating system where IFTA reports are actually prepared and printed. As Figure 2.8 shows, this part of the system consists of the four levels described below.

3a - Import Trip Log Files In the first level, the reformatted trip log file “convert.txt” for each truck is imported into the database environment. Because the convert.txt file represents a week of trip logs for one truck, 30 different convert.txt files are generated by the ifta.bas computer code and imported one by one into PARADOX.

The reformatted convert.txt files are saved in a “data.db” table. Once all the trip logs for each truck are imported, “data.db” becomes a large table which contains one week of information for all 30 trucks. As new trip log files arrive each week, they are reformatted and added to the data.db table using the described procedure.

The data for all trucks are kept in one table (i.e., data.db) because it is convenient for accessing the data. Using PARADOX queries, data can be retrieved from the table in a desired format. For example, trip data for a particular truck, fleet, or carrier for a specific time and date can be retrieved easily by a simple query. The approximate size of one month of trip data for 30 trucks is one megabyte. Therefore, in order to keep the data.db table in a manageable size, trip logs are saved in a new data.db table once the old one reaches a designated limit. For example, data1.db table may contain trip data collected from January to March, while data2.db would contain data for the months of April to June.

3b - Enter Purchased Fuel Information. The next level of the third step is the entry of the fuel purchase data. Approximately two weeks after the end of each month, the motor carriers participating in the project provided CTRE with fuel purchase data for their trucks to CTRE. Of the six participating motor carriers, five sent their fuel purchase data on paper records which were then keyed in, and one sent its fuel data on a computer diskette. The fuel purchase data submitted in electronic format were imported directly into the database application using a standard data format (fixed length text). The purchased fuel information of the rest of the motor carriers was, however, sent on hard copies which were much less efficient due to the need for manual data entry. The purchased fuel data are stored in a "fueldb.db" table.

Step 3c - Calculate the Mileage per Jurisdiction. The data.db and fueldb.db tables generated in steps 3a and 3b are considered the data sources for the designed IFTA report generating system. The computer program involved in the third level of step three is a PARADOX script named "ifta-i.ssl." The ifta-i.ssl script uses data.db and fueldb.db tables to retrieve the mileage and fuel data of each truck to be analyzed.

By running the ifta-i.ssl program, a user enters in a dialog box a carrier name, a truck number, and a specific period for which the IFTA report is desired. As soon as the dialog box is closed, ifta-i.ssl starts running by inserting a truck mileage and fuel data, retrieved from data.db and fueldb.db tables (i.e., mileage and fuel data sources), into "file.db" and "fuelinfo.db" tables, respectively. The file.db table goes through different levels of analyses in the ifta-i.ssl script before a truck mileage (taxable and nontaxable) per jurisdiction is calculated. The calculated mileage per jurisdiction of each truck is stored in "ifta.db" table. The retrieved fuel data in the fuelinfo.db table need no more analyses at this stage.

The ifta-i.ssl script not only determines a truck's mileage per jurisdiction, it also prepares truck mileage and fuel summary reports to be printed at the end of the script run. Appendix I includes the listings of the ifta-i.ssl script.

The ifta-i.ssl script is run for each truck. Each run adds the calculated mileage per jurisdiction and fuel data of a truck to the ifta.db and fuelinfo.db tables, respectively. Therefore, by the end of this level of step three, ifta.db and fuelinfo.db tables contain mileage per jurisdiction and fuel data of all 30 trucks for the requested period.

Step 3d - Generate IFTA Reports. Having ifta.db and fuelinfo.db tables prepared in the previous level, the next PARADOX script named "ifta-ii.ssl" is run to link the two tables. Ifta-ii.ssl script generates an IFTA report for each motor carrier. In the case of this project, six IFTA reports (i.e., one for each participating motor carrier) are produced at the end of the script run. The designed IFTA report is a common form among all participating states and meets the requirements defined in the IFTA manuals. Samples of IFTA and truck mileage and fuel summary reports are included in Appendix B. Appendix A includes the listings of the ifta-ii.ssl script.

Step 4 - Send IFTA Reports to Base States

On a monthly basis, the prepared IFTA reports and the individual truck mileage and fuel summary reports are mailed to the base states for audit evaluation and to the participating motor carriers. The reports can be transmitted electronically to base states; however, to retrieve the reports as they appear on paper, the base states would need the PARADOX database system. Fortunately, the base states do not need the data as formatted, but need access to the data included in the report. The report data could be sent to base states in an ASCII or DBF format and read into their computer systems. Appendix C contains the entire July 1995 IFTA reports data in a delimited text format.

Observations

The system designed for IFTA report generation for the AMASCOT project was able to meet IFTA reporting requirements. In comparison to the current manual data collection system and IFTA report preparation procedure, the computerized system developed in the test has been shown to be an efficient and accurate system. The only real differences between current methods and the test system is the automation enabled by electronic data. Automation aside, the test process followed the steps of the current IFTA report preparation procedure, with fuel and mileage data being collected and tabulated for IFTA reporting and IFTA reports being generated. For example, in the test system, advanced on-board equipment replaces the truck driver's duties to record odometer readings and other related information. Also, the routine that the motor carriers' clerks currently follow to prepare IFTA reports, once they receive drivers' trip logs, is now replaced with an automated routine in this developed system.

The project's success in integrating the automated mileage and route data into the IFTA reporting process using commercially available database software demonstrates the feasibility of integrating such data into current motor carrier business software or other commercially available business software. In addition, the costs of modifying commercially available motor carrier software to integrate electronic route and mileage data are expected to be affordable. In fact, a motor carrier industry and software provider focus group estimated that integration of these data into current commercial software applications would cost from $1,000–5,000 for an entire fleet (see *General Motor Carrier System Implementation Options and Cost Estimates* in this Part 2 document).

Electronic Data Transfer

Because many of the possible state benefits are dependent on electronic data transfer between the motor carrier or its agent and the base jurisdiction, a secondary goal of the test was to investigate the feasibility of electronically transmitting IFTA and IRP data to the base jurisdiction. Toward this goal, CTRE worked with the Iowa DOT Office of

Motor Carrier Services to test an electronic transfer of project data from CTRE to the Iowa DOT.

The data generated in the IFTA report preparation process could be exported in a number of formats, including comma delimited ASCII, fixed length text, dbf (database file), Quattro Pro, Lotus, and Excel. These file types allow easy integration of data into commercial or custom software. Most commercial software can accommodate these file types, particularly the general formats such as comma delimited ASCII, fixed length text, and dbf. Integrating the data into custom software packages may require development of code to acquire the data in a given format and re-format it for use by the custom software. Appendix C is a source data file in comma delimited ASCII format which was used to generate the customized IFTA reports used in the project. To test the feasibility of electronic data transfer between motor carriers and states, it was planned that the Iowa DOT would receive a similar electronic source data file from CTRE and test loading the electronic data into its system.

During the test, CTRE exported the IFTA reporting source data file to a comma delimited ASCII data file similar to that shown in Appendix C. This file was then loaded to the CTRE bulletin board system. The Iowa DOT utilized commercially available communications software and downloaded the source data to a PC. In an actual implementation, this process would be reversed. The base jurisdiction would provide a facility such as an electronic mailbox or bulletin board system that motor carriers could access through a modem and upload the necessary data.

The Iowa DOT had planned to import the data into its current system to test its usability. However, staff constraints kept the Iowa DOT from being able to allocate the resources necessary to develop computer code that would import the source data file into their system. While the code to integrate the test electronic IFTA report data into the Iowa DOT system was anticipated to be relatively straightforward, increasing the workload of the Iowa DOT's limited staff resources to develop code specifically for the test was not justifiable, particularly when this code would not be compatible with a production system. As a result, the test concluded without getting the data the final step into the Iowa DOT system.

Final integration into the state mainframe system notwithstanding, the project successfully demonstrated the feasibility of an entirely electronic data path for IFTA and IRP compliance:

- All mileage data were collected and transferred electronically.
- Fuel data for one motor carrier were transferred using electronic media (diskette).

- Fuel and mileage data were integrated and IFTA reports generated electronically.
- IFTA reporting data were provided to a jurisdiction electronically.
- All data needed to be maintained for IFTA and IRP compliance were archived in an electronic format.

As identified in the *Evaluation Report on State Agency Costs, Benefits, and Acceptance*, (Part3 of this document), the real issues impeding electronic data transfer between motor carriers and base states are the lack of standards for data format and transfer protocols, the inexperience of IFTA and IRP agencies with electronic methods of payment, and the lack of public agency infrastructure (both hardware and software) for the data interchange. Obviously, the lack of standards is the most vexing of the two issues since states are unlikely to invest resources to make electronic data transfer possible without standards to ensure the value of their investment.

Conclusions

The electronic mileage data generated by the test system are suitable for generating the necessary reports and maintaining the individual vehicle data records required for IFTA and IRP compliance. The data were easily integrated with both paper and electronic fuel purchase records and IFTA reports, were generated using only low-level computer programming and commercially available database software. Assuming a marketplace exists, mainstreaming of this technology does not pose any technological challenges, and integration costs are estimated to be low.

Further, electronic data transfer between base states and motor carriers is feasible, with the issues of EDI standards and infrastructure and electronic methods of payment being the most significant impediments. Because EDI is key to achieving a majority of the possible benefits to state agencies (see Part 3 of this document, *Evaluation Report on State Agency Costs, Benefits, and Acceptance*), states interested in streamlining their IFTA and IRP processing should step up their efforts to develop standards for EDI of IFTA and IRP reporting data and electronic methods of payment to allow implementation of EDI facilities once these are in place.

EVALUATION SUBCOMMITTEE REPORT ON THE ACCEPTABILITY OF AUTOMATED ELECTRONIC MILEAGE DATA COLLECTION SYSTEM FOR IFTA COMPLIANCE

The Evaluation Subcommittee of the AMASCOT (Automated Mileage and Stateline Crossing Operational Test) project was charged with reviewing and analyzing output from the various technologies incorporated into the project. These technologies included a Global Positioning System (GPS) receiver, a jurisdiction detection algorithm/database, and a route collection and storage algorithm.

From this review a determination was to be made of the technology's ability to provide a basis for accurate mileage reporting under both IRP (International Registration Plan) and IFTA (International Fuel Tax Agreement). The testing was to result in a recommendation regarding the feasibility of using the technologies to provide electronic mileage reporting which would meet the audit guidelines of both agreements.

Analysis of the output of the test technologies installed in a group of review vehicles was conducted by motor carrier auditors from the three partner jurisdictions of Iowa, Minnesota, and Wisconsin. This section discusses the test criteria used to evaluate the data acceptability as developed by the Evaluation Subcommittee and the results of the state auditors' reviews using those criteria.

Data Acceptability Criteria

Early in the evaluation process it was decided that the final results would be based on review of the project mileage records of 30 trucks, equally divided among six trucking companies, for a period of three months. However, prior to the full 30 -truck test fleet implementation, the subcommittee had opportunity to review the output and the accompanying carrier documentation for several selected vehicles. This provided a chance for Evaluation Subcommittee members to familiarize themselves with the system and to provide feedback to the developers concerning minor errors and discrepancies.

It was decided that for the official audit test of the 30 trucks, several sources of information would be utilized to assess the accuracy of the system. The motor carrier participants in the test provided access to both IVDRs (Individual Vehicle Distance Records) and DOT logbooks for the full three month test period, and these were used to make comparisons to the mileage records generated using the test system.

The months chosen for the final test period were May, June, and July 1995. The project equipment was operational for all but five of the 30 test trucks at the beginning of May, and all were fully operational by May 26. The miles reported, in total and by jurisdiction, from the project systems were then compared to:

1. Odometer/hubometer miles as recorded by drivers on the IVDRs.
2. Miles calculated by state auditors using current computer atlas software (Rand-McNally's Milemaker or PCMiler) over the route of travel as recorded by drivers on the IVDRs.

3. Miles calculated using computer atlas software over the route of travel as indicated in the drivers' log books.

4. Miles calculated using computer atlas software over the route of travel as indicated by locational information recorded in the project output. Also, for purposes of this test, half of the vehicles were set to record an hourly location reading in addition to the "event" readings kept for all units. This was to determine if enough events (starts, stops, border crossings, etc.) would take place in a vehicle's normal course of activity to provide a complete picture of the vehicle's movements for audit purposes.

Results of State Auditors' Reviews

Comparison of miles on the monthly activity reports printed by the Center for Transportation Research and Education (CTRE) for each of the test units against miles determined through the methods previously described disclosed few discrepancies. In many cases it was found that the project miles were greater than those determined strictly from routes of travel, since all local miles were recorded.

Total trip miles from project results were nearly the same as those reported by the drivers from odometer readings. However, the auditors felt that the jurisdictional distribution of mileage was more accurate using the data collected by the automated electronic mileage data collection system, since available time and routing information indicated that border crossing readings were being taken at or very near the point and time of actual border crossing.

The state auditor reviews indicated that, in general, the test system was able to:

1. Determine jurisdictional border crossing points and record accurate odometer readings at those points.

2. Accurately accumulate distance, in total and by jurisdiction, including distance on routes designated as nontaxable for purposes of this test.

3. Provide information about other truck activity, including trip starting and stopping points, periods of no movement, engine shutdowns, etc. The auditors felt that the information provided for the normal vehicle events was sufficient for audit purposes. The hourly readings kept for half of the test vehicles, as described earlier, were not judged to be essential for system auditability.

4. Assign a recognizable place name to each latitude/longitude location reading kept by the system. This interpretation was provided during the post-pro-

cessing step, when a custom Rand-McNally map database program was used to match the lat/longs with place names or route numbers.

Conclusions

After reviewing the mileage information for the test vehicles of the AMASCOT project, the state auditors have concluded that:

- The system that was tested proves that the technology is capable of being used to accurately record and accumulate miles for fuel tax and licensing reporting purposes. The system tested fulfills the basic intent of IRP and IFTA mileage record-keeping requirements. Minor adjustments, as outlined on the following pages, will allow this technology to meet all requirements.
- This technology is capable of providing an automatic, completely electronic alternative method to the current practice of drivers keeping mileage records by hand on an IVDR. The documents reviewed indicate the potential to increase the accuracy of mileage data and to provide both time and cost savings for jurisdictional processing and audit functions.

It should be noted that while any recommendations by the Evaluation Subcommittee could be applied to the general concepts of using similar technology for mileage reporting, our review was of only one company's prototype system implemented to meet the test design. We have suggested language changes to the IRP and IFTA agreements which would assist other technology providers in developing equipment which could also meet IFTA and IRP guidelines, but it will be incumbent upon these technology developers to provide all necessary informational elements. For example, technology providers might attempt to decrease costs by not providing the step to "interpolate" latitude/longitude defined locations to readable place names or highway numbers. A system could be developed and sold which would bypass this important step but would not be acceptable for audits conducted under either current agreement.

Suggested Modifications to IFTA and IRP Guidelines

Following are suggested changes to IFTA and IRP guidelines:

International Fuel Tax Agreement

The IFTA addresses the use of on-board recording devices in the IFTA Procedures Manual, III.5.a-g and the Audit Manual V.B.I.d.

Suggested modifications to IFTA include the following:

- **Procedures Manual III.5.d 6.** The device must automatically update a life-to-date ~~odometer~~ *distance recording device* when the vehicle is placed in motion or the operator must enter the current vehicle odometer reading when the on-board recording device is connected to the vehicle.
- **Procedures Manual III.5.e 4.** Beginning and ending odometer, hubometer, *or life-to-date distance recording device* reading of the trip (may be waived by base jurisdiction);
- **Procedures Manual III.5.f 3.** An exception report that identifies all edited data, omissions of required data (see Section III.a.5.e), system failures, noncontinuous life-to-date ~~odometer~~ *distance* readings, travel to noncontiguous states, and trips where the location of the beginning trip is not the ending location of the previous trip.
- **Audit Manual V.B.I.d.** Beginning and ending odometer, hubometer, *or life-to-date distance recording device* reading of the trip (may be waived by base jurisdiction);

International Registration Plan

The IRP addresses on-board recording devices in the Uniform Operation Audit Procedure Guidelines IV.B.3 and V.A-G.

Suggested modifications to IRP include the following:

- **Uniform Operation Audit Procedure Guidelines V.D.6.** The device must automatically update a life-to-date ~~odometer~~ *distance recording device* when the vehicle is placed in motion or the operator must enter the current vehicle odometer reading when the on-board recording device is connected to the vehicle.
- **Uniform Operation Audit Procedure Guidelines V.E.3.** Route of travel and/or trip beginning and ending life-to-date ~~mileage~~ *distance* information.
- **Uniform Operation Audit Procedure Guidelines V.F.3.** An exception report that identifies all edited data, omissions of required data (see Section III.a.5.e), system failures, noncontinuous life-to-date ~~odometer~~ *distance* readings, travel to noncontiguous states, and trips where the location of the beginning trip is not the ending location of the previous trip.
- **Uniform Operation Audit Procedure Guidelines IV.B.3.** Route of travel and/or beginning and ending odometer, hubometer, *or life-to-date distance recording device* reading of the trip;

APPENDIX A

LISTINGS OF THE COMPUTER PROGRAMS

IFTA.BAS

A QBASIC Computer Program for Reformatting the Trip Logs

```
REM 11/8/94
REM UPDATED 2/8/95
REM UPDATED 3/14/95
REM UPDATED 5/26/95

REM    OPEN "108.rnd" FOR INPUT AS #1
REM    OPEN "112.rnd" FOR INPUT AS #1
REM    OPEN "114.rnd" FOR INPUT AS #1
REM    OPEN "121.rnd" FOR INPUT AS #1

REM    OPEN "9032172.rnd" FOR INPUT AS #1
REM    OPEN "9032180.rnd" FOR INPUT AS #1
   OPEN "9132077.rnd" FOR INPUT AS #1
REM    OPEN "9132106.rnd" FOR INPUT AS #1
REM    OPEN "913208.rnd" FOR INPUT AS #1
REM    OPEN "92.rnd" FOR INPUT AS #1

REM    OPEN "18593.rnd" FOR INPUT AS #1
REM    OPEN "18793.rnd" FOR INPUT AS #1
REM    OPEN "19393.rnd" FOR INPUT AS #1
REM    OPEN "19493.rnd" FOR INPUT AS #1

REM    OPEN "1190.rnd" FOR INPUT AS #1
REM    OPEN "1213.rnd" FOR INPUT AS #1
REM    OPEN "1276.rnd" FOR INPUT AS #1
REM    OPEN "1465.rnd" FOR INPUT AS #1
REM    OPEN "1547.rnd" FOR INPUT AS #1

REM    OPEN "R48730.rnd" FOR INPUT AS #1
REM    OPEN "R48748.rnd" FOR INPUT AS #1
REM    OPEN "R48754.rnd" FOR INPUT AS #1
REM    OPEN "R48778.rnd" FOR INPUT AS #1
REM    OPEN "R48802.rnd" FOR INPUT AS #1
```

```
REM    OPEN "546.rnd" FOR INPUT AS #1
REM    OPEN "551.rnd" FOR INPUT AS #1
REM    OPEN "558.rnd" FOR INPUT AS #1
REM    OPEN "559.rnd" FOR INPUT AS #1
REM    OPEN "565.rnd" FOR INPUT AS #1

   ER = 1                                  '0 for output#2, 1 for output#3

   OPEN "CONVERT" FOR OUTPUT AS #2
   OPEN "ERRDET1" FOR OUTPUT AS #3         'for error detection procedure

   IF ER = 0 THEN 9 ELSE 91
9  WRITE #2, "F1", 2, "F3", "F4", "F5", 6, "F7", "F8", "F9", "F10", "F11", "F12"
   GOTO 92
91 WRITE #3, "F1", 2, "F3", "F4", "F5", 6, "F7", "F8", "F9", "F10", "F11", "F12", "F13"

92  No = 0
    NNo = 10000
    COUNTER = 0

10  I = 1
    J = 1
    C = 0                                  'counter for commas in location field
   CC = 0

   INPUT #1, F$(J)

30  IF CC = 0 THEN 5
    CC = CC - 1

   IF ((F$(1) = "TB") OR (F$(1) = "TC")) AND (J - CC > 8) THEN CC = C - 2
   IF ((F$(1) <> "TB") AND (F$(1) <> "TC")) AND (J - CC > 6) THEN CC = C - 2

   FF$(J) = F$(J - CC)
   GOTO 6

5   FF$(J) = F$(J)
6   P = INSTR(FF$(J), CHR$(32))
   IF I = 1 THEN 35
   IF (F$(1) = "LR") OR (F$(1) = "LD") OR (F$(1) = "LV") OR (F$(1) = "LC") THEN 31
ELSE 32
31  IF P = 0 THEN 40 ELSE 35
32  IF P = 0 THEN 33 ELSE 35

33  IF ((I < 7 + CC) AND ((F$(1) = "TB") OR (F$(1) = "TC"))) OR ((I < 5 + CC) AND ((F$(1)
<> "TB") OR (F$(1) <> "TC"))) THEN 34 ELSE 40
```

```
34  K = I
39  C = C + 1
   J = J + 1
   INPUT #1, F$(J)
   FF$(J) = FF$(K) + F$(J)
   P = INSTR(FF$(J), CHR$(32))
   K = K + 1
   IF P = 0 THEN GOTO 39
   CC = C

35 F$(I) = LEFT$(FF$(J), (P - 1))
   F$(I + 1) = RIGHT$(FF$(J), (LEN(FF$(J)) - P))

   IF (P = 1) AND (J = I) THEN 36
   IF (P = 1) AND (J > I) THEN 38
   IF (P <> 1) AND (J > I) THEN 37

   I = I + 1
36  J = J + 1
   GOTO 30

37  I = I + 1
38  GOTO 30

40  IF F$(1) = “TB” THEN 41 ELSE 42
41  No = No + 1                    ‘for counting TBs in a file
    FTB$ = F$(4)

42  IF F$(1) = “TN” THEN NNo = NNo + 1 ‘for counting TNs in a file

    IF F$(1) = “LR” THEN 50 ELSE 45
45  IF (F$(1) = “LD”) OR (F$(1) = “LV”) OR (F$(1) = “LC”) THEN 55 ELSE 47
47  IF ((F$(1) = “TB”) OR (F$(1) = “TC”)) THEN 57 ELSE 48
48  IF ((F$(1) = “TN”) OR (F$(1) = “TT”)) THEN 58 ELSE 59

50  IF ER = 0 THEN 350 ELSE 450
350 WRITE #2, F$(1), No, F$(2), F$(3)
    GOTO 60
450 WRITE #3, F$(1), No, F$(2), F$(3)
    GOTO 60

55  IF ER = 0 THEN 355 ELSE 455
355 WRITE #2, F$(1), No, B$, B$, F$(2)
    GOTO 60
455 WRITE #3, F$(1), No, B$, B$, F$(2)
    GOTO 60

57  MILE = VAL(F$(2))                    ‘converting odometer string to number
```

```
‘    COUNTER = COUNTER + 1
‘    IF (COUNTER > 1) AND (F$(1) = “TC”) AND (No = TNo) AND (F$(3) <> TST$) THEN
157 ELSE 257
‘
‘157 FLAG = FLAG + 1
‘    F$(1) = “TB”
‘    No = No + 1
‘    F$(3) = TST$
‘
‘257 TNo = No
‘    TST$ = F$(4)

   IF ER = 0 THEN 357 ELSE 457
357 WRITE #2, F$(1), No, B$, B$, B$, MILE, F$(3), F$(4), F$(5), F$(6), F$(7), F$(8)
   GOTO 60
457 ST$ = RIGHT$(F$(6), 2)    ‘provides a field for the jurisdiction that a truck is in—for error detection
   WRITE #3, F$(1), No, B$, B$, B$, MILE, F$(3), F$(4), F$(5), F$(6), ST$, F$(7), F$(8)
   GOTO 60

58  MILE = VAL(F$(2))
    IF ER = 0 THEN 358 ELSE 458
358 WRITE #2, F$(1), NNo, B$, B$, B$, MILE, B$, FTB$, F$(3), F$(4), F$(5), F$(6)
    GOTO 60
458 ST$ = RIGHT$(F$(4), 2)
    WRITE #3, F$(1), NNo, B$, B$, B$, MILE, B$, FTB$, F$(3), F$(4), ST$, F$(5), F$(6)
   GOTO 60

59  MILE = VAL(F$(2))
    IF ER = 0 THEN 359 ELSE 459
359 WRITE #2, F$(1), No, B$, B$, B$, MILE, B$, FTB$, F$(3), F$(4), F$(5), F$(6)
    GOTO 60
459 ST$ = RIGHT$(F$(4), 2)
    WRITE #3, F$(1), No, B$, B$, B$, MILE, B$, FTB$, F$(3), F$(4), ST$, F$(5), F$(6)

60  IF EOF(1) THEN 100
    GOTO 10
‘100 WRITE #2, FLAG                                   ‘to know number of changes
100  END
```

IFTA-I.SSL

A PARADOX Script to Calculate a Truck Mileage per Jurisdiction

```
;Part-I of IFTA report generation
;For the first truck “code” should be set equal to zero to initialize the selected tables.  After the ;first run the
code variable should be changed to 0.  The run number of this script depends to the ;number of trucks
```

which IFTA reports are generated for. For example, for 30 trucks this script ;will be run 30 times. In the first run variable code should be set to 1, then it has be changed to ;zero for the remaining 29 runs. Once IFTA-I.SSL script is run 30 times, IFAT-II.SSL will be ;engaged to generate the IFTA reports.
;This script ALSO generates individual truck fuel and mileage summary report AND a truck fuel ;information report.

```
method run(var eventInfo Event)
  var
    data3 query
    slecfuel query
    ifta4 query
    cname string
    trknum string
    bdate string
    edate string
    code number
    rep report
  endvar

;variable code is 1 for the first run, for the rest is 0
  code = 0
   if code = 1 then
    empty (“fuelinfo.db”)
    empty (“ifta.db”)
  endif

  cname =””
  trknum =””
  bdate =””
  edate =””
  cname =””

  cname.view (“Enter carrier name (CAPITAL):”)
  trknum.view (“Enter truck number:”)
  bdate.view (“Enter beginning date (m/d/y):”)
  edate.view (“Enter ending date (m/d/y):”)

  executeqbefile (“data1.qbe”)
  executeqbefile (“data2.qbe”)
;equivalent to data3.qbe query—data selection from data.db table
  data3 = query
  data.db |Code  |No      |Carrier Name |Vehicle ID|Mile |Ex. Jurisdiction|En. Jurisdiction|Location|Time
|Date|
     |check|checkplus |check~cname |~trknum|check|check|check|check|  |check>=~bdate,<~edate|
  endquery

  executeqbe(data3,”file.db”)

  executeqbefile (“ifta1.qbe”)
```

```
  executeqbefile ("ifta2.qbe")
  executeqbefile ("ifta3.qbe")

; replaces ifta4.qbe query—ifta4.qbe doesn't play in script environment
  ifta4 = query
    file.db |Code |No    |Carrier Name|Mile  |Ex. Jurisdiction|En. Jurisdiction|Time |Date |
             |check|check|check          |check|check     |check     |check|check|
  endquery

  executeqbe(ifta4)
  copy(":priv:answer.db","file.db")

  executeqbefile ("ifta5.qbe")
  executeqbefile ("ifta6.qbe")
  executeqbefile ("ifta7.qbe")
  executeqbefile ("ifta8.qbe")
  executeqbefile ("ifta9.qbe")

;equivalent to slecfuel.qbe query—fuel selection from fueldb.db table
  slecfuel = query
    fueldb.db |StCode|Seller St|Carrier Name|Truck Number|Purchase Date|Code|Unit|# of Units|
           Total Price|Tax Paid-Gal|Seller Name|Seller City|Seller Zip|Purchaser Name|
       |check |check|check ~cname|check~trknum|check>=~bdate,<~edate|check D|check G| check |
check          |check          |check        |check       |check      |check               |
   endquery

  executeqbe(slecfuel,"fueltrk.db")

  add("fueltrk.db","fuelinfo.db",true,false)

;Generating individual truck and mileage summary report

  empty("iftatrk.db")

  executeqbefile ("iftatk9.qbe")
  executeqbefile ("iftatk91.qbe")
  executeqbefile ("iftatk92.qbe")
  executeqbefile ("iftatk93.qbe")
  executeqbefile ("iftatk94.qbe")
  executeqbefile ("iftatk95.qbe")

  executeqbefile ("trkrpt1.qbe")
  executeqbefile ("trkrpt2.qbe")

    empty ("carrinf2.db")
    empty ("report2.db")

  executeqbefile ("trkrpt6.qbe")
  executeqbefile ("trkrpt8.qbe")
```

```
  executeqbefile ("trkrpt9.qbe")

  rep.print("truck.rsl")                ;individual truck fuel and mileage summary report
  rep.print("fueltrk.rsl")              ;a truck fuel information report

endmethod
```

IFTA-II.SSL

A PARADOX Script to Generate IFTA Report

```
;Part-II of IFTA report generation

method run(var eventInfo Event)

  var
    rep report
  endvar

  empty("carrinf2.db")
  empty("report2.db")

  executeqbefile("ifta91.qbe")
  executeqbefile("ifta92.qbe")
  executeqbefile("ifta93.qbe")
  executeqbefile("ifta94.qbe")
  executeqbefile("ifta95.qbe")
  executeqbefile("carrpt1.qbe")
  executeqbefile("carrpt2.qbe")
  executeqbefile("carrpt3.qbe")
  executeqbefile("carrpt31.qbe")
  executeqbefile("carrpt32.qbe")
  executeqbefile("carrpt4.qbe")
  executeqbefile("carrpt5.qbe")
  executeqbefile("carrpt6.qbe")
  executeqbefile("carrpt7.qbe")
  executeqbefile("carrpt8.qbe")
  executeqbefile("carrpt9.qbe")
  executeqbefile("carrpt91.qbe")

  rep.print("ifta.rsl")                                       ;IFTA report

endmethod
```

APPENDIX B

SAMPLES OF REPORTS

September 7, 1995

International Fuel Tax Agreement
July 95 Tax Report

Carrier Name : A
Fleet Number :
Account Number :
Contact Person :

Licensee Name and Mailing Address :

Total Miles (All Jurisdictions) :	43278.2
Total Fuel (All Jurisdictions) :	6953.5
Average Miles per Gallon :	6.22

Juris-diction	Tax Rate	Total Miles	Total Taxable Miles	Taxable Gallons	Tax Paid Gallons	Net Taxable Gallons	Tax Due	Int. Due 1.0%	TOTAL DUE
AR	0.1850	391.9	391.9	63.0	106.1	-43.1	-7.98	0.00	-7.98
AZ	0.1800	1270.1	1270.1	204.1	0.0	204.1	36.73	0.00	36.73
AS	0.0800			204.1			16.33	0.00	16.33
CO	0.2050	582.6	582.6	93.6	131.0	-37.4	-7.67	0.00	-7.67
IA	0.2250	1972.6	1320.8	212.2	437.7	-225.5	-50.73	0.00	-50.73
ID	0.2100	72.0	72.0	11.6	0.0	11.6	2.43	0.00	2.43
IL	0.2750	3576.7	3576.7	574.7	548.1	26.6	7.31	0.00	7.31
IN	0.1600	4611.4	4611.4	740.9	442.9	298.0	47.68	0.00	47.68
IS	0.1100			740.9			81.50	0.00	81.50
KS	0.2000	1455.0	1455.0	233.8	105.0	128.8	25.75	0.00	25.75
LA	0.2000	491.9	491.9	79.0	117.5	-38.5	-7.69	0.00	-7.69
MN	0.2000	808.2	808.2	129.9	116.0	13.9	2.77	0.00	2.77
MO	0.1300	1505.9	1505.9	242.0	77.3	164.7	21.40	0.00	21.40
MS	0.1800	365.7	365.7	58.8	0.0	58.8	10.58	0.00	10.58
NC	0.2170	441.5	441.5	70.9	145.0	-74.1	-16.07	0.00	-16.07
NE	0.2600	453.1	453.1	72.8	82.2	-9.4	-2.44	0.00	-2.44
NM	0.1800	724.4	724.4	116.4	410.1	-293.7	-52.87	0.00	-52.87
NV	0.2700	543.3	543.3	87.3	208.1	-120.8	-32.62	0.00	-32.62
OH	0.2200	3107.6	3107.6	499.3	643.7	-144.4	-31.77	0.00	-31.77
OS	0.0300			499.3			14.98	0.00	14.98
OK	0.1300	109.5	109.5	17.6	0.0	17.6	2.29	0.00	2.29
TN	0.1700	939.9	939.9	151.0	104.0	47.0	7.99	0.00	7.99
UT	0.1900	703.6	703.6	113.0	253.2	-140.2	-26.63	0.00	-26.63
WI	0.2320	8664.9	8664.9	1392.2	1522.6	-130.4	-30.26	0.00	-30.26
WY	0.0800	797.1	797.1	128.1	0.0	128.1	10.25	0.00	10.25
Non IFTA Juris.		9689.3							

NET TOTAL : $21.26

September 7, 1995

Individual Truck Fuel & Mileage
All Jurisdictions
July 95 Summary Report

Carrier Name : A
Fleet Number :
Truck Number: 1190

Total Miles : 10875.2
Total Fuel : 1634.1
Average Miles per Gallon : 6.66

Jurisdiction	Total Miles	Fuel - Gallons
AZ	494.7	0.0
CA	364.2	0.0
CO	582.6	131.0
CT	101.0	0.0
IA	440.8	130.0
IL	443.7	306.1
IN	1152.7	0.0
KS	877.4	105.0
KY	392.1	0.0
MA	34.9	0.0
MN	341.1	0.0
MO	230.5	0.0
NC	312.7	145.0
NJ	72.6	0.0
NM	399.8	122.0
NV	138.6	131.0
NY	655.8	0.0
OH	677.5	160.0
OK	55.1	0.0
PA	354.6	165.0
TN	278.4	0.0
TX	91.1	0.0
UT	359.6	0.0
WI	2023.7	239.0

September 7, 1995

Truck Fuel Information
July 95

Carrier Name : A
Truck Number : 1190

Jurisdiction	Purchase Date	Code	Unit	No. of Units	Total Price	Tax Paid-Gal
CO	7/5/95	D	G	131.00	$137.94	131.00
IA	7/8/95	D	G	130.00	$137.30	130.00
IL	7/11/95	D	G	155.10	$166.08	155.10
IL	7/23/95	D	G	151.00	$160.89	151.00
KS	7/1/95	D	G	105.00	$117.50	105.00
NC	7/24/95	D	G	145.00	$142.62	145.00
NM	7/2/95	D	G	122.00	$138.96	122.00
NV	7/4/95	D	G	131.00	$154.22	131.00
OH	7/18/95	D	G	160.00	$170.73	160.00
PA	7/16/95	D	G	165.00	$175.56	165.00
WI	7/12/95	D	G	104.00	$105.33	104.00
WI	7/27/95	D	G	135.00	$137.29	135.00

September 7, 1995

Individual Truck Fuel & Mileage
All Jurisdictions
July 95 Summary Report

Carrier Name : A
Fleet Number :
Truck Number: 1213

Total Miles : 9867.1
Total Fuel : 1593.1
Average Miles per Gallon : 6.19

Jurisdiction	Total Miles	Fuel - Gallons
GA	792.6	260.0
IA	250.3	0.0
IL	1079.0	149.0
IN	1250.9	0.0
KY	802.2	200.0
MD	149.1	0.0
MI	112.7	0.0
MN	128.2	0.0
NC	128.8	0.0
OH	858.4	176.0
PA	825.1	118.0
SC	150.9	0.0
TN	649.1	104.0
VA	272.4	0.0
WI	2377.8	586.1
WV	39.5	0.0

September 7, 1995

Truck Fuel Information
July 95

Carrier Name : A
Truck Number : 1213

Jurisdiction	Purchase Date	Code	Unit	No. of Units	Total Price	Tax Paid-Gal
GA	7/28/95	D	G	100.00	$104.90	100.00
GA	7/29/95	D	G	160.00	$149.44	160.00
IL	7/24/95	D	G	149.00	$161.67	149.00
KY	7/14/95	D	G	34.00	$32.45	34.00
KY	7/14/95	D	G	166.00	$175.80	166.00
OH	7/6/95	D	G	176.00	$183.74	176.00
PA	7/25/95	D	G	118.00	$125.09	118.00
TN	7/16/95	D	G	104.00	$104.42	104.00
WI	7/3/95	D	G	128.00	$138.25	128.00
WI	7/9/95	D	G	135.10	$136.85	135.10
WI	7/12/95	D	G	171.00	$191.35	171.00
WI	7/18/95	D	G	152.00	$162.19	152.00

September 7, 1995

Individual Truck Fuel & Mileage
All Jurisdictions
July 95 Summary Report

Carrier Name : A
Fleet Number :
Truck Number: 1276

Total Miles :	9920.7
Total Fuel :	1871.9
Average Miles per Gallon :	5.30

Jurisdiction	Total Miles	Fuel - Gallons
AR	391.9	106.1
AZ	775.4	0.0
CA	972.8	398.9
IA	278.0	121.7
IL	572.3	0.0
IN	153.7	0.0
KS	398.4	0.0
LA	491.9	117.5
MO	712.1	77.3
MS	365.7	0.0
NM	324.6	288.1
NV	404.7	77.1
NY	128.3	129.0
OH	221.8	90.0
OK	54.4	0.0
PA	613.9	0.0
TN	12.4	0.0
TX	1712.7	132.1
UT	195.4	161.1
WI	728.8	173.0
WV	14.0	0.0
WY	397.5	0.0

September 7, 1995

Truck Fuel Information
July 95

Carrier Name : A
Truck Number : 1276

Jurisdiction	Purchase Date	Code	Unit	No. of Units	Total Price	Tax Paid-Gal
AR	7/29/95	D	G	106.10	$105.96	106.10
CA	7/18/95	D	G	139.40	$160.35	139.40
CA	7/20/95	D	G	130.20	$130.05	130.20
CA	7/25/95	D	G	129.30	$147.20	129.30
IA	7/22/95	D	G	121.70	$127.94	121.70
LA	7/27/95	D	G	117.50	$117.38	117.50
MO	7/29/95	D	G	77.30	$76.43	77.30
NM	7/17/95	D	G	170.10	$190.33	170.10
NM	7/19/95	D	G	118.00	$128.01	118.00
NV	7/24/95	D	G	77.10	$88.74	77.10
NY	7/31/95	D	G	129.00	$149.77	129.00
OH	7/30/95	D	G	90.00	$93.95	90.00
TX	7/27/95	D	G	132.10	$145.45	132.10
UT	7/23/95	D	G	161.10	$182.07	161.10
WI	7/21/95	D	G	173.00	$191.86	173.00

September 7, 1995

Individual Truck Fuel & Mileage
All Jurisdictions
July 95 Summary Report

Carrier Name : A
Fleet Number :
Truck Number: 1465

Total Miles :	5332.3
Total Fuel :	727.9
Average Miles per Gallon :	7.33

Jurisdiction	Total Miles	Fuel - Gallons
IL	932.9	0.0
IN	721.4	150.0
MN	210.2	0.0
NY	404.9	0.0
OH	1042.2	217.7
PA	631.8	100.0
WI	1388.9	260.2

September 7, 1995

Truck Fuel Information
July 95

Carrier Name : A
Truck Number : 1465

Jurisdiction	Purchase Date	Code	Unit	No. of Units	Total Price	Tax Paid-Gal
IN	7/17/95	D	G	58.00	$57.95	58.00
IN	7/25/95	D	G	92.00	$93.21	92.00
OH	7/13/95	D	G	116.00	$124.36	116.00
OH	7/15/95	D	G	101.70	$106.21	101.70
PA	7/23/95	D	G	100.00	$105.90	100.00
WI	7/12/95	D	G	108.00	$119.23	108.00
WI	7/18/95	D	G	78.10	$78.80	78.10
WI	7/25/95	D	G	74.10	$74.61	74.10

September 7, 1995

Individual Truck Fuel & Mileage
All Jurisdictions
July 95 Summary Report

Carrier Name : A
Fleet Number :
Truck Number: 1547

Total Miles : 7282.9
Total Fuel : 1126.5
Average Miles per Gallon : 6.47

Jurisdiction	Total Miles	Fuel - Gallons
IA	1003.5	186.0
ID	72.0	0.0
IL	548.8	93.0
IN	1332.7	292.9
KS	179.2	0.0
MN	128.7	116.0
MO	563.3	0.0
NE	453.1	82.2
OH	307.7	0.0
UT	148.6	92.1
WI	2145.7	264.3
WY	399.6	0.0

September 7, 1995

Truck Fuel Information
July 95

Carrier Name : A
Truck Number : 1547

Jurisdiction	Purchase Date	Code	Unit	No. of Units	Total Price	Tax Paid-Gal
IA	7/6/95	D	G	115.00	$121.79	115.00
IA	7/7/95	D	G	71.00	$74.69	71.00
IL	7/29/95	D	G	93.00	$101.84	93.00
IN	7/10/95	D	G	107.50	$108.15	107.50
IN	7/25/95	D	G	85.00	$84.41	85.00
IN	7/27/95	D	G	100.40	$100.07	100.40
MN	7/31/95	D	G	116.00	$136.76	116.00
NE	7/2/95	D	G	82.20	$90.45	82.20
UT	7/1/95	D	G	92.10	$105.77	92.10
WI	7/4/95	D	G	102.00	$117.22	102.00
WI	7/11/95	D	G	64.00	$68.61	64.00
WI	7/12/95	D	G	20.00	$20.26	20.00
WI	7/24/95	D	G	78.30	$83.12	78.30

APPENDIX C

JULY 1995 IFTA REPORTS - ASCII FORMAT

“ABJOH”,”JOHNSRUD”,”AB”,0.2444,123.9000,123.9000,20.2187,0.0000,20.2187,4.9414,0.0000,4.9414

“ARJ”,”JOHNSRUD”,”AR”,0.1850,505.4000,505.4000,82.4739,100.0000,-17.5261,-3.2423,0.0000,-3.2423

“ARR”,”ROEHL”,”AR”,0.1850,391.9000,391.9000,62.9665,106.1000,-43.1335,-7.9797,0.0000,-7.9797

“ARRUA”,”RUAN”,”AR”,0.1850,109.2000,109.2000,15.2134,0.0000,15.2134,2.8145,0.0000,2.8145

“ARSKI”,”SKINNER”,”AR”,0.1850,62.2000,62.2000,10.5338,0.0000,10.5338,1.9488,0.0000,1.9488

“AZCA”,”CALEDONIA”,”AZ”,0.1800,468.4000,468.4000,77.8079,132.0000,-54.1921,-9.7546,0.0000,-9.7546

“AZJOH”,”JOHNSRUD”,”AZ”,0.1800,829.3000,829.3000,135.3296,0.0000,135.3296,24.3593,0.0000,24.3593

“AZROE”,”ROEHL”,”AZ”,0.1800,1270.1000,1270.1000,204.0667,0.0000,204.0667,36.7320,0.0000,36.7320

“AZSCA”,”CALEDONIA”,”AS”,0.0800,,,77.8079,,,6.2246,0.0000,6.2246

“AZSJO”,”JOHNSRUD”,”AS”,0.0800,,,135.3296,,,10.8264,0.0000,10.8264

“AZSRO”,”ROEHL”,”AS”,0.0800,,,204.0667,,,16.3253,0.0000,16.3253

“COJ”,”JOHNSRUD”,”CO”,0.2050,1354.9000,1354.9000,221.0998,211.0000,10.0998,2.0705,0.0000,2.0705

“COR”,”ROEHL”,”CO”,0.2050,582.6000,582.6000,93.6062,131.0000,-37.3938,-7.6657,0.0000,-7.6657

“CORU”,”RUAN”,”CO”,0.2050,1013.2000,1013.2000,141.1558,268.0000,-126.8442,-26.0031,0.0000,-26.0031

“IAC”,”CENEX”,”IA”,0.2250,422.4000,422.4000,69.0153,37.2000,31.8153,7.1584,0.0000,7.1584

“IACA”,”CALEDONIA”,”IA”,0.2250,8926.7000,7642.2000,1269.4776,1708.6000,-439.1224,-98.8025,0.0000,-98.8025

“IAJ”,”JOHNSRUD”,”IA”,0.2250,1629.5000,355.4000,57.9961,424.7000,-366.7039,-82.5084,0.0000,-82.5084

“IAR”,”ROEHL”,”IA”,0.2250,1972.6000,1320.8000,212.2127,437.7000,-225.4873,-50.7346,0.0000,-50.7346

“IARU”,”RUAN”,”IA”,0.2250,5890.7000,5111.0000,712.0482,2356.0000,-1643.9518,-369.8891,0.0000,-369.8891

“IASKI”,”SKINNER”,”IA”,0.2250,892.7000,752.1000,127.3707,0.0000,127.3707,28.6584,0.0000,28.6584

“IDCAL”,”CALEDONIA”,”ID”,0.2100,289.1000,289.1000,48.0236,0.0000,48.0236,10.0850,0.0000,10.0850

“IDJOH”,”JOHNSRUD”,”ID”,0.2100,244.8000,244.8000,39.9478,0.0000,39.9478,8.3890,0.0000,8.3890

“IDROE”,”ROEHL”,”ID”,0.2100,72.0000,72.0000,11.5682,0.0000,11.5682,2.4293,0.0000,2.4293

“ILC”,”CENEX”,”IL”,0.2750,5037.9000,5037.9000,823.1353,723.1000,100.0353,27.5097,0.0000,27.5097

“ILCA”,”CALEDONIA”,”IL”,0.2750,5134.1000,5134.1000,852.8467,630.8000,222.0467,61.0628,0.0000,61.0628

“ILJ”,”JOHNSRUD”,”IL”,0.2750,3294.8000,3294.8000,537.6630,312.7000,224.9630,61.8648,0.0000,61.8648

“ILR”,”ROEHL”,”IL”,0.2750,3576.7000,3576.7000,574.6677,548.1000,26.5677,7.3061,0.0000,7.3061

“ILRUA”,”RUAN”,”IL”,0.2750,2967.0000,2967.0000,413.3530,0.0000,413.3530,113.6721,0.0000,113.6721

“ILS”,”SKINNER”,”IL”,0.2750,4515.0000,4515.0000,764.6309,75.0000,689.6309,189.6485,0.0000,189.6485

“INC”,”CENEX”,”IN”,0.1600,351.7000,351.7000,57.4638,69.3000,-11.8362,-1.8938,0.0000,-1.8938

“INCA”,”CALEDONIA”,”IN”,0.1600,734.8000,734.8000,122.0607,106.0000,16.0607,2.5697,0.0000,2.5697

“INJ”,”JOHNSRUD”,”IN”,0.1600,783.0000,783.0000,127.7741,202.0000,-74.2259,-11.8761,0.0000,-11.8761

“INR”,”ROEHL”,”IN”,0.1600,4611.4000,4611.4000,740.9127,442.9000,298.0127,47.6820,0.0000,47.6820

“INRU”,”RUAN”,”IN”,0.1600,1976.1000,1976.1000,275.3040,83.2000,192.1040,30.7366,0.0000,30.7366

“INS”,”SKINNER”,”IN”,0.1600,3824.6000,3824.6000,647.7093,674.0000,-26.2907,-4.2065,0.0000,-4.2065

“INSCA”,”CALEDONIA”,”IS”,0.1100,,,122.0607,,,13.4267,0.0000,13.4267

“INSCE”,”CENEX”,”IS”,0.1100,,,57.4638,,,6.3210,0.0000,6.3210

“INSJO”,”JOHNSRUD”,”IS”,0.1100,,,127.7741,,,14.0552,0.0000,14.0552

“INSRO”,”ROEHL”,”IS”,0.1100,,,740.9127,,,81.5004,0.0000,81.5004

“INSRU”,”RUAN”,”IS”,0.1100,,,275.3040,,,30.2834,0.0000,30.2834

"INSSK","SKINNER","IS",0.1100,,,647.7093,,,71.2480,0.0000,71.2480

"KSC","CENEX","KS",0.2000,738.3000,738.3000,120.6298,106.0000,14.6298,2.9260,0.0000,2.9260

"KSCAL","CALEDONIA","KS",0.2000,50.8000,50.8000,8.4386,0.0000,8.4386,1.6877,0.0000,1.6877

"KSJ","JOHNSRUD","KS",0.2000,1282.0000,1282.0000,209.2036,172.7000,36.5036,7.3007,0.0000,7.3007

"KSR","ROEHL","KS",0.2000,1455.0000,1455.0000,233.7746,105.0000,128.7746,25.7549,0.0000,25.7549

"KSRUA","RUAN","KS",0.2000,756.4000,756.4000,105.3792,0.0000,105.3792,21.0758,0.0000,21.0758

"KSSKI","SKINNER","KS",0.2000,142.2000,142.2000,24.0821,0.0000,24.0821,4.8164,0.0000,4.8164

"LAR","ROEHL","LA",0.2000,491.9000,491.9000,79.0335,117.5000,-38.4665,-7.6933,0.0000,-7.6933

"MNC","CENEX","MN",0.2000,12695.5000,12695.5000,2074.2996,2466.4000,-392.1004,-78.4201,0.0000,-78.4201

"MNCA","CALEDONIA","MN",0.2000,4662.2000,4662.2000,774.4574,2313.7000,-1539.2426,-307.8485,0.0000,-307.8485

"MNJOH","JOHNSRUD","MN",0.2000,22.4000,22.4000,3.6554,0.0000,3.6554,0.7311,0.0000,0.7311

"MNR","ROEHL","MN",0.2000,808.2000,808.2000,129.8533,116.0000,13.8533,2.7707,0.0000,2.7707

"MNRUA","RUAN","MN",0.2000,1933.6000,1933.6000,269.3830,0.0000,269.3830,53.8766,0.0000,53.8766

"MNS","SKINNER","MN",0.2000,2362.6000,2362.6000,400.1145,160.5000,239.6145,47.9229,0.0000,47.9229

"MOCA","CALEDONIA","MO",0.1300,955.0000,955.0000,158.6390,180.0000,-21.3610,-2.7769,0.0000,-2.7769

"MOCEN","CENEX","MO",0.1300,223.2000,223.2000,36.4683,0.0000,36.4683,4.7409,0.0000,4.7409

"MOJ","JOHNSRUD","MO",0.1300,1078.5000,1078.5000,175.9954,329.6000,-153.6046,-19.9686,0.0000,-19.9686

"MOR","ROEHL","MO",0.1300,1505.9000,1505.9000,241.9527,77.3000,164.6527,21.4048,0.0000,21.4048

"MORUA","RUAN","MO",0.1300,331.8000,331.8000,46.2253,0.0000,46.2253,6.0093,0.0000,6.0093

"MOS","SKINNER","MO",0.1300,923.3000,923.3000,156.3641,216.0000,-59.6359,-7.7527,0.0000,-7.7527

"MSROE","ROEHL","MS",0.1800,365.7000,365.7000,58.7569,0.0000,58.7569,10.5763,0.0000,10.5763

"MTC","CENEX","MT",0.2475,314.9000,314.9000,51.4511,44.1000,7.3511,1.8194,0.0000,1.8194

“MTCA”,”CALEDONIA”,”MT”,0.2475,2677.9000,2677.9000,444.8371,162.4000,282.4371,69.9032,0.0000,69.9032

“MTJ”,”JOHNSRUD”,”MT”,0.2475,1380.8000,1380.8000,225.3263,244.8000,-19.4737,-4.8197,0.0000,-4.8197

“NCJOH”,”JOHNSRUD”,”NC”,0.2170,339.6000,339.6000,55.4177,0.0000,55.4177,12.0256,0.0000,12.0256

“NCR”,”ROEHL”,”NC”,0.2170,441.5000,441.5000,70.9357,145.0000,-74.0643,-16.0719,0.0000,-16.0719

“NCRU”,”RUAN”,”NC”,0.2170,1524.3000,1524.3000,212.3606,256.9000,-44.5394,-9.6650,0.0000,-9.6650

“NCS”,”SKINNER”,”NC”,0.2170,171.0000,171.0000,28.9594,125.0000,-96.0406,-20.8408,0.0000,-20.8408

“NDC”,”CENEX”,”ND”,0.1700,1679.6000,1679.6000,274.4274,209.1000,65.3274,11.1057,0.0000,11.1057

“NDCA”,”CALEDONIA”,”ND”,0.1700,347.8000,347.8000,57.7745,90.9000,-33.1255,-5.6313,0.0000,-5.6313

“NECAL”,”CALEDONIA”,”NE”,0.2600,1835.2000,1835.2000,304.8527,0.0000,304.8527,79.2617,0.0000,79.2617

“NEJ”,”JOHNSRUD”,”NE”,0.2600,2528.0000,2528.0000,412.5325,252.1000,160.4325,41.7124,0.0000,41.7124

“NER”,”ROEHL”,”NE”,0.2600,453.1000,453.1000,72.7995,82.2000,-9.4005,-2.4441,0.0000,-2.4441

“NERUA”,”RUAN”,”NE”,0.2600,1627.3000,1627.3000,226.7103,0.0000,226.7103,58.9447,0.0000,58.9447

“NMCAL”,”CALEDONIA”,”NM”,0.1800,370.5000,370.5000,61.5453,0.0000,61.5453,11.0782,0.0000,11.0782

“NMJ”,”JOHNSRUD”,”NM”,0.1800,548.3000,548.3000,89.4745,224.8000,-135.3255,-24.3586,0.0000,-24.3586

“NMR”,”ROEHL”,”NM”,0.1800,724.4000,724.4000,116.3892,410.1000,-293.7108,-52.8679,0.0000,-52.8679

“NVCA”,”CALEDONIA”,”NV”,0.2700,1303.1000,1303.1000,216.4634,281.4000,-64.9366,-17.5329,0.0000,-17.5329

“NVJ”,”JOHNSRUD”,”NV”,0.2700,784.9000,784.9000,128.0842,102.6000,25.4842,6.8807,0.0000,6.8807

“NVR”,”ROEHL”,”NV”,0.2700,543.3000,543.3000,87.2919,208.1000,-120.8081,-32.6182,0.0000,-32.6182

“OHCAL”,”CALEDONIA”,”OH”,0.2200,105.5000,105.5000,17.5250,0.0000,17.5250,3.8555,0.0000,3.8555

“OHJOH”,”JOHNSRUD”,”OH”,0.2200,254.5000,254.5000,41.5307,0.0000,41.5307,9.1367,0.0000,9.1367

“OHR”,”ROEHL”,”OH”,0.2200,3107.6000,3107.6000,499.2975,643.7000,-144.4025,-31.7686,0.0000,-31.7686

“OHRU”,”RUAN”,”OH”,0.2200,2262.1000,2262.1000,315.1486,551.4000,-236.2514,-51.9753,0.0000,-51.9753

“OHS”,”SKINNER”,”OH”,0.2200,1928.4000,1928.4000,326.5812,348.0000,-21.4188,-4.7121,0.0000,-4.7121

“OHSCA”,”CALEDONIA”,”OS”,0.0300,,,17.5250,,,0.5258,0.0000,0.5258

“OHSJO”,”JOHNSRUD”,”OS”,0.0300,,,41.5307,,,1.2459,0.0000,1.2459

“OHSRO”,”ROEHL”,”OS”,0.0300,,,499.2975,,,14.9789,0.0000,14.9789

“OHSRU”,”RUAN”,”OS”,0.0300,,,315.1486,,,9.4545,0.0000,9.4545

“OHSSK”,”SKINNER”,”OS”,0.0300,,,326.5812,,,9.7974,0.0000,9.7974

“OKCA”,”CALEDONIA”,”OK”,0.1300,343.4000,343.4000,57.0436,120.0000,-62.9564,-8.1843,0.0000,-8.1843

“OKJOH”,”JOHNSRUD”,”OK”,0.1300,521.8000,521.8000,85.1501,0.0000,85.1501,11.0695,0.0000,11.0695

“OKROE”,”ROEHL”,”OK”,0.1300,109.5000,109.5000,17.5933,0.0000,17.5933,2.2871,0.0000,2.2871

“OKRUA”,”RUAN”,”OK”,0.1300,902.7000,902.7000,125.7613,0.0000,125.7613,16.3490,0.0000,16.3490

“OKSKI”,”SKINNER”,”OK”,0.1300,204.6000,204.6000,34.6497,0.0000,34.6497,4.5045,0.0000,4.5045

“ORCAL”,”CALEDONIA”,”OR”,0.0000,309.1000,309.1000,51.3459,0.0000,51.3459,0.0000,0.0000,0.0000

“SDCA”,”CALEDONIA”,”SD”,0.1800,1920.3000,1920.3000,318.9890,264.3000,54.6890,9.8440,0.0000,9.8440

“SDJ”,”JOHNSRUD”,”SD”,0.1800,409.3000,409.3000,66.7918,105.4000,-38.6082,-6.9495,0.0000,-6.9495

“SDRUA”,”RUAN”,”SD”,0.1800,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000

“TNCEN”,”CENEX”,”TN”,0.1700,118.4000,118.4000,19.3452,0.0000,19.3452,3.2887,0.0000,3.2887

“TNJ”,”JOHNSRUD”,”TN”,0.1700,1405.5000,1405.5000,229.3570,274.9000,-45.5430,-7.7423,0.0000,-7.7423

“TNR”,”ROEHL”,”TN”,0.1700,939.9000,939.9000,151.0136,104.0000,47.0136,7.9923,0.0000,7.9923

“TNRUA”,”RUAN”,”TN”,0.1700,425.3000,425.3000,59.2514,0.0000,59.2514,10.0727,0.0000,10.0727

“TNSKI”,”SKINNER”,”TN”,0.1700,871.1000,871.1000,147.5238,0.0000,147.5238,25.0790,0.0000,25.0790

“UTCA”,”CALEDONIA”,”UT”,0.1900,1835.4000,1835.4000,304.8859,265.0000,39.8859,7.5783,0.0000,7.5783

“UTJ”,”JOHNSRUD”,”UT”,0.1900,1248.1000,1248.1000,203.6716,371.9000,-168.2284,-31.9634,0.0000,-31.9634

“UTR”,”ROEHL”,”UT”,0.1900,703.6000,703.6000,113.0473,253.2000,-140.1527,-26.6290,0.0000,-26.6290

“WACA”,”CALEDONIA”,”WA”,0.2300,1437.4000,1437.4000,238.7725,249.9000,-11.1275,-2.5593,0.0000,-2.5593

“WAJ”,”JOHNSRUD”,”WA”,0.2300,481.0000,481.0000,78.4921,83.4000,-4.9079,-1.1288,0.0000,-1.1288

“WIC”,”CENEX”,”WI”,0.2320,3886.4000,3886.4000,634.9933,699.0000,-64.0067,-14.8495,0.0000,-14.8495

“WICA”,”CALEDONIA”,”WI”,0.2320,5766.6000,5766.6000,957.9139,380.2000,577.7139,134.0296,0.0000,134.0296

“WIJOH”,”JOHNSRUD”,”WI”,0.2320,309.3000,309.3000,50.4732,0.0000,50.4732,11.7098,0.0000,11.7098

“WIR”,”ROEHL”,”WI”,0.2320,8664.9000,8664.9000,1392.1878,1522.6000,-130.4122,-30.2556,0.0000,-30.2556

“WIRUA”,”RUAN”,”WI”,0.2320,940.5000,940.5000,131.0275,0.0000,131.0275,30.3984,0.0000,30.3984

“WIS”,”SKINNER”,”WI”,0.2320,8927.9000,8927.9000,1511.9709,2668.0000,-1156.0291,-268.1987,0.0000,-268.1987

“WYCA”,”CALEDONIA”,”WY”,0.0800,2673.7000,2673.7000,444.1394,477.9000,-33.7606,-2.7008,0.0000,-2.7008

“WYCEN”,”CENEX”,”WY”,0.0800,51.1000,51.1000,8.3492,0.0000,8.3492,0.6679,0.0000,0.6679

“WYJ”,”JOHNSRUD”,”WY”,0.0800,931.3000,931.3000,151.9745,178.4000,-26.4255,-2.1140,0.0000,-2.1140

“WYROE”,”ROEHL”,”WY”,0.0800,797.1000,797.1000,128.0699,0.0000,128.0699,10.2456,0.0000,10.2456

AMASCOT:

Automated Mileage and Stateline Crossing Operational Test

Final Report

Part 3 of 4: State Acceptance and Benefits Evaluation

May 1, 1996

Principal Investigator
Bill M. McCall

Principal Contributor
Michael L. Hancock

Center for Transportation Research and Education
Iowa State University

Wisconsin Department of Transportation

CTRE
Center for Transportation Research and Education

Iowa Department of Transportation

Iowa State University

U.S. Department of Transportation

Department of Public Safety, State of Minnesota

CONTENTS

LIST OF FIGURES

BACKGROUND

The Automated Mileage and Stateline Crossing Operational Test (AMASCOT) tested the feasibility of automating the collection of mileage-by-jurisdiction data and electronic data interchange for IFTA and IRP reporting. The test involved the states of Iowa, Minnesota, and Wisconsin and motor carriers from these three states. The test equipped 30 interstate commercial vehicles with prototype electronic mileage-by-jurisdiction data collection devices, collected mileage-by-jurisdiction data from the vehicles as they operated throughout the United States and Canada in their normal course of business, integrated these mileage data with fuel purchase data to generate the data necessary for IFTA reporting, and evaluated the ability of an electronic mileage data collection system and the data generated to meet IFTA and IRP requirements. The test also investigated the feasibility of transmitting IFTA and IRP reporting data electronically from the motor carrier to the base state.

The scope of Part 2 of the AMASCOT Final Report is to document the evaluation of the AMASCOT related to the following evaluation goals:

- Evaluate the difference in audit costs between the current method of processing IFTA and IRP reports and the automated method.
- Determine participating states' acceptance of the automated method and their willingness to change the method of processing.
- Discuss legal, institutional, and project contracting issues encountered during the operational test.

Related to these evaluation goals, this document reports the methodology used and findings related to current state processes and costs for IFTA and IRP reporting; the possible and perceived benefits of automated, electronic mileage data collection and electronic filing; general indications of possible state employee acceptance; and potential barriers to implementation by states.

METHODOLOGY

When designing the state acceptance, benefits, and costs evaluation effort, the Evaluation Subcommittee recognized the need for the evaluation effort to allow for differences among states in their approaches to IFTA and IRP administration. In addition, direct comparisons among states were not seen as necessary or desirable. As a result, the most appropriate way to evaluate the potential impacts of automated, electronic mileage data collection and electronic filing on states' current processes and identify states' perceptions of automated, electronic data collection and the AMASCOT project was to look at each state as a separate case study.

Further, because IRP filing is less frequent than IFTA (therefore a smaller part of state work), uses the same mileage data, and is often audited in conjunction with IFTA filings, the state evaluation focused on the IFTA processes. Benefits identified for IFTA processing and auditing are also applicable to IRP, though to a lesser extent in processing due to the IRP requirement for only a single mileage report annually versus the IFTA requirement for fuel and mileage reporting quarterly.

Each case study examined the following areas:

- processes for IFTA processing
- processes for IFTA auditing
- current costs for IFTA and IRP functions as identified by states
- potential benefits and changes in current processes resulting from automated, electronic mileage data collection and filing
- perceptions of state processing and auditing personnel regarding potential benefits and their likelihood
- possible barriers to state implementation

In these case studies, two basic methods were used to identify current state processes and costs for IFTA and IRP reporting, the possible and perceived benefits of automated electronic data collection and EDI, general indications of possible state employee acceptance, and potential barriers to implementation: 1) site visits and interviews with state processing and audit personnel and 2) questionnaires distributed to both processing and audit personnel. Both methods were reviewed by the Evaluation Subcommittee and approved for action.

In the first effort, state evaluation team members visited with IFTA/IRP administrative personnel of the three participating states to identify their step-by-step processes for both IFTA auditing and IFTA quarterly return processing. Following each visit, the processes were documented and organized into process maps with a draft copy sent to each state for review and identification of any necessary revisions. All final copies of both the process narrative and the process maps were approved by each state. Once the process documentation had been validated by the states, the implications of automated electronic mileage data collection were identified and analyzed.

As part of this effort, costs for state processing and auditing functions were identified where possible. However, a traditional cost/benefit study was not possible due to 1) differences in the methods of costing and level of detail of the available cost data for state processes; 2) the lack of experiential data to estimate the impact of automated, electronic mileage data collection and electronic filing on the states' processes and costs; and 3) the dependence of state costs on the number of motor carriers adopting automated, electronic mileage data collection and filing, which is beyond the scope of this study to predict. Rather, the cost data available allowed a tabulation of the current state costs as identified by the participating states and identification of the areas of the process that could be positively affected by automated, electronic mileage data collection and electronic filing.

For the second effort, state evaluation team members developed questionnaires for the two areas of state involvement in IFTA/IRP—administration and auditing. Two separate questionnaires were used—one for the auditing staff members and the other for the processing staff members.

The auditing questionnaire made inquiries about the following topics:

(1) background information regarding position, tenure, and responsibilities

(2) knowledge of the AMASCOT project

(3) relevant changes/benefits related to automated data collection technology

(4) data accuracy and security expectations

(5) resource savings/reallocation expectations

(6) general receptivity and acceptance of automated electronic data collection

The IFTA processing questionnaire made inquiries about similar topics from a processing viewpoint:

(1) background information regarding position, tenure, and responsibilities

(2) knowledge of the AMASCOT project

(3) relevant changes/benefits related to automated data collection technology

(4) time spent on IFTA quarterly report tasks

(5) resource savings/reallocation expectations

(6) general receptivity and acceptance of automated electronic data collection and filing

Draft copies of the questionnaires were sent to members of the Evaluation Subcommittee for review—one person whose duties included IFTA processing and another whose duties included IFTA auditing. Both individuals reviewed and approved the questionnaire for their area of expertise before the questionnaires were distributed.

The questionnaires were sent to all three states following completion of the operational test portion of the project. Supervisors for the processing and auditing functions in each state were asked to identify the number of questionnaires that were needed for distribution. The questionnaires were then sent to the appropriate supervisors in auditing and processing. Envelopes were included with the questionnaires so that the respondents could return the surveys anonymously. The supervisors were asked to distribute the questionnaires to the employees in their department along with the envelopes and to ask their personnel to answer the surveys candidly and to seal them in the envelopes provided to protect the confidentiality of their responses. To further ensure confidentiality, the surveys were only coded to track the type of survey and the state. No coding was used to track the surveys by respondent. In total, 16 auditing and 39 processing questionnaires were sent to the states.

Because the sample size was small and concerns over survey length kept the questionnaires short, the questionnaires were not intended to support statistical analysis but instead to provide indications of the general perceptions and receptivity of the target group toward automated electronic data collection and electronic filing for IFTA and IRP.

EVALUATION FINDINGS

These case studies focused on the following:

- processes for IFTA auditing
- current costs for IFTA and IRP functions as identified by states
- potential benefits and changes in current processes resulting from automated, electronic mileage data collection and filing
- perceptions of state processing and auditing personnel regarding potential benefits and their likelihood
- possible barriers to state implementation

Evaluation Findings for the Iowa Department of Transportation

This section identifies the current processes used by the Iowa Department of Transportation for IFTA reporting and auditing. In the Iowa process, IFTA and IRP are administered through two distinct entities; the Office of Motor Carrier Services performs all credentialing and report processing functions, and the Bureau of Finance, Motor Carrier Audits performs all auditing functions related to IFTA and IRP administration.

Iowa IFTA Quarterly Return Processing

To identify the processes used by the Iowa DOT Office of Motor Carrier Services for IFTA processing, state evaluation team representatives met with the Director of Motor Carrier Services and several MCS staff members to discuss their steps for IFTA processing. The following process description and process map were developed from this meeting and subsequent discussions:

1) Mail service sorts mail. Those pieces intended for Motor Carrier services are opened and sorted into those that include payment and those that do not. Envelope, paperwork, and any funds are clipped together. Mail is delivered to MCS once per day.

2) If the IFTA report includes payment, the payment is checked against the amount due reported and to ensure proper signature, entered onto the processing system, and recorded on a daily deposit record.

3) All reports are reviewed for completeness and correctness. If the report is not complete or correct, it is returned to the motor carrier with a letter identifying the problem.

4) Acceptable reports are entered into the IFTA processing system.

5) Daily transaction and error reports are generated to flag those reports with data entry errors, and any errors in data entry are corrected.

6) IFTA reports processed in a day are kept together in a batch. The batch totals resulting from the actual reports are balanced against the totals generated by the system for the same batch of reports. If the batch balances, the batch of reports continues on. If not, missing or extra reports are identified and corrected. Any data entry errors identified are sent back for corrections.

7) If the carrier is receiving a refund, the system is flagged to print and mail a refund check.

8) If the carrier is not receiving a refund, the system is flagged to print the appropriate credit letter or billing.

   - For those carriers that were billed, if payment is not received within 30 days, a second billing letter is mailed.

   - If second billing notice has been sent and no payment has been received within 60 days from original billing, the motor carrier's IFTA account and credentials are flagged as suspended on the system and a letter of cancellation is mailed.

9) At a specified cut-off date and time, the system generates a report of any motor carriers that have IFTA accounts but have not filed current quarterly reports. Motor carriers appearing on this report have their accounts and credentials flagged as suspended on the system, and a letter notifying them of cancellation of their IFTA account is mailed.

10) All IFTA reporting activity is archived to microfilm once per year.

A process map for the Iowa DOT Quarterly IFTA Processing activity is shown in Figure 3.1.

Iowa IFTA Quarterly Report Processing Costs. Currently, Iowa does not track IFTA administration costs on a detailed basis. However, mailing costs for billing notices, credit letters, quarterly filing forms and rates, and other mailings were reported as $6,040 for fiscal year 1994.

Potential Benefits and Cost Savings for IFTA Quarterly Return Processing. Currently, mileage data are recorded manually by the driver and turned in to the carrier for reporting purposes. The data are then entered on a manual form by the motor carrier staff, mailed into the state agency, and re-keyed into the state processing system by the state processing personnel. With automatic mileage data collection and electronic fuel tax reporting, fuel tax returns could be processed electronically. Motor carriers or their service providers could collect electronic data from the vehicle, use these data to generate IFTA quarterly reports, and submit these reports to the base state via Electronic Data Interchange (EDI). For the Iowa DOT Office of Motor Carrier Services, automated, electronic mileage data collection and electronic filing offers the following benefits for IFTA processing:

- **Reduced labor costs for opening, sorting, and delivering mailed-in, manual returns.**
- **Reduced data entry.**
- **Reduced problems related to hand-written filings.** Most carriers compile the necessary IFTA data, make the necessary calculations for IFTA, and then hand-write the IFTA return. These hand-written returns often create legibility problems for states. Electronic returns would reduce the number of hand-written returns and the associated legibility problems.
- **Reduced base state follow-up due to IFTA filing errors.** The use of electronic data and filing reduces the opportunities for motor carriers to make mistakes in their IFTA filing. Reduced errors lessens the need for the base state to follow up with carriers for corrected filings.

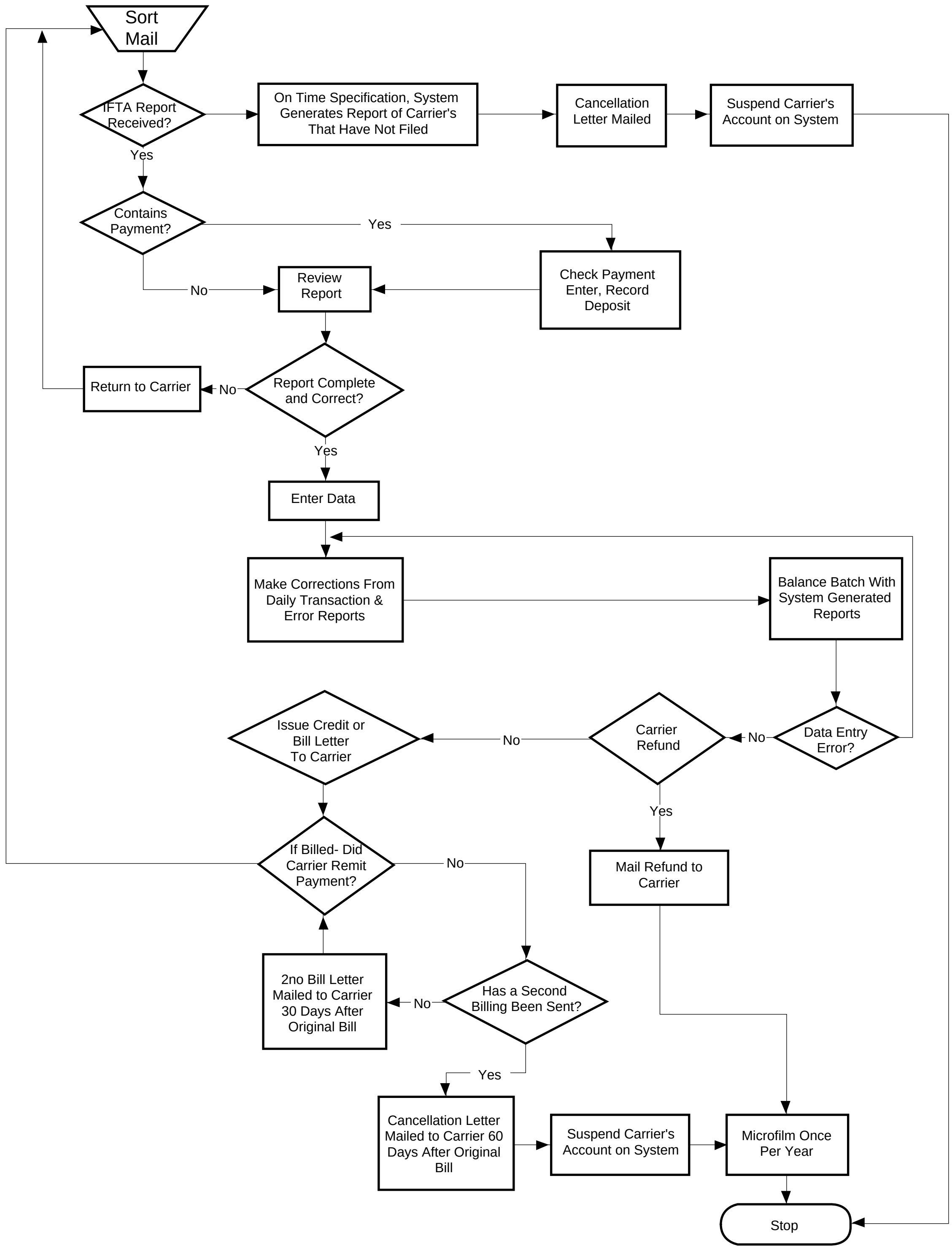

Figure 3.1 Iowa DOT IFTA Reporting Process Map

- **Reduced labor for verification and data entry of payments through EFT.** Along with receiving returns electronically, funds due could also be received electronically. EFT would eliminate the need for processing personnel to verify the payment, enter it on the system for deposit, and reconcile reports and payments manually.
- **Reduced labor and mail costs associated with preparing mailings for manual returns.** Currently, the base state sends each IFTA registered carrier manual return forms every quarter. These mailings could be eliminated for those carriers that would be filing electronically if the IFTA rates are made available to carriers electronically.
- **Reduced labor and storage space/materials costs related to retaining and using data.** Electronic data would reduce time required for storage and retrieval of filing data and reduce the physical space and materials (paper, file folders, etc.) necessary.
- **Reallocation of staff where additional help is needed.** Reductions in the staff time required to complete IFTA report processing will allow shifting of resources to other areas such as assisting companies reporting for the first time or to other areas of motor carrier regulatory administration.

While these benefits would be possible for the Iowa DOT Office of Motor Carrier Services if automated electronic data collection and filing were implemented by Iowa and its base state carriers, the impact or value of these benefits is difficult to estimate in any meaningful way. These benefits are dependent on the number of motor carriers who implement electronic data collection and filing, which is difficult to predict in a potentially emerging marketplace.

In addition, while the Iowa DOT was unable to provide detailed costs for IFTA processing, using the other states as a guide we can estimate that the costs of the Iowa DOT's IFTA processing are similar, probably less than $125,000 per year. Consequently, electronic data collection and filing would have to reduce processing costs by a very high percentage to result in large monetary savings for the Iowa DOT. At the same time, however, staff levels at the Iowa DOT Office of Motor Carrier Services have been cut to a minimum, resulting in considerable difficulty in maintaining the desired levels of service. Thus, staff time is at a premium. As a result, the benefits to the Iowa DOT Office of Motor Carrier Services are not likely to be in the form of direct money cost savings but in the form of staff time that can be reallocated to maintaining other necessary motor carrier services or enhancing IFTA and other motor carrier services as needed. In short, electronic mileage data collection and filing can make the Iowa DOT Office of Motor Carrier Services more productive and better able to accommodate current and future demands on staff.

Iowa IFTA Auditing

To identify the processes, costs, and potential benefits of automated, electronic data collection, the evaluation team met with the Motor Carrier Audit Supervisor of the Iowa DOT to document Iowa's IFTA auditing processes and costs.

Iowa DOT IFTA Audit Process. In general, most audits are conducted at the motor carrier's place of business. However, seven to eight percent of the total audits performed are presently conducted at the state office. These in-house audits typically involve small one-to two-truck carriers and are performed when auditors have not been able to schedule a visit with the carrier. These carriers' small size allows the data necessary for an audit to be easily provided to the auditors. If the in-house audit does not prove sufficient, the Iowa auditors will still go to the carrier's site. In-house audits of larger carriers are not done due to the logistics of providing access to the necessary documentation.

The Iowa DOT classifies motor carrier audits as either limited reviews or full audits, using the carrier's size and previous audit history to determine the level of documentation to be reviewed and the scope of paper files to be maintained. Limited reviews include an examination of the motor carrier's process for IFTA recordkeeping and quarterly filing and a limited sampling of the support records. These reviews result in a one-page report of records. These reviews result in a one-page report of findings and are generally assigned by the audit supervisor for small carriers which have not had previous compliance problems. Field auditors have the authority to upgrade any limited review to a full audit if, during the course of the review, information is discovered that suggests a full audit is necessary. Generally, 75–80 percent of audits conducted by the Iowa DOT audit staff are done as limited reviews, allowing the staff to maintain efficient use of their time to focus efforts on carriers with significant compliance issues.

The following process narrative describes the Iowa DOT's process for IFTA audits, as approved by the Iowa DOT.

1) Motor Carrier Audit Supervisor selects motor carriers to be audited.

2) Supervisor suggests limited review or full audit.

3) Auditor sends notification letter to carrier up to three months prior to audit.

4) Auditor contacts carrier by phone to set audit appointment.

5) Audit preparation includes previous audit file, IFTA reports, current IRP registration.

6) Full audit includes:

    a) examining 10 percent of trucks, one month for each of three years

b) analyzing data using route mileage and spreadsheet software

c) evaluation and recommendation by auditor for necessary action

d) supervisor review and approval

e) opportunity for appeal by carrier

7) Limited review includes only a general review of the data unless additional new information warrants a full audit.

Figure 3.2 is the corresponding process map for the Iowa DOT's IFTA/IRP auditing process.

Iowa DOT IFTA Auditing Costs. The Iowa DOT, Bureau of Finance, Motor Carrier Audits was able identify the following costs for IFTA/IRP auditing during fiscal year 1994:

Salaries	$176,103
Benefits	44,500
Travel, vehicle, office support	57,000
TOTAL AUDIT COSTS (1994)	$277,603

Potential Benefits and Cost Savings. Potential IFTA/IRP auditing benefits for the Iowa DOT from electronic mileage data collection were identified as the following:

- **Time savings (resulting in more audits) due to improved data accessibility.** During the actual audit, auditors spend a significant amount of time searching through paper documentation at the carrier's site and then entering the data into auditing software (usually a spreadsheet program and a route mileage program). Electronic information would reduce these manual steps and be more easily queried to facilitate faster and easier audits. By reducing the time needed for each audit, the Iowa DOT could audit many more carriers per year.

- **More in-house audits due to improved data portability.** The feasibility of in-house audits is increased substantially by electronic data. The mileage and fuel purchase data requested by auditors could be supplied in electronic format much more easily than current paper records can be, thus enabling in-house audits for larger motor carriers. More in-house audits would result in:

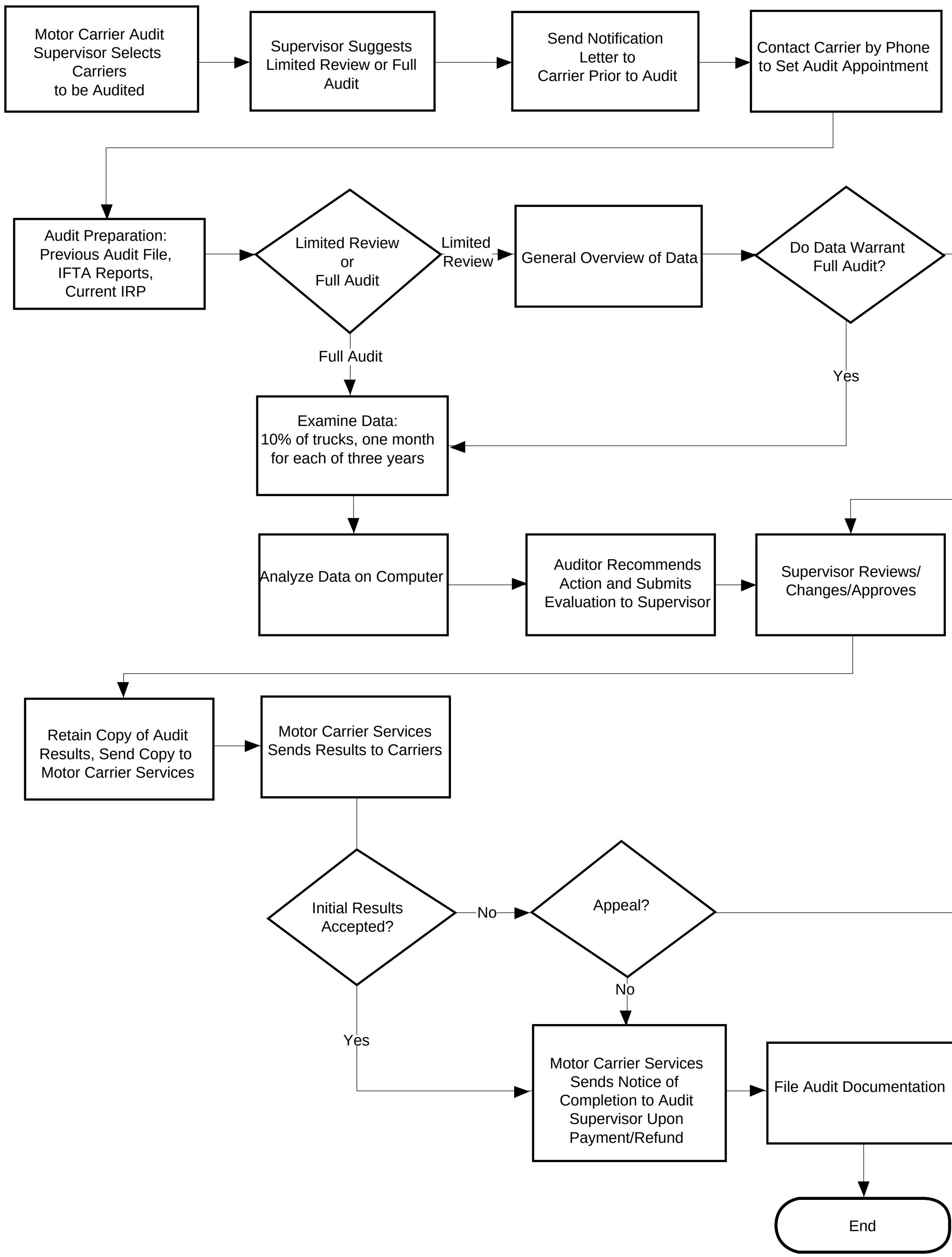

Figure 3.2 Iowa DOT IFTA Auditing Process Map

- **more audits** Less time spent traveling creates more time for audits.

- **less travel expense**

- **Better targeting of resources.** Electronic data would allow auditors to more easily request data samples for “pre-audits.” Audits of these limited electronic data samples could be combined with phone interviews and other information to assess whether a motor carrier needs more auditing attention. With reduced time in accessing and using electronic data, these “pre-audits” could reach more carriers. Similar to limited reviews, these “pre-audits” could indicate potential trouble areas in a motor carrier’s process more quickly than a manual limited review.

While general costs were identified for audit processes, the impact of electronic mileage data collection on these costs is dependent on the number of carriers who implement this type of technology. With annual costs of less than $300,000, large monetary savings are not likely even with very large impacts on staff time and travel.

Iowa’s audit supervisor indicated that carriers with as few as two trucks can be ranked in the top 25 percent of Iowa carriers by accrued mileage. Because the majority of Iowa carriers are small carriers, large impacts on the Iowa audit process are not likely until implementation of electronic mileage data collection reaches carriers with fewer than ten trucks.

However, Iowa’s audit supervisor also indicated that widespread implementation of electronic mileage data collection by larger carriers (more than 50 trucks) and equipment leasing and service firms would lead to noticeable impacts. Like the Iowa processing staff, any reductions in staff time or travel due to electronic mileage data is likely to result in increased productivity (more audits) and better service to motor carriers, particularly those using electronic mileage data collection.

Summary of the Iowa DOT IFTA Processing Staff and Audit Staff Surveys

To identify the benefits expected by processing and auditing staff and gauge their receptivity for electronic mileage data collection and electronic filing, short questionnaires were distributed to the Iowa DOT IFTA processing and auditing staffs. The questionnaires were designed to provide a general measure of the staffs’ knowledge and attitudes toward the AMASCOT project, their perceptions of the benefits of electronic mileage data collection and electronic filing and the likelihood of those benefits, and their receptivity toward implementation of electronic mileage data collection and electronic filing. Following is a summary of results from both the processing and auditing staffs:

Iowa IFTA Processing Staff Survey. Twenty processing questionnaires were sent to the Iowa DOT Office of Motor Carrier Services for distribution. Fourteen of these processing questionnaires were completed and returned. Examination of survey responses resulted in the following indications:

Knowledge about AMASCOT. Of the 14 surveys returned, only five respondents answered inquiries about general knowledge of AMASCOT. Of those five, none knew about AMASCOT, had discussed AMASCOT in general with a supervisor or colleague, or had discussed potential benefits and changes that would result from AMASCOT implementation with a supervisor or colleague.

Perceived Benefits. Responses to inquiries regarding the accuracy of current IFTA returns and the accuracy possible with electronic mileage data collection and filing indicated that Iowa's processing staff feel the accuracy on the IFTA quarterly returns is average, and, despite knowing nothing about AMASCOT, they expect the accuracy to increase with electronic mileage data collection and electronic filing. Similarly, nine out of 14 respondents could see potential benefit as likely to very likely for less data entry, more efficient storage and retrieval of data, less time spent resolving inaccuracies, and more reliance on their IFTA processing software to determine inaccuracies.

If electronic mileage data collection and filing results a substantial reduction in data entry as expected by processing staff, 10 out of 14 respondents indicated they would use the time to recheck the accuracy of their own work, complete additional tasks of their own, help others with their tasks, or assume additional responsibilities.

Receptivity to Electronic Mileage Data Collection and Electronic Filing. Iowa processing staff survey results indicate a high receptivity for electronic mileage data collection and electronic filing. Eight of 14 respondents were slightly to very receptive to automatic mileage data collection for IFTA reporting, while the remaining six were indifferent. Responses related to receptivity toward electronic filing of IFTA reports show that six of 14 were very receptive, two were slightly receptive, five were indifferent, and one was very resistant. It is interesting to note, however, that the one individual who was very resistant also responded that all of the listed benefits were very likely to occur given implementation of electronic mileage data collection and electronic filing.

Iowa Auditing Staff Survey. A total of six auditing questionnaires were provided to the Iowa DOT, Bureau of Finance, Motor Carrier Audits. One of these six auditing questionnaires was not distributed. The remaining five auditing questionnaires were completed and returned. Tabulation of these surveys resulting in the following indications:

Knowledge about AMASCOT. All of the auditors surveyed knew at least some of the details about AMASCOT and have had discussions about AMASCOT with their supervisor, particularly concerning possible benefits of electronic mileage data collection. The change discussed the most was the decreased time needed for each audit. Only two out of five auditors had discussed changing auditing methods from manual to automated software methods, the possibility of reducing the need to visit the carrier's location, and the ease of querying information. Pre-screening of data prior to the audit was discussed with only one person.

Perceived Benefits. The benefits perceived as most likely were the ability to audit the electronic data using specially developed audit software, the ease of querying information, and the decrease in time required to perform audits. Benefits perceived as less likely to occur included decreased visits to motor carrier locations and pre-screening of audit data. Four out of five auditors believe that data would be more accessible, and three out of five say this greater accessibility would promote greater audit efficiency. Three out of five auditors believe that accuracy would be greater with an electronic mileage data collection device.

If the auditors spend less time auditing each carrier, all of the auditors would utilize the time saved by conducting more audits and most would review their own work more thoroughly to ensure accuracy. One out of five would help others with unfinished tasks, and two out of five would expect to take on additional responsibilities within their function.

If the benefits are actually realized, cost savings are projected most significantly from less manual data entry and higher reporting accuracy. Some cost savings are foreseen with decreased audit time, and very little cost savings are foreseen with decreased travel. No cost savings are expected from decreased mailings to motor carriers.

Receptivity to Electronic Mileage Data Collection and Electronic Filing Overall, four of the five Iowa auditors were receptive to the electronic fuel tax data collection and reporting device and were cautiously optimistic about the benefits to be realized with implementation. The auditors indicated that they believed that the device would be acceptable among the auditing community, but the device would have to be very tamper proof. Their questionnaire responses indicate they believe accuracy will improve and also provide a cost savings. All factors considered, the auditors see AMASCOT technology as providing the opportunity to conduct more audits.

Summary Evaluation Conclusions of the Iowa Case Study

Clearly, the implementation of electronic mileage data collection and electronic filing for IFTA and IRP compliance will positively impact the Iowa DOT's IFTA/IRP processing and auditing processes. Analysis of Iowa IFTA processing and audit processes identified a number of potential benefits due to electronic mileage data collection and electronic filing, and many of these potential benefits were also perceived as likely by IFTA processing and auditing staff. Processing staff, for example, expected electronic mileage data collection and filing to result in reduced data entry, increased accuracy, reduced reconciliation of payments due to EFT, and less interaction with motor carriers to obtain correct data. These staff members indicated that the potential time savings would be used to better verify their own work, complete more of their own work, help others with their duties, or take on additional responsibilities.

Auditing staff expected electronic mileage data collection and filing to result in increased accuracy of mileage data and reporting, decreased time spent auditing due to increased data accessibility, and time savings due to the capability to audit mileage data using specialized software that could utilize the electronic data. Iowa's auditors expected to utilize any time savings created to more thoroughly check their own work and to conduct more audits.

Iowa auditing and processing supervisors agreed that the impact of electronic mileage data collection and filing on their systems is dependent on the level of implementation by Iowa-based motor carriers and that large impacts would not be realized until implementation had filtered down to carriers of fewer than ten trucks. However, Iowa auditing and processing supervisors also indicated that benefits accrued from implementation of electronic mileage data collection and filing by larger motor carriers (more than 50 trucks) and equipment leasing and service firms would be significant enough to be worthwhile.

Evaluation Findings for the Minnesota Department of Public Safety

This section identifies the current processes used by the Minnesota Department of Public Safety for IFTA reporting and auditing. IFTA and IRP are both administered through the same office in the Minnesota Department of Public Safety.

Minnesota IFTA Quarterly Report Processing

The evaluation team met with the Assistant IRP/IFTA Administrator of the Minnesota Department of Public Safety to discuss the steps involved with IFTA processing. The following process description and process map were developed from the meeting and subsequent discussions.

1) Departmental mail person opens, date stamps, and attaches envelope.
2) If money is received, the check and return go to the cashier to ring payment and validate return with amount received.
3) The return is forwarded to one of two processing teams. Carriers with internal prorate numbers of 1–2800 or 7000–9000 are assigned to team one, and carriers with numbers 2801–6999 are assigned to team two.

4) If complete information is not included, the return is put on hold until the carrier is contacted for necessary information.

5) If complete information is included, the data are entered onto an internal IFTA computer program.

6) If the carrier owes money, a bill is sent to the carrier.

7) If a refund is due, the return is processed the following Monday.

8) The designated staff person reviews and signs approval for a refund.

9) The request for refund is sent to Public Safety Finance, which sends all refunds directly to the carrier.

A process map for the Minnesota DPS Quarterly IFTA Processing activity is shown in Figure 3.3.

Minnesota IFTA Quarterly Report Processing Costs. Minnesota has outlined the following costs for the administration of IFTA quarterly filing:

Processing quarterly returns (annual costs)	$34,300
Mail costs	4,640
Printed forms	1,158
TOTAL PROCESSING COSTS (1994)	$40,098

Potential Benefits and Cost Savings for IFTA Quarterly Return Processing. Currently, mileage data are recorded manually by the driver and turned in to the carrier for reporting purposes. The data are then entered onto a manual form by the motor carrier staff, mailed in to the state agency, and re-keyed into the state processing system by the state processing personnel. With automatic mileage data collection and electronic fuel tax reporting, fuel tax returns could be processed electronically. Motor carriers or their service providers could collect electronic data from the vehicle, use these data to generate IFTA quarterly reports, and submit these reports to the base state via Electronic Data Interchange (EDI). For the Minnesota DPS, automated, electronic mileage data collection and electronic filing offers the following benefits for IFTA processing:

- **Reduced problems due to hand-written filings.** Electronically filed returns would eliminate the problem of illegibly written returns, which could result in reduced time spent by the state processing staff obtaining correct information from carriers. Minnesota reports that currently about one percent of all returns are illegible and unreadable.

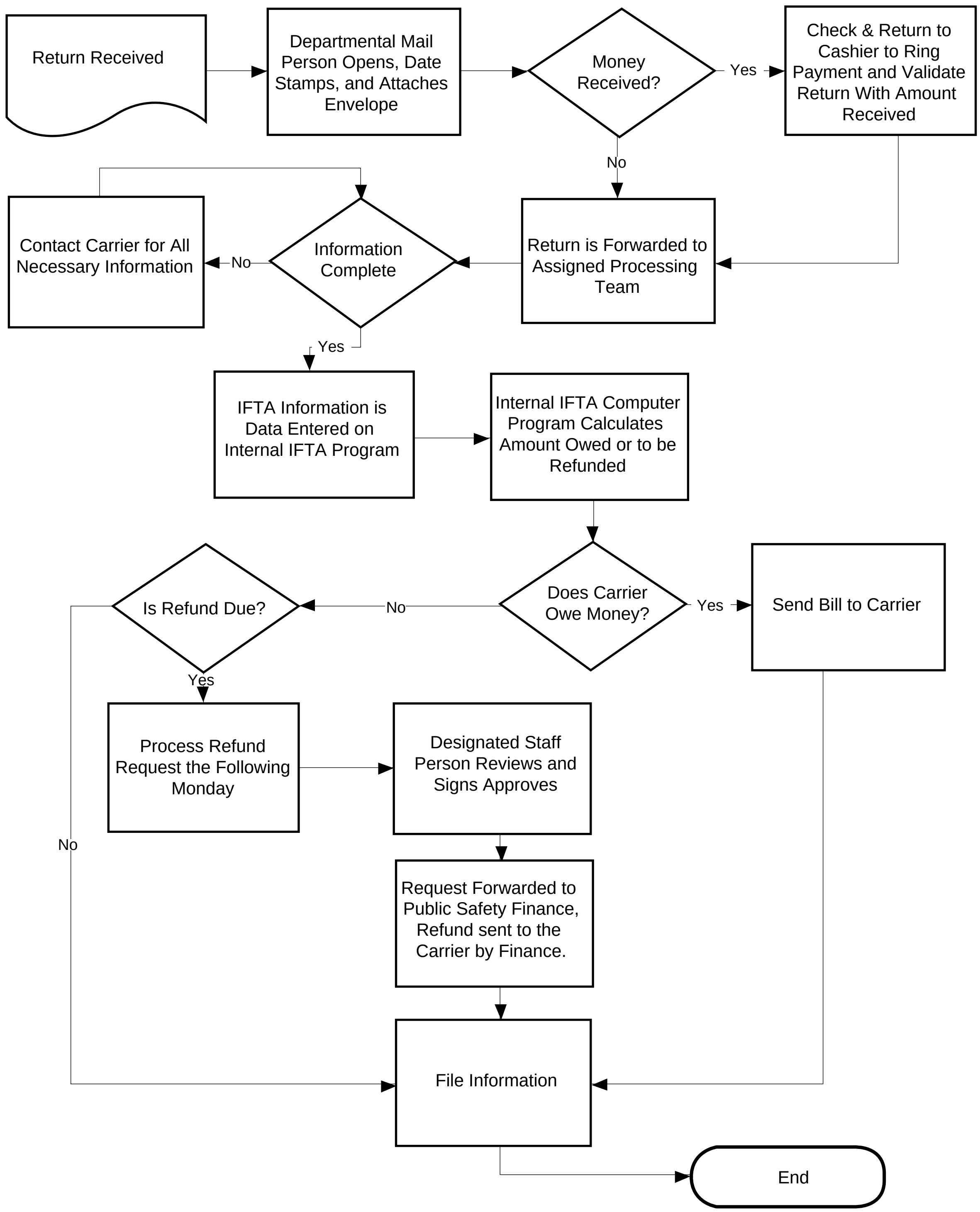

Figure 3.3 Minnesota DPS IFTA Reporting Process Map

- **Reduced base state follow-up due to IFTA filing errors.** Manual processing steps would be reduced, which would reduce the chance for data entry error and increase accuracy on quarterly fuel tax returns. Again, it would result in reduced time spent by the state processing staff obtaining correct information from carriers.
- **Reduced labor costs for data entry.** Data received electronically would not have to be re-keyed, thus reducing the workload of the processing staff.
- **Reallocation of staff where additional help is needed.** Reductions in staff time required to complete IFTA report processing will allow shifting of resources to other areas such as assisting companies reporting for the first time or to other areas of motor carrier regulatory administration.
- **Reduced labor and space/storage material costs.** Electronic data would not require as much space or as many storage containers as paper forms. In addition, data would be more easily filed and retrieved.
- **Reduced labor and material costs from quarterly return mailings.** State agencies send manual return forms to carriers, which requires addressing, stuffing, sealing, and applying postage to envelopes containing manual return forms. There is also the additional cost of printing the forms. These costs as well as the workload of both the mail department and the departmental mail person would be reduced.
- **Reduced labor and processing costs resulting from EFT.** Along with receiving returns electronically, funds due could also be received electronically. This would allow for a shorter time period between check receipt to the draw on carriers' accounts, which currently is about three days for Minnesota. It would also eliminate the processing step involving the cashier and all the subtasks involved with depositing the checks. For example, Minnesota places checks in a vault every night, balances the checks the following day, prepares a deposit ticket, and takes the checks to the cashier's unit of Public Safety. From there, the checks are picked up by the Department of Finance, taken to the bank, and then deposited the following day.

While these benefits are possible for the Minnesota Department of Public Safety if automated, electronic data collection and filing were implemented by Minnesota and its base state carriers, the impact or value of these benefits is difficult to estimate in any meaningful way. These benefits are dependent on the number of motor carriers who implement electronic data collection and filing, which is difficult to predict in a potentially emerging marketplace.

In addition, the Minnesota DPS provided detailed costs for IFTA processing of approximately $40,000 per year. Consequently, electronic data collection and filing would have to reduce processing costs by a very high percentage to result in measurable monetary savings. At the same time, however, staff levels at the Minnesota DPS have been reduced, making it difficult to maintain the desired levels of service. Thus, staff time is at a premium. As a result, the benefits to the Minnesota DPS would come in the form of staff time being reallocated to maintaining other necessary motor carrier services or enhancing IFTA and other motor carrier services as needed. In summary, electronic mileage data collection and filing can make the Minnesota

Department of Public Safety more productive and better able to accommodate current and future demands on staff.

Minnesota IFTA Auditing

To identify Minnesota's IFTA auditing processes, costs, and potential benefits of automated, electronic data collection, the evaluation team interviewed the Assistant IRP/IFTA Administrator of the Minnesota Department of Public Safety and documented the Minnesota process for IFTA quarterly report processing.

Minnesota DPS IFTA Audit Process. Following is the audit process documentation and flow chart developed for the Minnesota DPS:

1) Audit Supervisor and Auditor determine carriers to be audited.
2) Carriers selected for audits are contacted by phone to set an audit date.
3) Confirmation letter of audit date is sent and pre-audit questionnaire is included.
4) Pre-audit preparation includes downloading IFTA reports of audit period to a spreadsheet, manually searching the last three years of IRP paperwork, and manually entering the data off of the renewal IRP.
5) Audit is conducted and results are evaluated by the auditor.
6) Audit results are submitted to Audit Supervisor for review and approval.
7) Notification of the audit evaluation results are sent to the carrier.
8) Carriers have the opportunity for appeal in which an informal meeting would take place to discuss any new information provided by the carrier.

Figure 3.4 is the corresponding process map for the Minnesota DPS's IFTA/IRP auditing process.

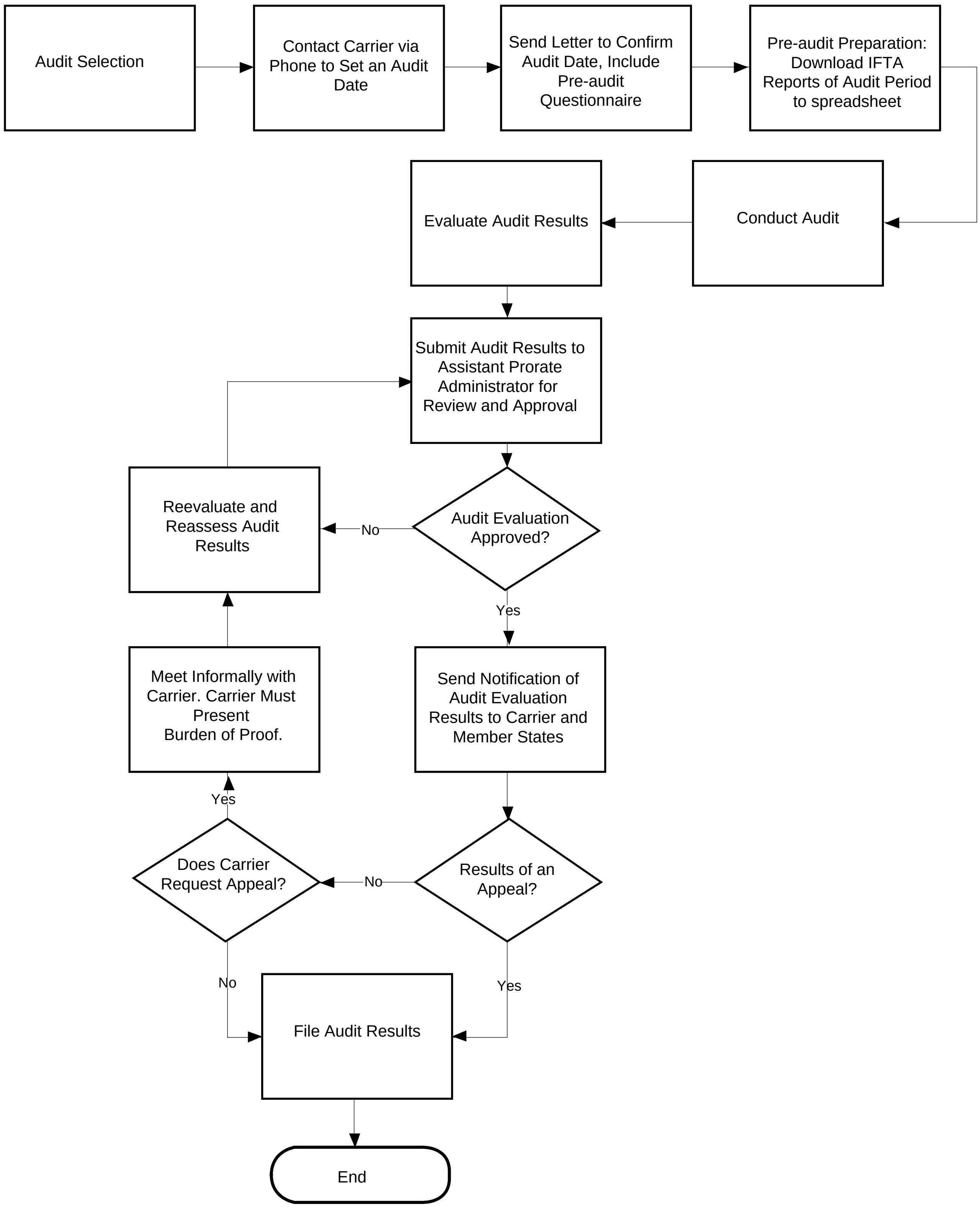

Figure 3.4 Minnesota DPS IFTA Auditing Process Map

Minnesota IFTA Auditing Costs. Minnesota has identified the following costs for fiscal 1994 IFTA/IRP auditing:

Auditing	$137,050
Travel expenses	9,600
Mileage and car cost	7,740
TOTAL AUDIT COSTS (1994)	$154,390

Potential Benefits and Cost Saving. Potential IFTA/IRP auditing benefits for the Minnesota DPS from electronic mileage data collection were identified as the following:

- **Time savings (resulting in more audits) due to improved data accessibility.** Currently, Minnesota auditors manually search through previous years of IRP data, enter current IRP data, and download IFTA information for audit preparation. During the actual audit, auditors spend a significant amount of time searching through paper documentation at the carrier's site and then entering the data into the auditing software. Electronic information would reduce these manual steps and be more easily queried to facilitate faster and easier audits. By reducing the time needed for each audit, Minnesota could audit many more carriers per year.

- **More in-house audits due to improved data portability.** Mileage and fuel purchase data requested for audits could be available electronically from the carrier instead of in paper form only. This would substantially increase the feasibility of in-house audits, which would lead to:

  - **more audits** Less time spent traveling creates more time for audits.

  - **less travel expense**

- **Better identification of auditing needs.** Because electronic data are more accessible to the auditors, electronic data would allow for a "pre-audit" of carrier data in order to pinpoint which carriers need more auditing attention. It would also help to quickly identify where potential problems exist in the motor carrier's process.

AMASCOT could provide cost savings in several areas. The cost per audit could be reduced by decreasing the number of hours the auditor spends on site and also by decreasing the total number of on-site visits. A reduction in visits would reduce the cost of traveling expense and would allow Minnesota to have fewer vehicles on reserve for audit travel. However, with annual costs of $150,000, large monetary savings are not likely even with very large impacts on staff time and travel.

Any potential cost savings are highly dependent on the number of carriers who implement this type of technology. Minnesota noted that 65 percent of carriers have between one and five vehicles, and only nine carriers have over 500 vehicles. Consequently, large impacts will not be realized until this technology reaches the small carriers.

Summary of the Minnesota DPS IFTA Processing and Audit Staff Surveys

To identify the benefits expected by processing and auditing staff and to gauge their receptivity for electronic mileage data collection and electronic filing, short questionnaires were distributed to the Minnesota DPS IFTA processing and auditing staffs. The questionnaires were designed to provide a general measure of the staffs' attitudes towards the AMASCOT project, their perceptions of the benefits of electronic mileage data collection and electronic filing and the likelihood of those benefits, and their receptivity toward implementation of electronic mileage data collection and electronic filing. Following is the summary of results from both the processing and auditing staffs.

Minnesota IFTA Processing Staff Survey. Eleven processing questionnaires were sent to the Minnesota DPS for distribution. Ten of these processing questionnaires were completed and returned. Results of the surveys indicated the following:

<u>Knowledge about AMASCOT.</u> Very few of the processing staff know about AMASCOT, have had discussions about AMASCOT, or have discussed potential benefits and changes that would result from AMASCOT implementation. However, supervisory staff in the processing function do know about and understand AMASCOT.

<u>Perceived Benefits.</u> Overall, the processing staff feel the accuracy on the IFTA quarterly returns is average to slightly above average, and, despite knowing little about AMASCOT, they expect the accuracy to increase slightly with electronic mileage data collection and electronic filing. In regard to the benefits, about half of the respondents did not feel knowledgeable enough to speculate. Of the respondents that did answer, most could see potential for less data entry, more efficient storage and retrieval of data, less time spent resolving inaccuracies, and more reliance on the computer to determine inaccuracies.

Again, about half of the participants did not respond to how they would utilize time saved given a substantial reduction in data entry workload. However, of those that did respond, some would spend time rechecking the accuracy of their own work but most would complete additional tasks of their own, help others with unfinished tasks, or assume additional permanent responsibilities.

Receptivity to Electronic Mileage Data Collection and Electronic Filing. Nine out of the ten respondents to the processing questionnaire were receptive to automatic mileage data collection and electronic filing of IFTA reports with one person not responding. Two of the receptive respondents are supervisory staff and the rest are general processing staff. This demonstrates receptivity from entry level to management.

Minnesota Auditing Staff Survey. A total of five auditing questionnaires were sent to Minnesota for distribution. Four auditing questionnaires were returned.

Knowledge about AMASCOT. Three out of the four auditors that responded know at least some of the details about AMASCOT and have had discussions about AMASCOT, usually with their supervisor and occasionally with the other auditors. Changes and benefits discussed the most were the decreased time needed for each audit and the ease of querying information. Some discussions, although to a lesser extent, involved the topics of changing auditing methods from manual to software, more in-house audits, and the pre-screening of data prior to the audit.

Perceived Benefits. The benefits perceived most likely to happen were the new method of auditing by software and the ease of querying information. Most of the auditors also believe that the electronic storage of data will make the auditing process more efficient. Only slightly less likely expected to occur were more in-house audits, pre-screening of audit data, and a decrease in the actual audit time. Overall, the auditors were very optimistic about the benefits.

Three out of four auditors believe that accuracy would be greater with the AMASCOT device and that the device would be acceptable among the auditing community. With higher data accuracy, the auditors also believe that evaluations will be improved. All of the auditors believe that the test project device is representative of a future device and find it extremely important to make it as tamper proof as possible.

If the benefits are actually realized, cost savings are projected most highly in the areas of decreased audit time, less manual data entry, and higher reporting accuracy. Very little cost savings were foreseen with decreased travel and mailings to motor carriers.

If the auditors spend less time auditing each carrier, all of the auditors believe they would utilize the time saved by conducting more audits. They would also assume additional responsibilities within their function and assist others with unfinished tasks. Half of the respondents would review their own work more thoroughly to ensure accuracy.

Receptivity to Electronic Mileage Data Collection and Electronic Filing. Overall, responding auditors were extremely receptive to the electronic fuel tax data collection and reporting device. They see high potential for more accurate reporting that results in improved audit evaluations and cost savings. Similar to Iowa, the auditors see the AMASCOT implementation resulting in the opportunity to audit more carriers.

Summary Evaluation Conclusions of the Minnesota Case Study

Clearly, the implementation of electronic mileage data collection and electronic filing for IFTA and IRP compliance will positively impact the Minnesota DPS's IFTA/IRP processing and auditing processes. Analysis of Minnesota IFTA processing and audit processes identified a number of potential benefits due to electronic data collection and electronic filing, and many of these potential benefits were also perceived as likely by IFTA processing and auditing staff.

Processing staff, for example, expected electronic mileage data collection and filing to result in reduced data entry, increased accuracy, and less interaction with motor carriers to obtain correct data. These staff members indicated that the potential time savings would be used to complete additional tasks of their own, help others with unfinished tasks, or assume additional permanent responsibilities.

Auditing staff expected electronic mileage data collection and filing to result in the new method of auditing by software and easier querying of information. They also expected accuracy of mileage data and reporting to increase, time spent auditing to decrease, and time savings due to the capability to audit mileage data using specialized software that could utilize the electronic data. Minnesota's auditors expected to utilize any time savings created to conduct more audits. They would also assume additional responsibilities within their function and assist others with unfinished tasks.

Minnesota auditing and processing supervisors agreed that the impact of electronic mileage data collection and filing on their systems is dependent on the level of implementation by Minnesota-based motor carriers and that large impacts would not be realized until implementation had filtered down to carriers of fewer than ten trucks. However, Minnesota auditing and processing supervisors also indicated that benefits accrued from implementation of electronic mileage data collection and filing by larger motor carriers (more than 50 trucks) and equipment leasing and service firms would be significant enough to be worthwhile.

Evaluation Findings for the Wisconsin Department of Transportation

This section identifies the current processes used by the Wisconsin Department of Transportation for IFTA reporting and auditing. In Wisconsin, the IFTA and IRP processing and auditing functions are administered through one office.

Wisconsin Quarterly Return Processing

To identify Wisconsin's IFTA filing processes, the evaluation team met with the Program Specialist of the Wisconsin DOT. The Program Specialist, along with giving a broad overview, also had arranged consultation/discussion with each IFTA processing staff member to get a better idea of the details involved.

Wisconsin DOT IFTA Quarterly Report Process Flow. The following process documentation and flow chart are the steps outlined for IFTA quarterly return processing, as approved by the Wisconsin Department of Transportation.

1) Incoming mail is divided among the fuel tax staff by predetermined alphabet sorts.
2) Returns are reviewed for completed information. If information is not complete, any information possible is processed and carriers are contacted to obtain necessary information.
3) When information is complete, data are entered on VISTA system.
4) If all fees are received, the deposit is completed. If all fees are not received, a billing notice is sent for the amount not received and a credit issued to the carrier's account for the amount that was received.
5) If a refund is due, it is the carrier's option for a credit to their account or a refund check.

A process map for the Wisconsin DOT Quarterly IFTA Processing activity is shown in Figure 3.5.

Wisconsin IFTA Quarterly Report Processing Costs. Wisconsin has outlined the following costs for the administration and auditing of IFTA reporting:

Processing quarterly returns (annual costs)	$ 38,000
Mail costs	5,000
TOTAL COSTS	$43,000

Potential Benefits and Cost Savings for IFTA Quarterly Return Processing. The current mileage data are collected manually by the driver and turned in to the carrier for reporting purposes. The data are then entered onto a manual form by the motor carrier staff, mailed to the state agency, and re-keyed into the state processing system by the state

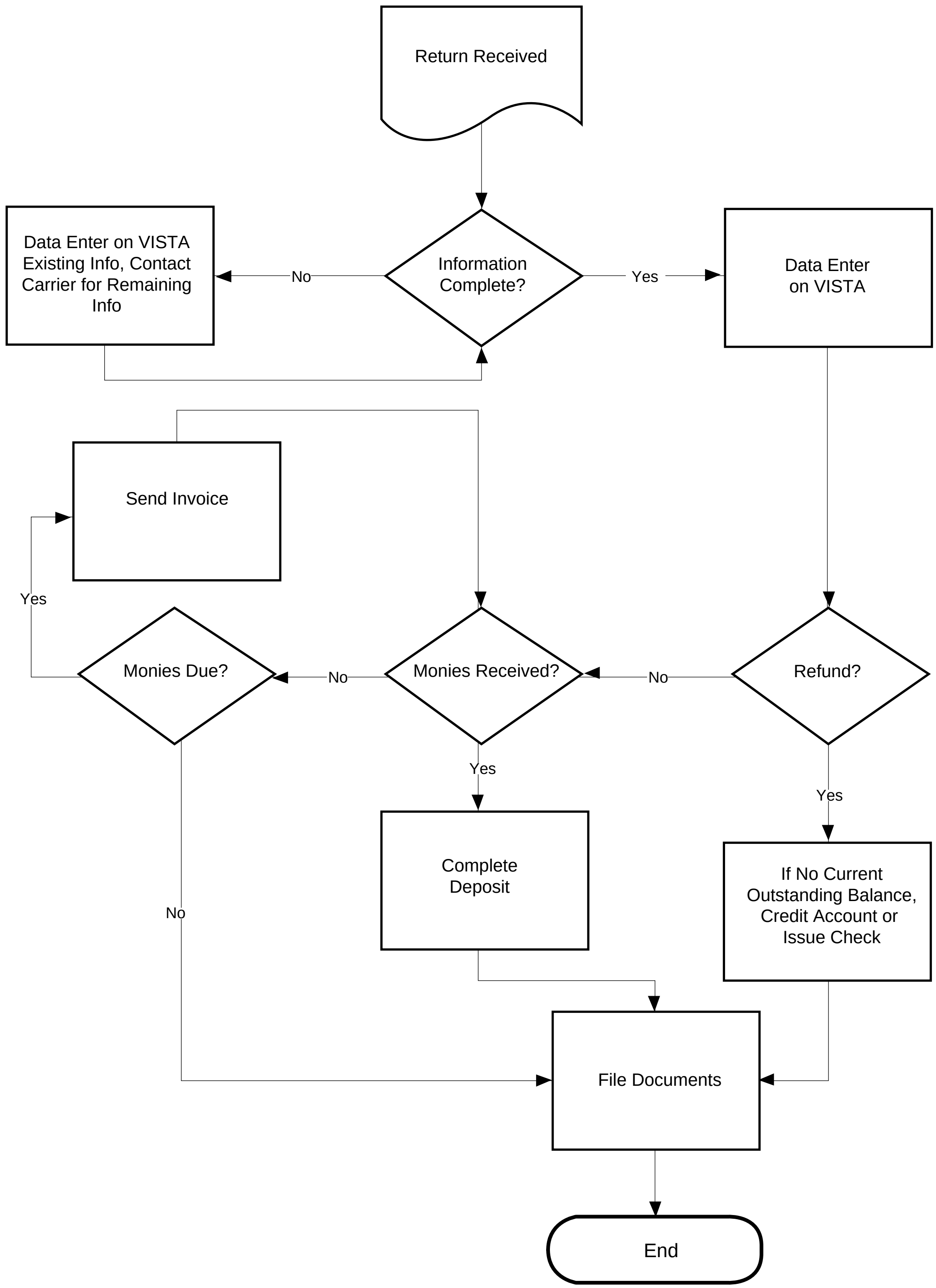

Figure 3.5 Wisconsin DOT IFTA Reporting Process Map

processing personnel. With automatic mileage data collection and electronic fuel tax reporting, fuel tax returns could be processed electronically. Motor carriers or their service providers could collect electronic data from the vehicle, use these data to generate IFTA quarterly reports, and submit these reports to the base state via Electronic Data Interchange (EDI). Automated, electronic mileage data collection and electronic filing offers the following benefits for IFTA processing for the Wisconsin DOT:

- **Reduced problems due to hand-written filings.** Electronically filed returns would eliminate the problem of illegibly written returns, which could result in reduced time spent by the state processing staff obtaining correct information from carriers.
- **Reduced base state follow-up due to IFTA filing errors.** Manual processing steps would be reduced, which would, in turn, reduce the chance for data entry error and increase accuracy on quarterly fuel tax returns. Again, it would result in reduced time spent by the state processing staff obtaining correct information from carriers.
- **Reduced labor costs for data entry.** Data received electronically would not have to be re-keyed, thus reducing the workload of the processing staff.
- **Reallocation of staff where additional help is needed.** Reductions in the staff time required to complete IFTA report processing would allow shifting of resources to other areas such as assisting companies reporting for the first time or to other areas of motor carrier regulatory administration.
- **Reduced labor and space/storage material costs.** Electronic data would not require as much space or as many storage containers as paper forms. In addition, data would be more easily filed and retrieved.
- **Reduced labor and material costs from quarterly return mailings.** State agencies send manual return forms to carriers, which requires addressing, stuffing, sealing and applying postage to envelopes containing manual return forms. There is also the additional cost of printing the forms. These costs as well as the workload of the mail department would be reduced.
- **Reduced labor and processing costs resulting from EFT.** Along with receiving returns electronically, funds due could also be received electronically. This would allow for a shorter time period between check receipt to the draw on carriers' accounts. It would also eliminate the data entry of checks received and the subsequent reconciliation of checks entered with actual checks received. Currently, Wisconsin has every processing staff member receiving and deposit-

ing checks. Checks must be stored in a safe every night, and the following day they must be compared with the breakdown report. The breakdown report tallies the checks entered on the computer the previous day. Once the actual checks balance with the breakdown report, they are sent to Finance. Ultimately, electronic transfer of funds could eliminate this middle station for receiving funds.

While these benefits are possible for the Wisconsin Department of Transportation, if automated, electronic data collection and filing were implemented by Wisconsin and its base state carriers, the impact or value of these benefits is difficult to estimate in any meaningful way. These benefits are dependent on the number of motor carriers who implement electronic data collection and filing, which is difficult to predict in a potentially emerging marketplace.

The Wisconsin DOT provided detailed costs for IFTA processing of approximately $90,000 per year based on fiscal 1994 data. Electronic data collection and filing would have to reduce processing costs by a very high percentage to result in large monetary savings. At the same time, however, staff levels in Wisconsin federal offices are being cut to a minimum, which makes it difficult to maintain the desired levels of service. Thus, staff time is at a premium. As a result, the benefits to the Wisconsin DOT would come in the form of staff time being reallocated to maintaining other necessary motor carrier services or enhancing IFTA and other motor carrier services as needed. In summary, electronic mileage data collection and filing can make the Wisconsin DOT more productive and better able to accommodate current and future demands on staff.

Wisconsin IFTA Auditing

To identify Wisconsin's IFTA auditing processes, costs, and potential benefits of automated, electronic data collection, the evaluation team also met with the Audit Supervisor of the Wisconsin Department of Transportation.

Wisconsin DOT IFTA Audit Process. Below is the auditing process flow documentation and process map developed for the Wisconsin DOT:

1) Audit selection is made.

2) Letters are sent one month prior to the month of the audit. A pre-audit questionnaire is included with this letter.

3) Audit preparation includes IFTA reports for the audit period and a report detailing miles per gallon (MPG) for the audit period.

4) Auditor calls motor carrier and schedules an audit.

5) The audit is performed in an average of 32 hours.

6) Audit results are submitted to the head of Audit Compliance for review.

7) Once approved, copies are sent to the carrier.

8) Carriers may request redetermination within 30 days. If redetermination is requested, the account on VISTA is flagged so that refunds/taxes are held until the audit is resolved.

9) When the audit is resolved, the results are entered on the audit database. A record is also kept of total hours spent per audit.

Figure 3.6 is the corresponding process map for the Wisconsin DOT's IFTA/IRP auditing process.

Wisconsin DOT IFTA Auditing Costs. The Wisconsin DOT has identified the following costs for IFTA/IRP auditing during fiscal year 1994:

Auditing	$115,392
Travel expenses	8,255
Mileage and car costs	6,085
TOTAL AUDITING COSTS (1994)	$129,732

Notes: 1) The processing staff does the preparation work for the audits and the closing of the audits.

2) Mileage expense is paid for audit travel vehicles.

Potential Benefits and Cost Savings. Potential IFTA/IRP auditing benefits for the Wisconsin DOT from electronic mileage data collection were identified as the following:

- **Time savings (resulting in more audits) due to improved data accessibility.** During the actual audit, auditors spend a significant amount of time searching through paper documentation at the carrier's site and then entering the data into the auditing software. Electronic information would reduce these manual steps and be more easily queried to facilitate faster and easier audits. By reducing the time needed for each audit, Wisconsin could audit many more carriers per year.
- **More in-house audits due to improved data portability.** Mileage and fuel purchase data requested for audits could be available electronically from the

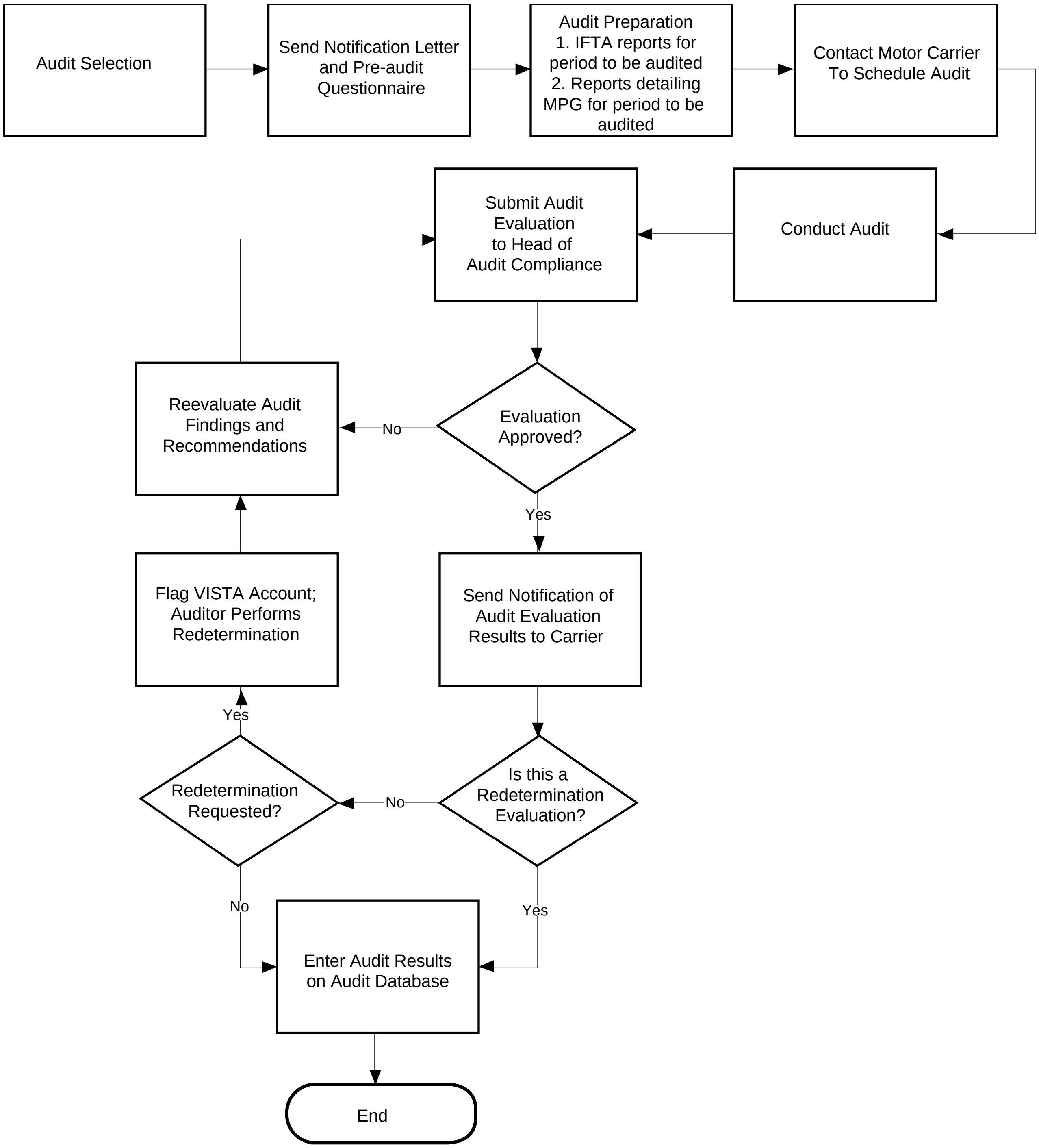

Figure 3.6 Wisconsin DOT IFTA Auditing Process Map

carrier instead of paper form only. This would substantially increase the feasibility of in-house audits, which would lead to :

- **more audits** Less time spent traveling creates more time for audits.

- **less travel expense**

- **Better identification of auditing needs.** Because electronic data are more accessible to the auditors, electronic data would allow for a “pre-audit” of carrier data. Audits of these limited electronic data samples could be combined with phone interviews and other information to assess whether a motor carrier needs more auditing attention. The electronic data could also quickly indicate potential problem areas that exist in the motor carrier’s process.

AMASCOT could provide cost savings in several areas. The cost per audit could be reduced by decreasing the number of hours the auditor spends on site and also by decreasing the total number of on-site visits. A reduction in visits would reduce the cost of traveling expense and mileage expense. However, with annual auditing costs of $130,000, large monetary savings are not likely even with very large impacts on staff time and travel. Any potential cost savings are highly dependent on the number of carriers who implement this type of technology.

Summary of the Wisconsin DOT IFTA Processing Staff and Audit Staff Surveys

Short questionnaires were distributed to the Wisconsin DOT IFTA processing and auditing staffs to identify the benefits expected by processing and auditing staff and to gauge their receptivity for electronic mileage data collection and electronic filing. The questionnaires were designed to provide a general measure of the staffs’ knowledge and attitudes towards the AMASCOT project, perception of real benefits and the likelihood of those benefits, and receptivity toward automatic mileage data collection and electronic fuel tax reporting. Following is a summary of the results from both the processing and auditing staffs:

Wisconsin IFTA Processing Survey. Eight processing questionnaires were sent to Wisconsin for distribution. Two processing questionnaires were not returned due to the choice of those individuals not to participate in the survey.

<u>Knowledge about AMASCOT.</u> Very few processing staff know about AMASCOT, have had discussions about AMASCOT, or have discussed potential benefits and changes that would result from AMASCOT implementation.

<u>Perceived Benefits.</u> Responses to inquiries regarding the accuracy of current IFTA returns and the accuracy possible with electronic mileage data collection and filing indicated that Wisconsin’s processing staff feel that the accuracy on the IFTA returns is average and

they expect the accuracy to stay the same with electronic mileage data collection and electronic filing. However, they did foresee less data entry and more efficient storage and retrieval of information.

If the data entry workload were substantially reduced, some time would be spent rechecking the accuracy of their own work, but most individuals would complete additional tasks of their own, help others with unfinished tasks, or assume additional permanent responsibilities.

Receptivity to Electronic Mileage Data Collection and Electronic Filing. Only three out of the six processing participants were receptive towards automatic mileage data collection for IFTA reporting and electronic filing of IFTA reports. Of the three receptive respondents, two are in supervisory positions, which shows some resistance of the general processing staff towards implementation. It is important to note, however, that similar to auditing, recent and severe budget cutbacks may be responsible for much of this apprehension.

Wisconsin Auditing Staff Survey. A total of five auditing questionnaires were sent to Wisconsin for distribution. Two auditing questionnaires were not returned due to the choice of those individuals not to participate in the survey.

Knowledge about AMASCOT. Every auditor that responded knows at least some details about AMASCOT and has had discussions about AMASCOT with the audit supervisor. Changes and benefits discussed the most were the ease of querying information, the changeover from manual auditing to auditing with software, and in-house audits. Discussed to a lesser extent were the decreased time required per audit and the pre-screening of data prior to the audit.

Perceived Benefits. The benefits perceived most likely to happen were the changeover from manual auditing to auditing by software, and the pre-screening of data prior to each audit. Some benefit was foreseen for conducting more in-house audits and easier querying of information, but none of the auditors was optimistic about decreasing the time required to perform each audit. Only one out of three auditors believed that data accessibility would improve, but two out of three responded that auditing efficiency would increase with electronic storage of data. Wisconsin auditors seem to perceive few benefits with implementation of AMASCOT.

Two out of three auditors believe that accuracy would be greater with the AMASCOT device, that the device would be acceptable among the auditing community, and that the test device is representative of a future device. All of the auditors agree that a tamper proof device is important for acceptance within the auditing community.

If the benefits are actually realized, cost savings are projected most highly in the areas of decreased audit times, less manual data entry, and higher reporting accuracy. Some cost savings were projected to occur with decreased travel to carriers, but very little cost savings was foreseen with decreased mailings to motor carriers.

If the auditors spend less time auditing each carrier, all of the auditors believe it is likely that they would utilize the time saved by conducting more audits, assuming additional responsibilities, assisting other with tasks, and reviewing data for accuracy. The auditors believed it very unlikely that no change would take place.

<u>Receptivity to Electronic Mileage Data Collection and Electronic Filing.</u> Of the three auditors, two are receptive and one is indifferent to the implementation of automatic mileage data collection and electronic fuel tax reporting. Overall, the auditors believe that it will increase reporting accuracy and may ultimately lead to a cost savings, but they are not overly optimistic about the likelihood of possible benefits. During the evaluation team's visit to Wisconsin, the supervisor noted that the auditors may be resistant to electronic data because unlike handwritten information, you cannot see it or touch it.

Summary Evaluation Conclusions of the Wisconsin Case Study

Clearly, the implementation of electronic mileage data collection and electronic filing for IFTA and IRP compliance will positively impact the Wisconsin DOT's IFTA/IRP processing and auditing processes. Analysis of Wisconsin IFTA processing and audit processes identified a number of potential benefits due to electronic mileage data collection and electronic filing, and many of these potential benefits were also perceived as likely by IFTA processing and auditing staff.

Processing staff, for example, expected electronic mileage data collection and filing to result in reduced data entry and more efficient storage and retrieval of information. Staff members indicated that the potential time savings would be used to complete additional tasks of their own, help others with unfinished tasks, or assume additional permanent responsibilities.

Auditing staff expected electronic mileage data collection and filing to result in increased accuracy of mileage data and reporting, increased auditing efficiency due to electronic storage of data, and time savings due to the capability to audit mileage data using specialized software that could utilize the electronic data. Wisconsin's auditors expected to utilize any time savings created to conduct more audits, assume additional responsibilities, assist others with tasks, and review data for accuracy.

Wisconsin auditing and processing supervisors agreed that the impact of electronic mileage data collection and filing on their systems is dependent on the level of implementation by Wisconsin-based motor carriers and that large impacts would not be realized until implementation had filtered down to carriers of less than ten trucks. However, Wisconsin auditing and processing supervisors also indicated that benefits accrued from the implementation of electronic mileage data collection and filing by larger motor carriers (more than 50 trucks) and equipment leasing and service firms would be significant enough to be worthwhile.

Cumulative Summary of State Case Studies

Overall, Minnesota was most enthusiastic about electronic mileage data collection and filing. Although most of the processing staff knew little about the AMASCOT project, they could perceive a great deal of benefit resulting from implementation. Auditors had great opportunity to discuss the AMASCOT project with their supervisors and colleagues and were equally as optimistic about the benefits. Both the processing and auditing staffs demonstrated high receptivity from entry level to management level.

Information gathered from Wisconsin was less clear cut. Wisconsin auditors could see the potential benefits, probably because they had opportunity to discuss the benefits with their supervisor. However, they were not overly optimistic about the likelihood of those benefits. Wisconsin processing, non-supervisory staff generally were resistant to electronic mileage data collection and filing. However, the attitudes here may be heavily influenced by the fact that Wisconsin has had severe budget cutbacks and job incumbents feel job security is low. Therefore, they may feel that any automation may worsen their job security even more.

Lastly, Iowa processing and auditing staff indicated both receptivity and optimism about the implementation of electronic mileage data collection and filing. Over half of Iowa’s processing staff were highly receptive to electronic mileage data collection and EDI, despite knowing little about the AMASCOT project. They perceive numerous benefits with implementation of electronic mileage data collection and EDI and see great likelihood of realizing the benefits. Iowa auditors also perceive benefits but are cautiously optimistic about realizing the benefits. Like the processing staff, Iowa’s auditors also indicated a high receptivity to electronic mileage data collection and filing.

STATE LEGAL, INSTITUTIONAL, AND CONTRACTING ISSUES

The evaluation objectives included identification of legal and institutional issues encountered during the project or likely to be faced if states want to implement automated electronic mileage data collection and filing. No legal issues were uncovered during the test or the evaluation, and contracting issues were limited solely to the contract with the technology provider. A number of institutional issues were uncovered as well. Contracting and institutional issues are discussed in the following sections.

Analysis of the three participating states' processes and staff perceptions uncovered several institutional issues. These issues are not unique to the study states, and some or all are likely to exist in every state. These issues include the following:

- Lack of EDI standards for transmitting IFTA and IRP reporting data from motor carriers or their agents to states. Currently, there is no standard for submitting electronic data to states for IFTA and IRP reporting. None of the states involved in the project was routinely accepting data from motor carriers in an electronic format. Without such a standard, states, motor carriers, and technology providers are reluctant to move forward with EDI at the risk of having their efforts discarded when standards are developed.

- Lack of electronic method of payment to facilitate electronic filing of IFTA and IRP data. IFTA and IRP require that payment accompany the filing document. As a result, electronic data transfer of IFTA and IRP reporting data would require some means to enable payment at the time the data are accepted by a state. None of the states in the test currently has in place any methods for electronic funds transfer, credit card payment, or other means which would allow motor carriers or their agents to provide means of payment with their electronic submissions.

- Lack of facility to accept electronic data. While all the states involved in the project were interested in EDI for IFTA and IRP filing, none of them has facilities in place to accept electronic data from outside sources. Until states implement some means of easily receiving and integrating electronic data from outside sources into their data processing systems, EDI for IFTA and IRP cannot be executed.

- Staff resistance to electronic data transfer. One human concern states may encounter when automating portions of the IFTA and IRP filing process is staff resistance, most likely due to concerns over job security. Such issues are not new, but states should take care to be aware of these concerns and address them as necessary to ensure new business processes are accepted and able to meet their full potential.

Fortunately, these issues have very real and achievable solutions, many of which are already being put in place through other efforts. In the case of EDI standards, states are working through the IFTA and IRP organizations to develop the data standards necessary for EDI between states and between motor carriers or their agents and states. In addition, the states participating in AMASCOT as well as others are currently involved in other operational tests (i.e.. electronic one-stop credentialing projects) that are also working to address the issues of EDI between states and motor carriers as well as electronic payment and development of the infrastructure facilities and processes to support EDI.

CONCLUDING REMARKS

States can benefit from automated electronic mileage data collection and electronic filing for IFTA and IRP compliance through reduced staff inputs for data entry, ensuring the integrity of the data received, reduced data storage requirements, and increased data accessibility and portability. The extent of these benefits will vary by state but will mainly be influenced by the rate of implementation of such systems by motor carriers.

States face a number of institutional issues in implementing automated electronic mileage data collection and electronic filing for IFTA and IRP; however, these issues have achievable solutions and are being addressed through other efforts as well. The most significant turning point will be when the IFTA and IRP communities acknowledge acceptance of these technologies for IFTA and IRP compliance. Such acceptance will allow implementation of these technologies by states and motor carriers that perceive an appropriate level of benefit. The base state philosophy of the IFTA and IRP agreements further serves to encourage pioneering of these technologies and their benefits to the states and motor carriers by leaving adoption of such technologies to the discretion of the base state.

AMASCOT:

Automated Mileage and Stateline Crossing Operational Test

Final Report

Part 4 of 4: Motor Carrier Acceptance and Benefits Evaluation

Prepared by
Western Highway Institute
1200 Bayhill Drive
San Bruno, CA 94066

May 1, 1996

Principal Investigator
Bill M. McCall

Principal Contributor
Michael L. Hancock

Center for Transportation Research and Education
Iowa State University

Wisconsin Department of Transportation

CTRE
Center for Transportation Research and Education

Iowa Department of Transportation

IOWA STATE UNIVERSITY

U.S. Department of Transportation

DEPARTMENT OF PUBLIC SAFETY
STATE OF MINNESOTA

CONTENTS

LIST OF FIGURES

EXECUTIVE SUMMARY

As a primary goal, the Automated Mileage and Stateline Crossing Operational Test (AMASCOT) was to demonstrate and evaluate one specific technology concept designed to automate both the collection of mileage data and the filing of the reports required for motor carrier registration and fuel tax apportionment. The data collection equipment developed by Rockwell International Corporation (Rockwell) for the AMASCOT test was targeted for installation in 30 trucks. For testing purposes, a commitment to involve five long-haul interstate trucks was to be sought from each of six motor carriers.

Western Highway Institute (WHI), a division of the ATA Foundation, was designated as the lead project partner for motor carrier involvement and led a targeted recruiting effort working with and through the three project partner state trucking associations (STAs); i.e., Iowa, Minnesota, and Wisconsin. Conceptually, two carriers were sought that were based in Iowa, two based in Minnesota, and two based in Wisconsin, with the overall objective of obtaining the broadest possible range of trucking service orientation. Supplementing the industry-representation recruiting guidelines was a Rockwell-developed list of the considerations relative to the installation and use of the special project equipment. Chief among the Rockwell requirements was the absence of existing satellite communications equipment so as to avoid any potential interference with a carrier's normal operations.

Recruiting interviews with selected motor carrier candidates were conducted by a project team made up of representatives from the Center for Transportation Research and Education (CTRE), Rockwell, and WHI. Every carrier interviewed expressed a high level of interest in potential participation and was able to cite specific operations within their respective fleet which would fit well with the test planned. On team review, it was determined, however, that the fuel-use reporting concept of the LTL (less-than-truckload) candidate interviewed would not be positively impacted by the utilization of the Rockwell device. As a result, LTL operations were not utilized in the test to carry the recording device. The carrier selections as confirmed for participation consisted of the following types of service by base state:

Carrier Type	Iowa	Minnesota	Wisconsin	Total
For-hire, truckload	-	-	2	2
For-hire, tanker	1	1	-	2
Private fleet	-	1	-	1
Leased fleet	1	-	-	1
Total	2	2	2	6

Data collected by the recording devices on board the "test" trucks were downloaded via satellite directly to Rockwell and then transferred electronically to CTRE for processing. CTRE served as the host for the database in which the fuel purchase data for each truck, as provided by the carriers, were matched with the mileage records.

On a monthly basis the travel and fuel data by truck were extracted and distributed for review by both carrier and auditor. CTRE also aggregated each carrier's data monthly to produce proxy "test-fleet" IFTA reports. These reports were subsequently used to demonstrate the electronic report transfer capability set up with the several states.

Aside from helping to keep properly functioning recorders in the trucks and furnishing the required fuel data to CTRE, the participating motor carriers had very little involvement with the actual day-to-day conduct of the test. Even so, the AMASCOT evaluation visualized was <u>not</u> that of the test, but rather of the concepts being tested. As a result, the Motor Carrier's Evaluation required the definition of a "concept" system to serve as a uniform basis for assessment reference.

The "concept" model as defined called for the travel data gathered to be stored on the truck with download as required either directly to the headquarters computer or, alternatively, to some highly reliable data transfer device. The carrier would be able to preprocess the travel data as required to satisfy standard audit stipulations, to transform the data for use with an appropriately upgraded version of their existing software, to handle all subsequent processing necessary to produce and file the IRP and IFTA returns, and to retain the electronic travel data as the basis for future audit.

In preparation for the post-test evaluation interviews, the carriers were asked to participate in two pre-interview tasks. The first asked that an estimate of the costs associated with the current fuel-use reporting process be developed using the guidelines furnished. The cost-development worksheet provided was ultimately to become the basis for determining the extent to which the automated system might serve to reduce data gathering and reporting costs. The other assignment dealt with the acceptance of the travel data produced and involved cross-checking some of the project-generated data with that recorded on corresponding driver trip reports.

The actual field interviews were conducted beginning Monday, August 14, 1995, in Marshfield, Wisconsin, and finishing in Des Moines, Iowa, on the following Friday. In general, the conduct of the interviews worked out generally as anticipated. However, only two of the six carriers were found to have fully completed both the preparation of the cost worksheet and the review of the CTRE travel documents. This left four interviews incomplete and dependent upon the carrier promises to finish the remaining analytical work and respond to the related interview questions. Three of the four fulfilled their commitment completely and the fourth partially.

The evaluation interviews with each carrier sought information concerning:

- motor carrier processes for assessing new technology
- assessment of the operational test products and procedures
- applicability of the “concept” model to their company
- benefit/cost implications of the “concept” model

Key Motor Carrier Evaluation Findings

- Relative to the assessment of new technology, among the four for-hire carriers no formal process or procedures for technology evaluation were cited. While the largest of the organizations indicated the probability of some kind of cost-benefit assessment, the other three indicated they were more likely to rely principally on the reported experiences of others. The participating private fleet and the leasing company do dedicate resources to tracking and evaluating potential new technology applications, though it should be noted that both are somewhat atypical operations.
- Accuracy and reliability were the key attributes that would be sought in evaluating AMASCOT-type recorders, but rapid, convenient repairability was also among the more frequently mentioned expectations.
- Only four of the six carriers indicated that they did in fact examine the travel data reports produced. Three of these four reported finding excellent mileage data correlation (ratings of 4.5, 5, and 5 on a 1–5 scale, with 1 equal unacceptable).
- Concerning the IFTA-style reports produced, the only correlation problems reported seemingly had to do with differing cut-off dates. Because of this difference between the project’s periods and actual practice, the ratings assigned varied considerably, ranging from a low of 2 to a high of 5.
- The carriers’ assessment of the applicability of the “concept” model reflected the views of all six carriers and ran the whole rating gamut though seemingly falling into one of two distinct groups. Ratings of 3, 2, and 1 (1 being “no value”) came from the three largest companies, while the 3, 4, 5 group was made up of the smaller participants. Even so, elements of both groups expressed reservations concerning the possibility of not being able to constrain the availability of the AMASCOT time and place detail to the intended context of tax reporting.

- Relative to electronic data interchange (EDI), only two of the six carriers utilize the capability routinely. For them, the concept of incorporating electronic report filing and fund transfer was rated at 3; i.e., “nothing special,” The other four split equally between ratings of 3, “nothing special.” and 4, “looks O.K.”
- None of the six carriers reacted negatively to the concept of submitting to electronic audit as suggested in the “concept” model. However, considerable concern was expressed about how this might actually be accomplished. A distinct preference was stated for uploading the files requested rather than attempting to “limit access” within their corporate computer files.

Responses to the benefit/cost portion of the interviews were offered by only five of the six carriers, although all six made a stab at estimating current processing costs. As a guideline for assessment, the cost of equipping fleet trucks without existing satellite communication hardware was suggested at $900–1,200 per unit including a non-satellite download capability/device.

- For one carrier, processing costs given were stated on the per-unit basis as would be charged by a third party processing service and, therefore, were not amenable to partitioning for cost savings review. Of the others, four completed the driver’s cost portion of the estimating worksheet, although none ultimately considered it relevant. Potential savings in current processing costs therefore became the basis for the benefit/cost assessments.
- Most of the carriers agreed that the “concept” system had some potential to reduce the costs of collecting and processing their mileage data. These savings were seen as associated with reduced data entry and with the reconciliation process necessitated by driver omissions and recording errors and/or data entry errors. Even so, the necessity for integrating separately created fuel-data files and cost accounting identifiers limits the extent of the savings potential.
- Of the five respondents rating the “concept” model, three ratings were negative (ratings of 1 or 2), one was noncommittal (at 3), and one indicated “give-it-a-try” (a 4 rating). While the leasing company, the 4 rater, agreed that the “concept” model might be considered, it also acknowledged that the “stand-alone” system would never fully satisfy the corporate objectives for technology integration.

Conclusion: Participating motor carriers indicated that automated mileage data collection has the potential to reduce the costs of collecting and processing the mileage component of their fuel tax reporting data. These carriers also indicated, however, that an automated mileage data collection system like that used in AMASCOT would be considered for implementation only if it is accompanied by additional functionality and corresponding benefits.

Finally, the five responding carriers were given the option of considering an AMASCOT-type system enhanced by the integration of those attributes they had previously expressed as being desirable. The ratings given on this basis are seen as being consistent with the first interview observation reported relative to technology assessment. The ratings of the three for-hire carriers responding were either negative or noncommittal (ratings of 3 or less). This echoes the prevalent for-hire “wait-and-see” attitude previously recorded with respect to new technology. The private carrier and the leasing company, on the other hand, both gave their “enhanced systems” a positive endorsement (ratings of 4 and 5 respectively). This suggests consistency with the more pro-active stance these two indicated with respect to investigating new technology applications.

Conclusion: An AMASCOT-type system shows promise of initial acceptance principally by larger companies which have the resources and desire to experiment with new technology, but even then AMASCOT will likely have to be integrated with other applications which are responsive to more than just meeting taxation-induced reporting requirements.

WHI Concluding Observations

It should be noted that for-hire LTL operations, estimated to make up some 10 percent of the national heavy vehicle fleet, were excluded from participation in AMASCOT due to an administrative pre-judgment that there would be no positive impact on current business practices. The evaluation subsequently revealed, however, that any significant acceptance of AMASCOT technology will be tied to integration with some broader fleet management application. As a result, though the AMASCOT taxation reporting capabilities may not be significant for LTL, the fact remains that the broader potential for application in LTL was not examined.

As a concluding observation, all of the participating carriers acknowledged that the AMASCOT technology held the potential for effecting some time savings in their fuel-use reporting procedures. But moving to the point of “conceptually” quantifying and equipping to realize those savings proved too big a hurdle for most to visualize. Therefore, the conclusion concerning initial acceptance principally by larger companies should not be viewed as a deterrent to the process of seeking IFTA and IRP acceptance of AMASCOT-type technology. Once governmental acceptance is assured, the more technologically advanced carriers with clearly established cost savings potential will pioneer development of the prototype-type procedures necessary to define the “rules of participation” and to ultimately demonstrate the economic viability of the resulting system.

INTEGRATION OF POTENTIAL USERS INTO AMASCOT

Project Description

Interstate commercial vehicle operators pay fuel taxes and registration fees to each state in which they travel. These taxes and fees are generally calculated on an aggregated basis and are typically based on the proportion of miles traveled in each state. This means, of course, that an interstate carrier must be able to collect and document mileage and vehicle information for each trip made in every state. Although not yet universal, carriers can now handle most of their reporting and payment requirements through a single state referred to as their base state. This capability results from the widespread membership of the states in two revenue collection and sharing compacts, the International Registration Plan (IRP) and the International Fuel Tax Agreement (IFTA). In fact, all states are now under a federal mandate to join both the IRP and the IFTA or similar agreements by October 1, 1996. These two agreements have established uniform standards and procedures for use by the motor carriers to file their travel data and fuel-purchase reports and for the states in calculating, collecting, and distributing the tax and fee revenues to each other. In addition to serving as a processing clearinghouse, the base state is also responsible for auditing the motor carriers within its jurisdiction to ensure that all mileage and fuel-purchase data are collected and reported as required.

For motor carriers, the predominant current method of collecting mileage and stateline crossing data relies on the drivers to manually record the appropriate data on some type of trip sheet. Although IFTA and IRP each provide for automated data collection in their procedure manuals, automated stateline and mileage data collection has not been widely attempted. As a primary goal, the Automated Mileage and Stateline Crossing Operational Test (AMASCOT) was to demonstrate and evaluate one specific technology concept designed to automate both the collection of the required mileage data and the filing of the reports required for motor carrier registration and fuel tax apportionment.

The participating volunteer motor carriers utilized special project-provided equipment in their trucks to test the automated recording of the vehicle mileage associated with each state line as the units traveled among states in the normal course of business. For this test the drivers continued their normal manual mileage recording procedures to create the official travel records. The test-generated data were used only to prove the process. Fuel purchase data for each truck, as provided by the carriers, were matched with the mileage records downloaded from the trucks (via satellite) so as to jointly populate a project-created database. The Center for Transportation Research and Education (CTRE) served as the repository for the database, extracted the travel and fuel data by truck on a monthly basis for review by both carrier and state auditor, aggregated each carrier’s data monthly to produce proxy “test-fleet” IFTA reports, and followed through to demonstrate the electronic report transfer capability developed.

Motor Carrier Recruitment

The data collection equipment developed by Rockwell International for the AMASCOT test was targeted for installation in 30 trucks. For testing purposes, a commitment to involve five long-haul interstate trucks was to be sought from each of six motor carriers. Conceptually, two base-stated carriers were to be sought from each of the three participating states: Iowa, Minnesota, and Wisconsin. The carriers sought were to encompass the broadest possible range of service orientation; i.e., private versus for-hire, special commodity versus general freight, and small versus large operational size.

Additionally, a listing of considerations relative to the installation and use of the special project equipment was provided by Rockwell. Chief among the Rockwell requirements was the absence of existing communications equipment. This was necessary to preclude any test equipment interference with the carrier’s normal operations.

Western Highway Institute (WHI), a division of the ATA Foundation, was designated as the lead project partner for motor carrier involvement and led a targeted recruiting effort working with and through the three project partner state trucking associations (STAs). Each STA was appraised of the recruiting criteria and asked to identify four potentially willing motor carrier candidates.

To help ensure motor carrier representation from the private carrier ranks, the National Private Truck Council (NPTC) was also invited to suggest one or more candidates. The STA- and NPTC-developed lists of recommended carriers, including a brief description of the specific operational characteristics of each, were forwarded to WHI for compilation and re-dissemination. This facilitated a process which enabled all motor carrier project partners to reach agreement on the candidate list ultimately submitted for Steering Committee/Team Partner review and concurrence. The list, as submitted, included both primary and alternate designations since carrier participation agreements at this stage were still predicated on a yet-to-come full presentation of the commitments required.

Level of Motor Carrier Commitment Needed

Recruiting interviews were scheduled and conducted by a project team made up of representatives from ITC, Rockwell, and WHI. The interviews conducted with the candidate carriers served several purposes. However, one of the more important was to ensure that any agreement to participate was based on a well grounded understanding of the commitments required. In fact, these commitments were presented in both verbal and printed form.

Appendix A includes a reproduction of one of the hand-out materials used to help define the project and to establish the participation requirements. A second discussion topic and hand-out expanded on the evaluation participation requirement by presenting both the overall evaluation concept and, more to the point, the purposes and activities associated with the Motor Carrier Acceptance, Benefits, and Costs Evaluation. After describing the participation expectation and responding to all questions raised, the only response sought at the conclusion of the interview/presentation was an expression of continued corporate interest to become involved.

Participating Motor Carriers

Every carrier interviewed expressed a high level of interest in potential participation and was able to cite specific operations within their respective fleet which would fit well with the test planned. On team review, it was determined that the regular route scheduling and the "schedules by agreed miles" fuel-use reporting concept of the less-than-truckload (LTL) candidate interviewed would not be positively impacted by the utilization of the Rockwell device. As a result, the decision was made that LTL operations would not be utilized in the test to carry the recording device. It was agreed, however, that the LTL process would be mapped.

The notice of carrier selection was issued only after best overall carrier match with the project objectives had been established and individual willingness to participate once again affirmed. The carrier selection recommendations of the recruiting interview team, as confirmed by the AMASCOT Steering Committee, consisted of the following types of carriers by base state:

Carrier Type	**Iowa**	**Minnesota**	**Wisconsin**	**Total**
For-hire, truckload	-	-	2	2
For-hire, tanker	1	1	-	2
Private fleet	-	1	-	1
Leased fleet	1	-	-	1
Total	2	2	2	6

Following is a description of each carrier selected to have trucks carry the AMASCOT equipment and to participate in the motor carriers' evaluation. The listing is ordered by carrier type and parallels that of the matrix above.

Roehl Transport Inc. is a large for-hire truckload carrier based in Marshfield, Wisconsin. Roehl operates approximately 900 units in flat and van transportation, with approximately 450 of those units operating interstate in the contiguous 48 states. Roehl uses computer-aided functions extensively in its operations and is equipping units with in-vehicle tracking and communications systems.

Skinner Transfer is a smaller for-hire truckload carrier operating 135 units out of Reedsburg, Wisconsin. Skinner provides both flat-bed and van transportation in the contiguous 48 states with substantial mileage east of the Mississippi River. Skinner uses computer-aided functions in its administrative operations but has no current plans for installing on-board tracking and/or communications systems.

Johnsrud Transport, Inc. is a medium-sized for-hire special commodities carrier typically operating 80 to 90 food-grade tank truck units. Johnsrud is based in Des Moines, Iowa, and operates in the contiguous 48 states although service to/from the extreme northeast U.S. is not currently heavy. Johnsrud utilizes computers in most functional areas but is not equipped with in-vehicle tracking or communications equipment and has no immediate plans for moving in that direction.

Caledonia Haulers, Inc. is a small for-hire special commodities carrier based in Caledonia, Minnesota. Caledonia operates 40 food-grade tank units throughout the U.S. but with heavy emphasis on service in the Midwest. Caledonia's operations utilize computerized dispatch and maintenance functions but had no in-vehicle communications in place during the course of this operational test.

CENEX, Inc., based in St. Paul, Minnesota, is a large private carrier operating 240 tractors and 1,000 trailers in delivery of various agricultural services including the transport of hazardous materials. CENEX operates from the Midwest south to Texas, west to Washington, and north into Canada. Computer-aided functions are utilized throughout the company, with portable cellular radios the current means of in-vehicle communications.

Ruan Transport Corporation, with headquarters in Des Moines, Iowa, operates 6,000 tractors and 4,000 trailers in numerous fleets serving the contiguous 48 states through a network of 174 terminals. The particular Ruan fleet participating in the test operates out of a terminal in Milford, Iowa, and provides primarily a truckload service with some LTL (less-than-truckload) operations. Ruan utilizes computer-aided functions as well as in-vehicle tracking and communications systems extensively in its operations.

Hyman Freightways, Inc. is a regional LTL common carrier with their headquarters terminal located in Roseville, Minnesota. Hyman was the candidate carrier interviewed as a representative of the LTL transportation sector. Hyman trucks were not equipped with the Rockwell recording device due to a pre-judgment concerning probable irrelevance.

While the company had no actual evaluation involvement, its mileage recording and reporting procedures were analyzed and documented by CTRE as a contribution to the broader project emphasis which also recorded existing fuel-use reporting practices. Hyman operates 430 tractors, 725 semi-trailers, 1,016 doubles trailers, and 12 straight trucks in 17 states spanning Colorado to Ohio and Canada to Texas. The company incorporates computer-aided functions but does not utilize in-vehicle tracking or communications.

Evaluation Frame of Reference

Data collected by the recording devices on board the test trucks were downloaded via satellite directly to Rockwell and then transferred electronically to CTRE for processing. CTRE performed the Rand McNally-developed preprocessing procedures to turn the latitude-longitude coordinates into recognizable place names, developed and maintained a database to accommodate the mileage data, and gathered the related fuel purchase data from the carriers on a monthly basis. In addition, for each of the three months of the official operational test, CTRE extracted, printed, and mailed to each carrier (and their respective state auditor) a copy of the travel data recorded, a report of the related fuel data obtained, and an IFTA-type report for each truck. Aside from helping to keep properly functioning recorders in the trucks and transmitting the required fuel data to CTRE, the participating motor carriers had very little involvement with the actual conduct of the test.

In actuality, the operational test was an equipment demonstration combined with a market process assessment. As such, the AMASCOT evaluation visualized was not that of the test but rather that of the concepts being tested. How AMASCOT-type recorders might be integrated into or alter existing mileage-reporting systems was the issue of interest. As a result, the motor carriers' evaluation required not only an informational/educational component but also a single "visionary/concept" system to serve as a uniform basis for assessment reference.

The Concept System Postulated for the Motor Carriers' Evaluation

As structured, the AMASCOT operational test afforded participating motor carriers no specific opportunity for first-hand experience in working with the mileage data generated by the on-board recorders. Instead, the test added the convenience of satellite data transmission directly to Rockwell and synthesized the use of a third-party data processor (CTRE). The system could also have been configured as a very basic operation in which the data from the on-board recorders were downloaded either directly, or through some intermediate media, to the corporate computer system where all required processing would take place. Since the AMASCOT motor carriers' evaluation was by definition conceptual, this latter situation was selected to establish a single entry-level scenario as the basis for considering the potential for incorporating AMASCOT technology.

For purposes of this “concept” evaluation, the motor carrier's automated mileage and fuel-use reporting system and the appropriate governmental data handling capabilities are both assumed fully integrated and operational. It will be assumed that the motor carrier’s existing software has been modified and supplemented as necessary to accept and preprocess the “lat-long” data captured by the recorders. It is further assumed that the Rand-McNally format mileage data, as illustrated in the CTRE hard copy reports, will need to be retained in electronic form to provide the basis for the electronic auditing process visualized; however, the data will also have been reformatted as necessary to provide the travel data input required to fully satisfy all current corporate data processing needs. Fuel purchase data will have been collected, entered, and processed independently, using current or appropriately modified procedures, and can be readily merged with the mileage data to facilitate the desired consistency checking and internal reporting.

Software to develop and produce the required IRP and IFTA reports will have been integrated in the carrier’s data processing system and will enable direct electronic transmission in an approved format to the appropriate base state. The procedures for electronic reporting will also include provisions for effecting any required funds transfer electronically.

The Evaluation Subcommittee of AMASCOT anticipates that, in an operational version of the system, motor carriers would always store data electronically and that hard copy mileage documentation would not need to be printed unless specifically requested for a detailed follow-up audit. Any system ultimately judged acceptable would meet all IFTA and IRP requirements for logging stateline crossings and therefore collecting mileage data by jurisdiction. It is also anticipated that the data collected by such a system could be audited by base states using computer support. Given that proper device operation can be verified electronically, the recorded mileage records show no sign of irregularity, and the fuel data correspond as expected, there should be no audit basis anticipated for questioning either the accuracy or distribution of the reported mileage.

THE MOTOR CARRIER EVALUATION PROCESS

The original AMASCOT work program outlined a preliminary set of evaluation goals which were later refined to detail three separate but interrelated evaluation efforts. These efforts were described as (1) the Truck and Electronic Data Interchange Evaluation, (2) the State Acceptance and Benefits Evaluation and (3) the Motor Carrier Acceptance and Benefits Evaluation. The third evaluation is of specific interest here and was assigned for development to a Motor Carrier Task Force. The Motor Carrier Task Force was constituted largely of the association staff persons and a designated motor carrier representative from each of the three state trucking associations involved in the original contracting partnership. The task force was given the following general directives or goals to guide its efforts:

- Evaluate the difference in transaction and audit (internal and external) costs between the current process of collecting information and submitting IFTA and IRP reports and that of the automated process.
- Determine participating motor carriers' acceptance of the automated method and their willingness to change to the automated process.

For purposes of the motor carriers' evaluation process, the task force objectives were simply to facilitate the data gathering required to respond to the goals. In the first instance, the ground rules necessary to produce a consistent set of cost data were carefully defined and each participating carrier was asked to develop current process cost information related to their particular operation. Later in the evaluation process, the concept implementation of the automated system was assumed to be totally integrated with current procedures and the current cost data would provide a basis for working through an estimate of the concept cost implications with each carrier.

With respect to a motor carrier's acceptance of an automated system, the adopted project evaluation plan postulated that within any given organization several differing viewpoints might be found. It suggested that procedures might be structured to document the potentially differing acceptance perspectives of (1) drivers, (2) licensing and/or accounting personnel, and (3) management. In formalizing the evaluation process, the Motor Carrier Task Force took issue with this proposal, however. Citing the facts that proper use of electronics-in-the-cab is now an established driver expectation and that management rarely pursues a significant course of equipment acquisition in the absence of staff endorsement, the task force recommended and the Steering Committee endorsed a single evaluation interview initiated with management and continued as necessary with staff.

Generally speaking, the acceptance aspect of the evaluation dealt not only with reaction to the proposed implementation model but also sought to identify and record any suggestions as to how the model might be altered to make it more effective as a tool for enhancing motor carrier productivity. In addressing management acceptance, an attempt was made to identify and quantify the criteria that each carrier uses in gauging the success or failure of any new process proposal; i.e.; how much improvement would a new system proposal need to demonstrate in order to be considered for implementation.

To this point in the planning, the evaluation would have dealt only with the intellectual issues associated with the acceptance or rejection of a new system concept. Achieving the second goal required acknowledging that it is possible to find acceptance of merit, and likely even recognition of potential value, without suggesting that a decision to actually change is necessarily a foregone conclusion. The question that remained for management was “If it works for you, how good would it have to be for you to decide to go for it?” This question sought to deal with issues well beyond the scope of the proposed concept tool and to position the subject of this project within the broader decision-making context of the whole composite world of running a trucking operation.

Motor Carrier Pre-Evaluation Assignments

Current Process Costs

Late in July 1995, each participating carrier was mailed a document titled “Motor Carriers’ Evaluation of Potential Cost Savings.” That document, as developed by the Motor Carrier Task Force, defined the various elements of cost to be included in estimating the total current cost of fuel-use tax reporting. A worksheet was included as an attachment and was designed for use in developing the estimate. A copy of the complete instructional document as distributed is included as Appendix B.

The cover letter transmitting the cost estimation document indicated that this information was important for two reasons:

- To estimate the difference in cost between the existing and automated systems, a stated project goal.
- To serve as the basis for helping to determine how the automated system might work to reduce data gathering and reporting costs in a specific motor carrier’s environment.

Without the cost data in hand, the motor carriers’ evaluation interviews envisioned could not be completed and meeting all of the evaluation objectives would become impossible.

Acceptance of Travel Data

CTRE began distributing copies of the individual truck travel records in the Rand-McNally format to each carrier even before the three-month operational test officially began. The carriers had reportedly been instructed how to interpret the CTRE -produced reports; however, late in April 1995, it was evident that none of the participating carriers had actually examined the data closely. As a result, two additional project initiatives were undertaken in May 1995 to encourage motor carriers to examine/test the AMASCOT recording process.

5/95-WHI

AMASCOT

Example Data:

TS: Start TP: Stop TC: Cold Start TL: Location
TB: Border RG: Recover GPS ET: Transmitter Reboot

Event	Odometer		Qual	Location	Time	Date
TS	132734.8		2	033° 44'03.7N 118°17'38.8W	20:15:41	02/07/95
TP	132747.8		3	033° 48'09.3N 118°15'11.7W	20:46:32	02/07/95
ET	132747.8		0	000° 00'00.0N 000°00'00.0E	00:00:00	00/00/00
RG	132747.8		2	033° 48'08.0N 118°15'10.4W	21:23:23	02/07/95
TC	132747.8	CA CA	2	033° 48'08.0N 118°15'10.4W	21:23:23	02/07/95
TS	132748.0		3	033° 48'13.0N 118°15'07.0W	21:38:22	02/07/95
TB	132988.3	CA NV	1	035° 34'34.3N 115°24'15.5W	01:43:47	02/08/95
TB	133113.9	NV AZ	1	036° 49'06.8N 114°02'58.6W	03:43:39	02/08/95
TB	133143.2	AZ UT	1	036° 59'59.6N 113°37'21.2W	04:12:19	02/08/95
TP	133221.5		3	037° 01'39.0N 113°49'42.8W	05:38:54	02/08/95

INTERPRETIVE GUIDE

Event:
TL (Location), RG (Recover GPS) and ET (Transmitter Reboot) codes are primarily project diagnostic tools for Rockwell use. For Motor Carrier assessment review purposes these codes can be ignored. Typical truck startup will generate an "ET, RG, TC" series of records.

The codes of specific interest are:

TC (Cold Start): Engine re-started after having been turned off.
TS (Trip Start) & TP (Trip Stop): these are the primary delimiters of any unique movement. These two event are recorded on a time delayed basis-TS only after a one (1) minute reading history shows an average speed of at least 5 mph and-TP only after a five (5) minute history shoes no movement whatsoever.
TB (Border Crossing): Self explanatory. Codes given for "From" and "To" states respectively.

Odometer:
The reading recorded is that of the truck's electronic odometer. A unique "correction" factor will be required for each truck to correlate the "visual" and electronic odometer.

Qual:
A single digit diagnostic code indicating the quality of the GPS signal utilized. Possible codes are 0,1,2, and 3 where 0 indicates "No Signal Available". Early project reports show the code system as being reversed for Border Crossings and Other Events. However, following the late April equipment update, the Border Crossing signal quality codes were changed to confirm such that:

1 = Poor Quality 2 = Fair Quality 3= Good Quality

Location:
The calculated longitude and latitude coordinates illustrated above will have been replaced with "best fit" Rand-McNally location descriptors. The data switch was made as one of the post-processing steps undertaken by ITC.

Time &Date:
The 24-hour clock data as recorded is Greenwich Mean Time. This enables the basis for calculating Standard Time anywhere in the world. To determine:

EST	subtract 5 hours	EST	subtract 4 hours
CST	subtract 6 hours	CDT	subtract 5 hours
MST	subtract 7 hours	MDT	subtract 6 hours
PST	subtract 8 hours	PDT	subtract 7 hours

Keep in mind that the date may change in the process of the conversion; i.e. may become 1 day earlier.

Figure 1 - Interpretive Guide for Rockwell Record of Truck Activity

First, WHI, under Rockwell tutelage, developed and distributed a one-page interpretive guide, Figure 1, to help carriers understand the reports which were being forwarded. Second, CTRE began producing monthly mileage summaries by truck beginning with the May 1995 travel period. Combined, these two efforts were designed to made it easier for the carriers to selectively cross-check the project-generated data with the records they routinely produce.

As an additional data-review incentive, WHI offered to annotate the corresponding report data to illustrate how they might be compared with a completed trip sheet for a test truck. Figure 2 illustrates a portion of a CTRE produced Rand-McNally travel data report for one truck for a three-day period. The mark-up reflects the process required for a carrier to make a comparison of the system-generated data with the corresponding driver-recorded data. The objective was convince the carriers that the recording devices actually worked and not rely solely on the state auditors' judgment. This point was reiterated when evaluation time arrived. The pre-interview information provided to the carriers clearly indicated that an informed opinion would be sought concerning the accuracy/adequacy of the recorded travel data.

Evaluation Planning

The plan to be followed for collecting current cost data was issued as a pre-evaluation assignment and was detailed and discussed in a separate mailing. It was recognized that responding to the cost data request would likely require considerable digging and head scratching by the participating carriers. Even so, the current cost data were essential to the evaluation process to enable completion of the cost-benefits portion of the individual motor carrier's assessment and collectively to the broader overall project assessment.

The AMASCOT acceptance evaluations associated with the licensing processing/ accounting and management issues were planned to be accomplished via an interview process. A WHI project representative was to personally visit the offices of each participating carrier to discuss the information desired and to record the responses received. The week of August 14, 1995, was targeted for accomplishing the evaluation interviews. Telephone scheduling calls were undertaken to arrange these interviews at least two weeks prior to the anticipated office visits and, to the extent possible, a tentative interview agenda was sent (or faxed) at least one week in advance. (The content of that agenda will be discussed at further length later.) A plan for interviewing the processing personnel separately, following the session with management, was suggested as an option if the carrier felt that would contribute to better time utilization.

In communicating with the carriers, it was emphasized that there were no right answers to the evaluation questions. As noted, each organization differed and each participating

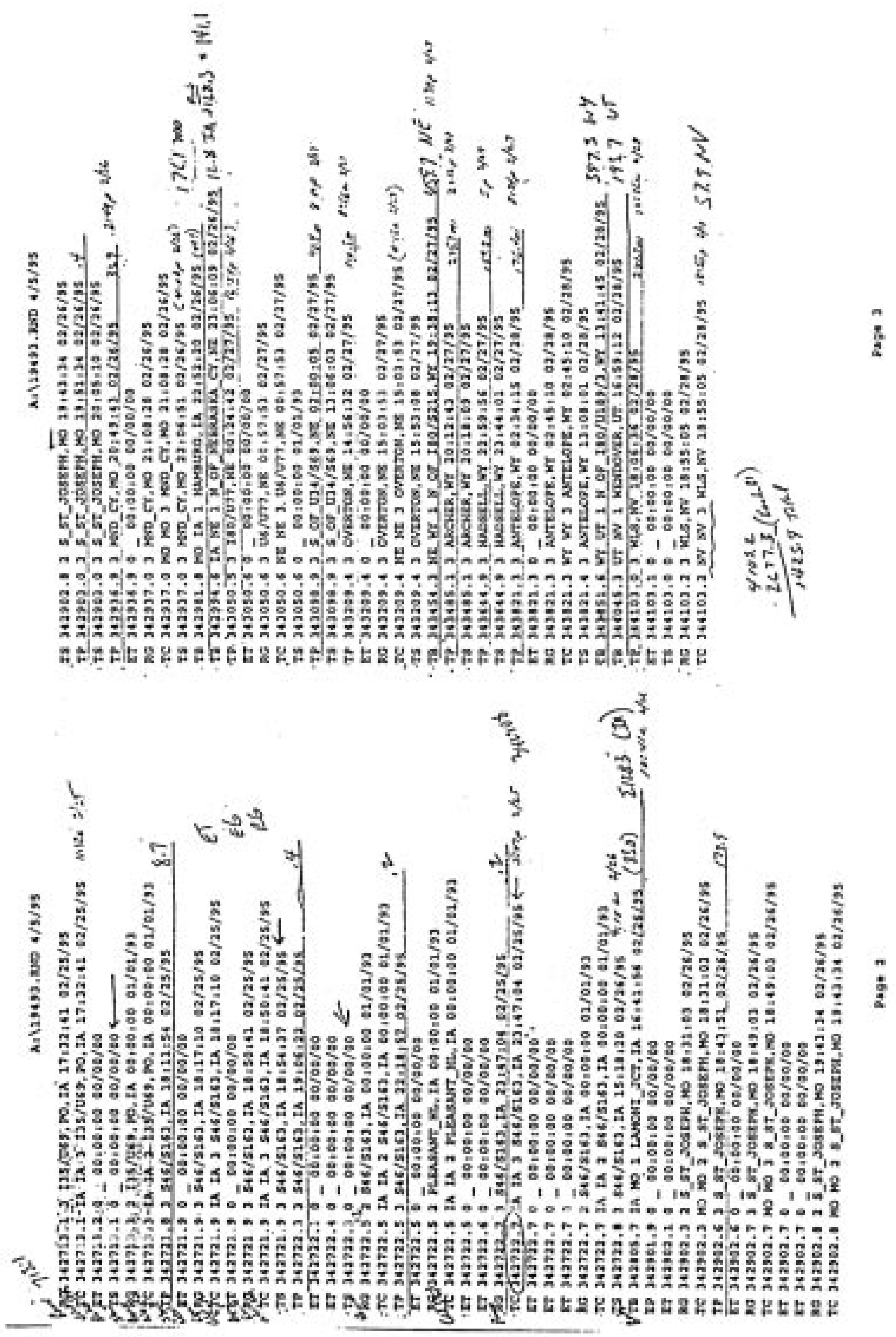

Figure 2 - Annotated Copy of "Rand McNally" Travel Data Records

motor carrier was selected with the anticipation that varying operations, organizational sizes, or geographic areas of service could produce potentially differing perspectives.

Project reporting was expected to take the form of case study presentations. It was recognized from the start that any authoritative extrapolation of evaluation data or opinions to a wider "industry" base might be possible only in areas which reflected virtually unanimous agreement.

The Evaluation Interview

The AMASCOT Motor Carriers' evaluation interview was designed to include a discussion of the following areas:

- **The basic assessment process in use for evaluating "new" technology**. What would be sought in evaluating an AMASCOT-type technology, and what would need to be found to make a "go" decision viable?
- **An assessment of the actual test, including the accuracy of both the data collected and the reports produced.** Suggestions as to how the process might have been tailored to better correlate with the actual mileage and fuel use data would also to be solicited.
- **The "concept" system as portrayed for the implementation evaluation would be fully explained and opinions sought concerning adaptability to the current operational situation.** Questions about various aspects of the "concept" model would be asked with respect to how well they relate to or satisfy the needs of this specific operation.
- **The applicability of the "concept model and the savings possible for this specific operation,** *g*iven the estimate of current process cost.

Following this general outline, a detailed interview script was developed to ensure that each evaluation session was similarly conducted and that responses were sought to the same identical questions.

One of the initial objectives was to place a copy of the interview script in the hands of the carriers a few days in advance of the scheduled session. While the document delivery objective was ultimately met, few, if any, of the carriers appeared to have had the time to give the interview topics much pre-session thought. The advance copy interview script document, as forwarded to the carriers, is included as Appendix C. A close examination of that script will reveal that a few non-evaluation questions relating to current operating practices were also incorporated. This proved a convenient way to satisfy other project requirements associated with process mapping.

The interviews were conducted as planned beginning with Roehl on Monday, August 14, 1995, in Marshfield, Wisconsin, and finishing up with Ruan in Des Moines, Iowa, on the following Friday. In general, the conduct of the interviews worked out as planned. However, only two of the six were found to have fully completed both the preparation of the cost worksheet and the review of the CTRE travel documents. Although only the two interviews were fully complete initially, the four incomplete carriers all agreed to:

- finish up their pre-interview assignments,
- complete the related questions on the copy of the interview script left with them, and
- fax or mail their responses to WHI within one week.

EVALUATION RESULTS

Following is a summary of the information obtained from the evaluation interviews conducted with the six participating motor carriers. The interviews, and the reporting which follows, addressed several key subject areas, with each subsequently pursued by a directed line of questioning. The subject areas focused on obtaining information about (1) the assessment process for new technology, (2) the assessment of the operational test products and procedures, (3) the assessment of the concept model applicability, and (4) the benefit/cost implications of the concept model. Where appropriate, opinions were sought concerning how the subject of interest might have been better tailored to fit their specific operation. The phrasing of the specific questions is found in Appendix C, should more definitive contextual relevance be found of interest.

About Your Assessment Process for "New" Technology

The first portion of the evaluation interview was designed to find out how various types and sizes of carriers determine the potential for new technology fit in their specific operation. Not surprisingly, responses to the "how do you do it" question appear to have varied most directly with the size of the fleet or company.

Among the four for-hire carriers, no formal process or procedures for technology evaluation were cited. While the largest of the organizations indicated the normality of some kind of cost-benefit assessment for any seriously considered technology integration, the other three indicated they were more likely to rely principally on the reported experiences of others. As suggested during several of the interviews, carriers tend to network relative to technology issues, and the report of, or the observation of, successful experiences by similar types of operators is likely the catalyst for many smaller organizations to begin considering the cost implications of new applications.

The participating private fleet, while perhaps larger than many, does authorize and allocate some personnel resources to track the progress of new technology developments. Even so, current guidelines for examining new tools are still being improved. As cited, a decision-making model which ensures maintaining consistency with initially defined objectives would be helpful but is still elusive.

For the participating leasing company, further increasing the efficiency of fleet maintenance and/or operations drives much of what they do. While the company's AMASCOT participation focused most directly on the potential for procedural improvements, a special projects section of the company is responsible for and typically leads the analysis of new opportunities.

Responses to the question about the performance attributes that would be sought in AMASCOT-type recorders centered on accuracy and reliability. Expanding on these were the following suggestions made by one or more of the carriers. It must be totally passive (requiring no driver attention), yet the driver must be able to know that its working properly. The system must be readily and quickly repairable/replaceable (dual-recording systems are unacceptable for other than very short-duration situations), storage capacity must be sizable to fit the application, and supplier installation uniformity must be established to enable original equipment manufacturers (OEMs) to anticipate and provide for easy installation (pre-drilled holes, brackets, etc.). Other expressed concerns dealt with the possibility of near-term obsolescence and upgradeability.

The final two questions related specifically to the characteristics of an AMASCOT-type system that would have to be demonstrated to be considered viable for their operation. Almost universally, the carriers felt that, while cost is the most obvious consideration, any seriously considered system would have to be capable of more than just gathering data for tax purposes. In fact, several expressed concern that having such specific time and place detail, when not required for mileage reporting, could be a nuisance and/or detriment if government were to demand access to enable cross-checking other record-keeping requirements.

To be usable, the system would have to be capable of being integrated (without inordinate expense) into existing processing systems so as to directly incorporate procedures for fuel-purchase recording. (As an aside, it was ventured that anything which might serve to encourage recognizing records from fuel service providers as proof-of-purchase would be extremely helpful.) Several also suggested that integration of the AMASCOT recorder would likely come about only as part of a composite communications system (including tractor vital-sign reporting, as suggested by one carrier).

Assessment of Operational Test Products and Procedures

Mileage Data

Questions 1 and 2 in this subject area sought an opinion (rating) of how well the test device/procedure replicated the carrier's official mileage records. The first asked how many driver trip reports (DTRs) had been utilized to cross-check the trip records as produced by CTRE. This was one of the pre-evaluation assignments/commitments; however, the number of actual comparisons expected was not stipulated nor was this made an issue. In the end, only four of the six carriers indicated that comparisons had been made even though an after-the-interview opportunity and "encouragement to become responsive" were offered. Once again, those that responded tended to be the larger companies. The two that defaulted were the smallest of those electing to participate.

The second question in this series asked that the carriers rate the mileage-related test reports on a scale of 1–5 (1 = unacceptable) according to how well they felt their official mileage records had been replicated. Three of the four that had made some data comparison indicated finding excellent correlation; i.e., ratings of 4.5, 5, and 5. The fourth, CENEX, identified some discrepancies and therefore rated the system as no better than average; i.e., a 3 rating.

Given the short duration of the official test and the late-stage timing of the data comparison, no attempt was made to determine the source of the CENEX data problem. However, the state auditor's evaluation promised a close scrutiny of the two data sets and where differences were observed the source of the problem was to be identified for resolution. During the course of preparations for the official test, there were several cases of observed data discrepancy that were identified and pursued to a remedy. As a result of this prior in-service corrective experience, there would appear to be no reason to expect that this data discrepancy could not have been explained and/or fixed given the opportunity.

Question 3 asked a general question about observations concerning ways in which the operational test reporting might have been altered to better correlate with records currently being generated. In this context comments were offered with respect to both the travel data and the IFTA-style reports.

Relative to the printed copies of the travel-data records, two suggestions were offered. First, the system needs to have the capability to make the AMASCOT odometer reading match the physical odometer reading, or vice versa. The conversion process required in the test seriously reduces the advantages of using the system. (The carriers cannot deal with constantly converting one to the other.) Second, the need for using Greenwich mean time (GMT) was understood, but some provision should be made to convert GMT to whatever time base the carrier chooses.

Concerning the IFTA-style reports, the only reported concern had to do with the inability to match the monthly cut-off date and time with that used by the carrier. As originally postulated and subsequently observed, report cut-off dates were defined somewhat differently by each participating carrier. Generally speaking, a carrier's reporting cut-off date is more likely to correlate with a trip date important for some other business purposes than it is to be the last hour of the last calendar day of the month.

IFTA-Style Reports

Questions 4 and 5 in this subject area asked the carriers about their observations concerning the accuracy of the prototype IFTA-style reports generated by CTRE. The reports, as illustrated in Figure 3, were produced for each carrier on a monthly basis summarizing the data for all reporting trucks, as a fleet report representation, and additionally for each truck separately. Again, these questions received responses from only the four largest carriers.

In response to the request to rate how well the AMASCOT fuel-use reporting matched their official data, no consistency of opinion was found. On a scale of 1–5 (1 = unacceptable), the four ratings given were 2, 3, 4, and 5. Although a few errors in fuel-data entry were noted, cut-off date seemingly explained the primary source of the differences observed. Ruan, the source of the 5 rating, had the best understanding of how the AMASCOT data were being processed and attempted to provide fuel data which corresponded. As a result Ruan simply verified the carry-through rather than trying to match the results with its corporate data.

The final question concerning the operational test asked how the fuel-use reporting process might have been altered to better reflect official company records. Most carriers covered this ground in response to an earlier question. As a result, the additional responses either amplified the explanation of how cut-off date was determined or offered good criticism which was beyond the scope of AMASCOT to address. One carrier cited the apparent requirement to continue producing and filing non-standard reports with states such as Idaho as a problem yet to be overcome. Another noted that if carriers were enabled to individually generate fileable reports there would need to be a single official source from which to download state gallonage pricing changes.

Assessment of "Concept" Model Applicability

Recall that the concept model called for the travel data gathered to be stored on the truck with download as required either directly to the headquarters computer or, alternatively, to some highly reliable data transfer device. The carrier would be able to pre-process the travel data as required to satisfy standard audit stipulations, transform the data for use with an appropriately upgraded version of their existing software, handle all subsequent

International Fuel Tax Agreement
July 95 Tax Report

Carrier Name :
Fleet Number :
Account Number :
Contact Person :

Licensee Name and Mailing Address :

Total Miles (All Jurisdictions) :	46116.6
Total Fuel (All Jurisdictions) :	7660.6
Average Miles per Gallon :	6.02

Juris-diction	Tax Rate	Total Miles	Total Taxable Miles	Taxable Gallons	Tax Paid Gallons	Net Taxable Gallons	Tax Due	Int. Due 1.0%	TOTAL DUE
AZ	0.1800	468.4	468.4	77.8	132.0	-54.2	-9.75	0.00	-9.75
AS	0.0800			77.8			6.22	0.00	6.22
IA	0.2250	8926.7	7642.2	1269.5	1708.6	-439.1	-98.80	0.00	-98.80
ID	0.2100	289.1	289.1	48.0	0.0	48.0	10.08	0.00	10.08
IL	0.2750	5134.1	5134.1	852.8	630.8	222.0	61.06	0.00	61.06
IN	0.1600	734.8	734.8	122.1	106.0	16.1	2.57	0.00	2.57
IS	0.1100			122.1			13.43	0.00	13.43
KS	0.2000	50.8	50.8	8.4	0.0	8.4	1.69	0.00	1.69
MN	0.2000	4662.2	4662.2	774.5	2313.7	-1539.2	-307.85	0.00	-307.85
MO	0.1300	955.0	955.0	158.6	180.0	-21.4	-2.78	0.00	-2.78
MT	0.2475	2677.9	2677.9	444.8	162.4	282.4	69.90	0.00	69.90
ND	0.1700	347.8	347.8	57.8	90.9	-33.1	-5.63	0.00	-5.63
NE	0.2600	1835.2	1835.2	304.9	0.0	304.9	79.26	0.00	79.26
NM	0.1800	370.5	370.5	61.5	0.0	61.5	11.08	0.00	11.08
NV	0.2700	1303.1	1303.1	216.5	281.4	-64.9	-17.53	0.00	-17.53
OH	0.2200	105.5	105.5	17.5	0.0	17.5	3.86	0.00	3.86
OS	0.0300			17.5			0.53	0.00	0.53
OK	0.1300	343.4	343.4	57.0	120.0	-63.0	-8.18	0.00	-8.18
OR	0.0000	309.1	309.1	51.3	0.0	51.3	0.00	0.00	0.00
SD	0.1800	1920.3	1920.3	319.0	264.3	54.7	9.84	0.00	9.84
UT	0.1900	1835.4	1835.4	304.9	265.0	39.9	7.58	0.00	7.58
WA	0.2300	1437.4	1437.4	238.8	249.9	-11.1	-2.56	0.00	-2.56
WI	0.2320	5766.6	5766.6	957.9	380.2	577.7	134.03	0.00	134.03
WY	0.0800	2673.7	2673.7	444.1	477.9	-33.8	-2.70	0.00	-2.70
Non IFTA Juris.		3969.6							

NET TOTAL : $44.96CR

September 7, 1995

Individual Truck Fuel & Mileage
All Jurisdictions
July 95 Summary Report

Carrier Name : RUAN
Fleet Number :
Truck Number: R14730

Total Miles :	7573.6
Total Fuel :	1210.6
Average Miles per Gallon :	6.26

Jurisdiction	Total Miles	Fuel - Gallons
GA	4.2	0.0
IA	774.2	547.5
IL	883.6	0.0
IN	845.6	0.0
KY	[illegible]	0.0
MN	[illegible]	0.0
NC	807.5	205.0
NJ	377.2	0.0
NY	[illegible]	0.0
OH	332.8	316.8
PA	775.3	140.3
TN	186.2	0.0
VA	86.1	0.0
WI	379.8	0.0
WV	181.4	0.0

Figure 3 Project Produced IFTA-Style Reports

processing necessary to produce and file the IRP and IFTA returns, and retain the electronic travel data as the audit base. For this portion of the interview, technology relevance was to be the subject of consideration, with cost issues set aside for the moment. All six carriers participated in this portion of the evaluation.

The first of this series of questions asked the carriers to rate the value of the concept system for their operation assuming that software integration was no problem. On a scale of 1–5 (1 = no value), the responses varied from 1 to 5. In this case the larger companies rated the concept from “nothing special” (3) to “no value” (1), while the smaller companies went the opposite direction. Ruan, Roehl, and CENEX made up the “3-2-1” group respectively with Caledonia, Johnsrud, and Skinner the reverse at 3-4-5.

The follow-up question inquired as to how the concept model might be changed to better fit their operation. The responses here revealed that the difference in perspective concerning the concept appears to be totally explained by the value placed on integration with other high-tech applications. While Ruan was willing to concede the possibility of some AMASCOT utility on a stand-alone basis, integration as part of a total satellite communications package was preferable and as such would also put Roehl on the list of candidate users. CENEX professed little immediate interest in satellite communications but also saw little use for AMASCOT data unless its full potential were utilized to produce “log books” as well. On the flip side, Caledonia might find the concept application advantageous but only as part of a total communications package and only if cost justification could be established. Johnsrud and Skinner both saw potential value in the concept system as a stand-alone application for their operations given some small adjustments.

Suggestions for improving the concept model included the following:

- Find a way to better integrate fuel data.
- In the absence of a communication system, transmit electronically “on the fly” when within approximately 100 miles of terminal.
- Given presumed auditable accuracy, forget trip detail for taxation purposes and go directly to corporate fleet processing.

Questions 3, 4, and 5 of this series focused on electronic data interchange (EDI) and how the carriers felt about filing reports and making payments electronically. Of the six respondents, only Roehl and Ruan currently use EDI routinely in their operations. As a result, responses to the remaining questions are based on opinion rather than experience and should be interpreted accordingly.

Rated on the scale of 1–5 (1 = irrelevant), the value of having electronic reporting/fund transfer incorporated in the AMASCOT concept model did not fare particularly well. The

EDI users both rated this transfer capability with the states at 3; i.e., “nothing special.” The other four split, two at 3 and two at 4. Overall, incorporating an electronic transfer capability as part of an AMASCOT-type application does not appear to add much to its attractiveness from a motor carrier perspective.

Regarding electronic fund transfer preferences, three carriers specifically noted the desirability of a wire transfer approach. One, without a lot of enthusiasm, suggested some type of escrow arrangement, and the only other opinion offered mentioned a debit system constrained by specific transaction authorization.

Questions 6 through 9 concerning the applicability of the concept model dealt with the subject of electronic auditing. The model proposed a selective electronic auditing capability initiated by an auditor request to review the records for a specific truck(s) for a specific travel period. The auditor would then be granted authorization to dial in to the carrier’s records library where the records requested would be “unlocked” to permit access.

When asked to rate the auditing concept using the 1–5 scale (1 = totally unacceptable), none of the six responding carriers reacted negatively. Ratings ranged from 3 to 5 with one at 3, three at 4, and two at 5. No apparent pattern of rating response similarity could be found with respect to carrier type. However, it appears safe to conclude that the concept of electronic auditing is one that motor carriers would favor pursuing if the proper safeguards can be established.

Three of the five carriers suggesting procedural preferences would limit the audit scan so as to involve only the specific records requested. Of these, two expressed a preference to upload the records requested rather than to enable or allow access to their computers. One carrier felt that the electronic scan should be limited to only those records generated on the truck, with fuel data furnished separately if required. The other comment suggested the desirability of having all data elements not specifically required for the audit stripped prior to releasing the files for inspection.

Generally, electronic audit was viewed as a potential time saver for motor carriers. For the most part, time currently required to physically locate, retrieve, and refile hard copy records would be eliminated, as would the need to house and accommodate auditors. er, one carrier, even after rating electronic audit quite high, did not feel that these savings would be significant for well run small operations. Other potential benefit expectations included a reduction in the hassle currently associated with inaccuracies and, in a sense, might change the whole audit emphasis to verification rather than discovery. Carrying this one step further, several carriers noted that a pre-audit capability built into their own systems could also serve as a means of authenticating the original records development process.

The attempt to obtain an estimated dollar value savings for electronic audit fell flat. As the carriers reported, too much currently depends on the audit agency, the audit request, and the auditor as an individual to generalize concerning audit costs. It was suggested further that, as IFTA becomes the norm, working with only one base state should in itself tend to diminish the costs currently being experienced. Even so, one of the smaller carriers did not feel he knew enough about IFTA audit mechanics at this point to espouse this position. Irrespective of the time saving and altered philosophy possibilities, one carrier observed that the opportunity to informally resolve apparent discrepancies would be lost if on-site auditor involvement were terminated.

The lone carrier willing to quantify an audit experience estimate suggested the likely necessity to commit two-and-a-half to three person-days to a typical routine audit. Assuming a sample of 30 units selected for review in a specified quarter, at least one day would be required to locate and gather the documents, two hours per day for some four days would be spent accommodating on-site auditor requests, and another half day would be required for refiling the records. If total elimination of this commitment were possible, a resource reallocation of some $250–$300 might be the result.

Benefit/Cost Implications of the "Concept" Model

The final portion of the evaluation interview walked the carriers through a thought process intended to help sort out the possible benefit/cost implications associated with considering implementation of the fully certified AMASCOT concept model. Recall that the concept model assumed a stand-alone recording device independent of any on-board communications requirement or implementation. Travel data as recorded would be downloaded either directly to the headquarters computer or to a secure interim storage device.

To provide the basis for cost consideration, CTRE arranged a special meeting of hardware and software professionals to explore the subject. The deliberations of that meeting are fully recorded in a CTRE-produced document which provides opportunity for a full examination of the assumptions and rationale. However, for purposes of this evaluation the carriers were provided with the following very preliminary and very general estimates as extracted and initially reported by CTRE :

.... Capital cost of on-board equipment (per unit):

With Rockwell satellite communication equipment	$4–500
Without or with another vendor's satellite communication equipment	$6–800
Non-satellite download device	$3–400

Expense of modified software: $1–5,000 (upgrade of commercially available system)

While all six of the participating carriers eventually made a stab at developing cost data associated with their current processing systems, only five responded to the benefit/cost portion of the evaluation. Ruan, the leasing company participant, provides fuel-use reporting services for its customers on a rate-per-truck basis and, as a result, the worksheet process suggested for developing estimated cost was not directly applicable. Four of the other five carriers followed the process suggested and developed an estimate of the proportionate-share value of the driver time. However, it is significant that in all five instances the drivers are paid on some mileage-related basis rather than by the hour. As a result, savings attributed to a reduced driver-time requirement were not seen as a company savings since the time saved could not be utilized for another productive (i.e., revenue generating) purpose.

The first three of the six questions in this subject area requested the carriers to consider how their existing procedures would likely change if an accepted AMASCOT concept model were to be implemented. Of the five respondents, four felt that even the concept system would alter the processes currently used to collect and process their travel mileage data. Most mentioned the implied reduction in data entry time, while one focused specifically on the elimination of the entry required relative to route-of-travel as a specific source of change. Another suggested that the processing steps would not likely change much because of the continuing necessity to tie the electronic records to the invoicing process for cost accounting purposes; however, the likelihood of a reduction in processing time was acknowledged. The fifth carrier failed to find in the concept model enough opportunity for procedural improvement to even consider implementation.

For the four acknowledging potential concept model applicability, the specific areas of potential time savings cited universally included reduced data entry. Also mentioned was savings in the area of the data reconciliation effort necessitated by driver recording omissions and recording or entry errors. One carrier ventured that data entry and data reconciliation activities combined accounted for 80–90 percent of their fuel-use reporting costs. That same carrier estimated that, if the implementation cost could be justified, introduction of the concept model might reduce that proportion to as little as 50 percent. In every case, any personnel time saved would be utilized to support activities in other departmental areas. The apparent implication is that in many cases trucking company administrative activities are frequently somewhat understaffed as the result of corporate growth pressures.

The extent of the estimated cost savings varied somewhat from company to company and ranged from two to three full-time positions down to “very minor.” Where potential savings were foreseen, all involved the processes associated with translating the travel reports into accurate data processing records. A savings of one-third to one-half of the dollars currently committed to those activities was generally suggested as being reasonably appropriate.

Once the benefits and costs had been examined, the final series of questions sought opinions about the likelihood of acceptance. The first of the ratings requested was that of the benefit/cost potential of the concept model. On a scale of 1–5 (1 = no benefit), the ratings assigned were one at 1, two at 2, one at 3, and one at 4. Judging from the ratings, it would appear that only one of the five would likely buy-in to the concept model.

The next question asked the yes-no buy-in question specifically and verified the initial observation. Only Ruan, with its rating at 4, responded "yes" they would be likely to consider the concept model. However, it was also acknowledged that the stand-alone system would never fully satisfy the Ruan objectives for technology integration. That the concept model might not meet with cost-effective industry favor was not too surprising. Given the costs of participation as estimated, the carriers seemingly needed more capability to justify such an expense.

The final question allowed each carrier to visualize an AMASCOT-type system which incorporated all of the elements that each had previously established as being desirable. Then a rating on the 1–5 scale (1 = no benefit) was requested in accordance with the benefit/cost potential foreseen for their operation. The ratings given were as follows:

For-hire

Truckload, large (Roehl) 2

Tanker, medium (Johnsrud) 3

Tanker, small (Caledonia) 3

Private (CENEX) 4

Leased fleet (Ruan) 5

From the comments offered, the carriers appeared to want a more fully integrated system incorporating the AMASCOT capabilities with, for example, a satellite communications system. However, even given that option, an AMASCOT-type system which responded only to taxation-induced reporting requirements still failed to generate benefit/cost acceptance by any of the for-hire motor carrier participants.

CONCLUSIONS AND OBSERVATIONS

As a primary goal, the AMASCOT operational test was to demonstrate and evaluate one specific technology concept designed to automate both the collection of mileage data and the filing of the reports required for motor carrier registration and fuel tax apportionment. The equipment developed by Rockwell for AMASCOT was targeted for installation in 30 trucks. Data collected by the recording devices on board the test trucks were downloaded via satellite directly to Rockwell and then transferred electronically to CTRE for processing.

CTRE served as the host for the database in which the fuel purchase data for each truck, as provided by the carriers, were matched with the mileage records. On a monthly basis the travel and fuel data by truck were extracted and distributed for review by both carrier and auditor. CTRE also aggregated each carrier's data monthly to produced proxy test-fleet IFTA reports. These reports were subsequently used to demonstrate the electronic report-transfer capability set up with the several states.

Aside from the adequacy of the test products, the AMASCOT evaluation visualized was not that of the test, but rather of the concepts being tested. As a result, the motor carriers' evaluation required the definition of a concept system to serve as a uniform basis for assessment reference. As defined, the concept model called for the travel data gathered to be stored on the truck with download as required either directly to the headquarters computer, or alternatively, to some highly reliable data transfer device. The carrier would be able to pre-process the travel data as required to satisfy standard audit stipulations, transform the data for use with an appropriately upgraded version of their existing software, handle all subsequent processing necessary to produce and file the IRP and IFTA returns, and retain the electronic travel data as the basis for future audit.

In preparation for the post-test evaluation interviews, the carriers were given two pre-interview assignments. The first asked that an estimate of the costs associated with the current fuel-use reporting process be developed to become the basis for determining the extent to which the automated system might serve to reduce data gathering and reporting costs. The other assignment dealt with the acceptance of the travel data produced and involved cross-checking some of the project-generated data with that recorded on corresponding driver trip reports.

Key Findings

The evaluation interviews found the following with respect to:

- The motor carrier assessment processes relative to new technology.

The objective of this portion of the evaluation interview was to find out how various types and sizes of carriers determine the potential for new technology to fit in their specific operation. As recorded, the participating private fleet and the leasing company both dedicate resources to tracking and evaluating new technology applications. Among the four for-hire carriers, however, no formal process or procedures for technology evaluation were cited. Most indicated that they were more likely to rely principally on the reported experiences of others. Irrespective, accuracy and reliability were the key attributes that would be sought in evaluating AMASCOT-type recorders, though rapid, convenient repairability was also among the more frequently mentioned expectations.

- The motor carrier assessments of the operational test products and procedures.

Mileage Data. Three of the four carriers that examined the travel data reports for their trucks reported finding excellent mileage data correlation. The fourth identified some apparent discrepancies, but there appears to be no reason to suspect that the problems could not have been explained or fixed had the test continued.

Fuel Use Reports. The only correlation problems reported with the IFTA-style reports CTRE produced apparently had to do principally with the use of differing cut-off dates. Generally speaking, a carrier's reporting cut-off date is frequently more likely to be a trip-specific time than it is to be the last hour of the last calendar day of the month.

- The motor carrier assessments of the concept model applicability.

The carriers' assessment of the applicability of the concept model reflected the views of all six carriers and the reactions seemingly fell into one of two distinct groups. The larger companies rated the concept low and appeared to be looking to technology to go even further toward streamlining the way they do business. The smaller companies, on the other hand, seemed content to consider incremental changes such as those suggested by the concept model. Even so, elements of both groups expressed reservations concerning the possibility of not being able to constrain the availability of the AMASCOT time and place detail to the intended context of tax reporting.

The two carriers routinely utilizing EDI considered the concept of incorporating electronic report filing and fund transfer as "nothing special." The other four split equally between ratings of "nothing special" and "looks O.K." Most wanted some way to explicitly control when funds transmitted were actually withdrawn from their accounts.

None of the six carriers reacted negatively to the concept of submitting to electronic audit as suggested in the concept model. However, considerable concern was expressed about how this might actually be accomplished. A distinct preference was stated for uploading files requested rather than attempting to limit access within their corporate computer files.

- The motor carrier benefit/cost implications of the concept model.

As a guideline for assessment, the cost of equipping fleet trucks without existing satellite communication hardware was suggested at $900–1200 per unit including a non-satellite download capability/device. Responses to this portion of the interview were offered by only five of the six carriers, although all six made a stab at estimating current processing costs.

Four of the five that responded also completed the driver's cost portion of the current cost estimate, although none ultimately considered it relevant. In each case, drivers are paid on some mileage-related rather than time-related basis, and reductions in driver time requirements were not seen as company savings; i.e., the time saved could not be utilized effectively for another revenue-generating purpose. Potential savings in current processing costs thus became the basis for the benefit/cost assessments.

Most agreed that the concept system had some potential to reduce the costs of collecting and processing their mileage data. These savings were seen as being associated with reduced data entry and with the reconciliation process necessitated by driver omissions and recording errors and/or data entry errors. Even so, the necessity for integrating separately created fuel-data files and cost accounting identifiers limits the savings potential. The resulting estimates of potential cost savings ranged from eliminating two to three full time positions down to "very minor." Where the possibility of savings was acknowledged, the suggested potential ranged from one-third to one-half of total current processing costs.

Of the five respondents rating the concept model, three ratings were negative, one was non-committal, and one indicated "give-it-a-try." However, even the highest rater acknowledged that the stand-alone system would never fully satisfy the company objectives for technology integration.

Conclusion: Participating motor carriers indicated that automated mileage data collection has the potential to reduce the costs of collecting and processing the mileage component of their fuel tax reporting data. These carriers also indicated, however, that an automated mileage data collection system like that used in AMASCOT would be considered for implementation only if it is accompanied by additional functionality and corresponding benefits.

Finally, the five responding carriers were given the option of considering an AMASCOT-type system enhanced by the integration attributes they expressed as being desirable. The ratings given on this basis are seen as being consistent with an earlier observation. The ratings of the three responding for-hire carriers were either negative or non-committal. This echoes the prevalent for-hire wait-and-see attitude previously reported with respect to new technology. The private carrier and the leasing company, on the other hand, both gave their enhanced systems a positive endorsement. This suggests consistency with the more pro-active stance these two indicated with respect to investigating new technology applications.

Conclusion: An AMASCOT-type system shows promise of initial acceptance principally by larger companies which have the resources and desire to experiment with new technology, but even then AMASCOT will likely have to be integrated with other applications which are responsive to more than just meeting taxation-induced reporting requirements.

WHI Concluding Observations

All of the participating carriers acknowledged that the AMASCOT technology held the potential for effecting some time savings in their fuel-use reporting procedures. But moving to the point of conceptually quantifying and equipping to realize those savings proved too big a hurdle for most to visualize. Therefore, the stated conclusion concerning initial acceptance principally by larger companies should not be viewed as a deterrent to the process of seeking IFTA and IRP acceptance of AMASCOT-type technology. Once governmental acceptance is assured, the more technologically-advanced carriers with clearly established cost savings potential will pioneer development of the prototype-type procedures necessary to define the rules of participation and to ultimately demonstrate the economic viability of the resulting system.

For-hire LTL operations, estimated to make up some 10 percent of the national heavy vehicle fleet, were excluded from participation in AMASCOT due to an administrative pre-judgment that there would be no positive impact on current business practices. The evaluation subsequently revealed, however, that any significant acceptance of AMASCOT technology will be tied to integration with some broader fleet management application. As a result, though the AMASCOT taxation reporting capabilities may not be significant for LTL, the fact remains that the broader potential for application in LTL was not examined.

In retrospect, the use of a satellite communications system to download the mileage data from the trucks can be seen as a mixed blessing. It did provide a mechanism to gather the data without imposing on or interfering with the carriers' normal operations; however, the project requirement that test trucks not have pre-existing communications equipment excluded seeking informed opinions from some of the most technology-progressive trucking organizations. It is acknowledged, however, that three of the participating carriers did provide a knowledge base with respect to the integration of advanced communications technology.

Additionally, the process of sorting out the proper operational protocol for interaction between the recording device and the satellite reporting device detracted some from the intended project focus. However, this experience led to an important carrier interaction discovery.

The difficulty of catching trucks to make changes in project equipment forced consideration of asking the carriers to travel to Cedar Rapids to attend a project demonstration and do-it-yourself training session for upgrading the software associated with the recording device. This turned out to be an excellent idea. All but one carrier sent at least one person to the all-day session, all felt they gained a better appreciation for the potential of the equipment, and all subsequently cooperated to get the equipment upgrades made more expeditiously than would otherwise have been possible.

The process by which the participating carriers were selected and recruited also worked out extremely well. A group of excellent, willing candidates from which to choose were produced through the partnership involvement of the three state trucking associations. The association staffs knew their membership with respect to type of trucking service/ operation, interest in new technology, and willingness to participate in public service projects of industry interest. First contact by the association representatives made subsequent contacts and work with the carriers flow smoothly for the other project team members.

Once obligated, motor carrier executives can generally be counted on to give you an hour or so of their time when you need it. Not necessarily so with others of their staff. They may tend to see outsider requests as simply another demand on their time. The idea of using recruiting interviews as the initial introduction to personnel from all activities of project interest also appears to have worked out well. By having all the key people from each company involved in the initial presentation and discussion, the cooperation received later in the project could generally be categorized as outstanding. One more point should be made. Especially among the smaller firms, the administrative staff is rather typically overextended with respect to both duties and demands on time.

Evaluation experience on several test projects suggests that researcher desires to obtain informed motor carrier opinion of test products based on independent analysis are likely to be frustrating, frustrated, or both. The AMASCOT carriers, by and large, met their project commitments with respect to the assignments they were given. But where gentle reminders and plenty of patience helped make it all work in this project, this good experience could well prove to be the exception rather than the expectation.

Project duration was an item of consideration in some of the AMASCOT motor carriers' commitments. While extended project duration did not become an issue in AMASCOT, time pressures did necessitate a shortening of the intended duration of the actual test. Two points come to mind in this regard. First, voluntary, uncompensated motor carrier participation in those projects is generally not free of cost, and project time extensions carry with them the potential for creating motor carrier unrest and unresponsiveness. Second, most knowledgeable observers will acknowledge that the motor carrier industry tends to be quite volatile and the longer a project gets, the greater the potential for changes in the industry personnel participating. Changes in personnel often signal changes in company priorities and, as a result, changes in views concerning prior commitments. Even the hand picked participants of AMASCOT demonstrated this propensity though involvement was held to about eight months. In designing any test requiring motor carrier involvement, try to limit the time of the commitment required to the shortest possible period necessary to accomplish the project objectives.

One final point needs to be noted about the cost data collected with respect to fuel-use reporting. While those data are obviously proprietary and will not be released, it was interesting to find that initially few of the carriers had any idea of the costs associated with maintaining their existing fuel-use reporting systems. Meeting the reporting requirements is generally viewed simply as a cost of doing business with little need for keeping cost records. As developed, the costs were used only individually by each carrier as a means of examining the cost savings potential of the AMASCOT technology. This is mentioned primarily because it became apparent very early that the project goal of estimating the costs associated with an automated system was well beyond the realm of reasonable expectation.

APPENDIX A

MOTOR CARRIER RECRUITMENT HANDOUT

AMASCOT- On-Board Automated Mileage and Stateline Crossing Operational Test
Interstate commercial vehicle operators are required to pay taxes and registration fees to each state in which they travel. For such operators, fuel taxes and registration fees are generally based on the proportion of miles traveled in each state. For the most part, provisions have been made for interstate carriers to register their trucks in a single base state where they file the required reports and pay all of such taxes and fees. To accommodate the required mileage and fuel-use reporting, an interstate carrier must collect, report, and maintain accurate mileage and vehicle information for each trip by state. The base state is responsible for processing this mileage and fuel purchase information to determine the taxes and fees due and the appropriate amounts for subsequent distribution to each state in which the motor carrier's trucks have traveled. The base state is also responsible for auditing motor carriers in its jurisdiction. IFTA and IRP agreements provide for uniformity in collecting fuel use tax and vehicle registration fees among base states. IFTA is an agreement among states for the uniform collection and distribution of fuel use tax revenues. IRP is a similar agreement among states for registration reciprocity and the payment of license fees on the basis of commercial fleet miles traveled in various states. Although IFTA and IRP provide for automated data collection in their Procedures Manuals, automated stateline and mileage data collection has not been widely attempted. Both IFTA and IRP Procedure Manuals specify requirements for on-board recording devices, Individual Vehicle Mileage Records (IVMR), and motor carrier accounting systems to maintain vehicle records for review by state auditors. The predominant current method of collecting the mileage and stateline crossing data necessary to prepare IFTA and IRP reports depends on the driver to accurately collect and record data on a trip sheet. Although most drivers try their best to collect and record data accurately, errors creep into any manual data gathering process. In addition, dealing with paper trip reports inevitably results in a major clerical burden for commercial vehicle operators. The goal of the AMASCOT operational test is to demonstrate and evaluate a technology concept designed to automate the collection of data and the filing of the motor carrier reports required for registration and fuel tax apportionment. The implementing partners for this operational test are state administrators and auditors from Iowa, Minnesota, and Wiscon-

sin; state motor carrier associations from these states; Rockwell International Inc.; Rand McNally-TDM, Inc.; the Iowa Transportation Center; the Western Highway Institute/ American Trucking Association Foundation, Inc.; and the Federal Highway Administration (FHWA).

Volunteer motor carriers will utilize special project-provided equipment in their trucks to test the automated recording of the vehicle mileage associated with each stateline crossing as the units travel among states in the normal course of business.

For this test, fuel purchase data for each state will be manually collected, matched with the mileage records previously downloaded from the truck, and entered in a special project database. The data set compiled for each vehicle will be integrated as appropriate with those of other units in the carrier's "test" fleet and submitted electronically to the appropriate base state as a proxy for the required mileage/fuel tax report.

As the project proceeds into the operational test planned, automated stateline crossing and mileage data collection equipment will be installed on some thirty trucks that will travel widely throughout the U.S. Data collected from the trucks and from the carriers will be aggregated at the Iowa Transportation Center* where prototypical IFTA reports will be prepared and submitted electronically to the base states involved. Participating state auditors will review project reports and the supporting motor carrier records to authenticate compliance with IFTA and IRP requirements

Motor carrier participants are expected to:

1) Facilitate the installation and removal of test-related equipment on trucks.

2) Agree to enabling any necessary test equipment repairs as expeditiously as possible to assure valid test participation.

3) Facilitate test vehicle mileage reporting and report preparation (IRP-comparable/IFTA) such that directly comparable data can be developed by the existing and automated systems.

4) Provide fuel tax payment data to ITC on a timely basis for each truck involved in the operational test.

5) Agree to cooperate with a maximum of two-test-specific, no cost, non-enforcement audit inspections during the course of the project as a means of validating the automatic system.

6) Participate in the Motor Carrier Economic Evaluation process.

*The Iowa Transportation Center has since become the Center for Transportation Research and Education.

APPENDIX B

MOTOR CARRIER’S EVALUATION OF POTENTIAL COST SAVINGS

(MILEAGE AND FUEL USE REPORTING)

AMASCOT

Automated Mileage and Stateline Crossing Operational Test

MOTOR CARRIER’S EVALUATION OF POTENTIAL COST SAVINGS

One of the stated AMASCOT evaluation goals is to estimate the extent of any potential motor carrier savings which might result from the integration of an automated mileage recording device in the fuel-use reporting process. The first step in the evaluation of this AMASCOT concept is to develop an estimate of the costs associated with existing fuel-use reporting procedures. These procedures vary considerably from carrier to carrier and, absent your participation, no good data currently exist to enable any kind of rational current-cost assessment.

Once estimated, carrier-specific costs for the current process can serve as the springboard from which to help visualize and quantify any potential cost savings that might be realized from the postulated future integration of an automated mileage recording system. With the current cost basis in hand, a rough estimate of the cost changes that might result from a specifically defined automation model will be developed for and in conjunction with each participating carrier to enable the project comparison desired. In the follow on portion of the evaluation, we will invite each carrier to suggest ways in which the “evaluation” model might have been altered to be more cost effective and a better fit for the needs of their particular operation.

Evaluation Objective:

- Analyze current costs of motor carriers to collect mileage and fuel data for fuel tax and registration apportionment requirements.

The formula will be a simple time and expense process. Determine the amount of man-hours and allocate the expenses your company associates with the process of collecting, recording, and reporting miles and fuel. The basis of this study is on one month of expenses.

For the purpose of this study, we will use four major components for costing.

- Salaries
- General Office Expenses
- Computer/Software Amortization Expenses
- Outside Services, if applicable

The following sections discuss each of these cost components in greater detail.

Salaries:

A worksheet for estimating the salary related costs of your current process is being provided so as to:

- Establish a common basis of estimation for all participating carriers
- Assist in identifying and quantifying how an automated mileage reporting system might ultimately act to alter the labor intensive aspects of your existing procedures.

Personnel Salaries should include:

1) An appropriate allocation of a portion for Drivers
2) Office Staff associated with the collection, auditing and recording of mileage and fuel data
3) Office Staff responsible for filing fuel tax returns

Monthly gross salaries of several individuals should be aggregated where appropriate and should include:

- Basic Employee Salary
- Company Payroll Taxes

- Health Insurance if applicable
- Company Pension if applicable
- Company 401-K or Stock Option Contributions if applicable
- Other Related Company Contributions for Compensation if applicable

Using the worksheet provided, calculate actual or estimate the man hours spent for a month for all applicable personnel. Multiply the percentage of each personnel's time by their salary expense to calculate their monthly salary expense.

General Office Expenses:
Office Expenses should include:

- Actual Cost of Trip Sheet Forms used, if applicable
- Postage or other related expense to forward Trip Sheets for processing
- Telephone expense for on-line computer connections for Trip Sheet data, if applicable
- Other expenses relating to Trip Sheet data collection purposes

Calculate actual or estimate the monthly computer/software amortization expenses. Calculate the actual or estimate the percentage amount of use of the Computer/Software. Multiply the applicable amortization expense by the Computer/Software percentage to calculate the total applicable expense. Total all applicable expenses for an overall Computer/Software amortization expense.

Service Expenses:
Service Expenses should include:

- Any outside fees to collect, audit, record, and file tax returns
- Any outside fees to perform other services associated with this cost study

Calculate actual or estimate monthly Service expenses. Total all applicable expenses for an overall Service Expense.

Total Current Cost:
Enter the applicable totals of General Office, Computer/Software Amortization and Service Expenses on the Salary determination worksheet and total the four items. Once submitted, this total will be viewed as being generally representative of the cost to collect mileage and fuel data for carriers of your particular type and size.

AMASCOT Motor Carriers' Evaluation

Mileage and Fuel Use Reporting

Estimated Salary Time/Cost Allocation for a (1) month cycle

1. Allocation of wages for a Representative Driver

(compensated recording/reporting time that might otherwise be available for another productive purpose)

a. Average miles/trip: ________ (miles)

b. Reporting/recording time/trip: ________ (hours)

c. Average trips per month: ________

d. Estimated reporting/recording time/driver/month: ________ (b times c = hours)

e. Number of trucks in fuel use reporting system: ________ (trucks)

f. Estimated driver reporting/recording time per month: ________ (d times e = hours)

g. Approximate driver compensation/hour: ________ ($)

h. Cost of driver reporting/recording time per month: ________ (f times g = $)

2. Other salary components of mileage and fuel use recording/reporting cost

Item	# People	% Time	Approx. Gross Salary	Attributable Cost
a. Driver supervision & training	_______	_______	_______	________
b. Processing of incoming DTRs	_______	_______	_______	________
c. Pre-entry DTR verification checking (required docs, consistent data)	_______	_______	_______	________
d. Reconciling incomplete DTR submittals	_______	_______	_______	________
e. DTR data entry (mileage and fuel)	_______	_______	_______	________
f. Data entry, "other" fuel purchase data	_______	_______	_______	________
g. Merge and/or reconcile mileage & fuel data	_______	_______	_______	________
h. Prepare required company reports: weekly, monthly, quarterly....................	_______	_______	_______	________

i. Reconcile any discrepancies identified........ ________ ________ ________ ________

Prepare & submit government reports:

j. IFTA ________ ________ ________ ________

k. Other fuel compact groups ________ ________ ________ ________

l. # ______ individual states ________ ________ ________ ________

m. Other salary components - Subtotal..._________

3. Total Cost Summary

Total Salary Allocation (1.h. +2.m.)..___________

General Office Allocation..___________

Computer/Software Allocation..___________

Outside Service Expense..___________

TOTAL CURRENT COST..___________

APPENDIX C

EVALUATION INTERVIEW SCRIPT

Western Highway Institute - Tel: 415/952-4900 - Fax: 415/588-0424

DATE: August 11, 1995

TO: AMASCOT Motor Carriers

FROM: Ken Heald, Team Leader, AMASCOT Motor Carriers' Evaluation

SUBJ: Advance Copy of Evaluation Interview Script

I. About your assessment process for "new" technology

1. When you have new hardware and/or software opportunities presented (such as AMASCOT), what process do you follow in making an evaluation of the product relative to your operation?
2. What characteristics or "performance" attributes would a device such as the AMASCOT recorder have to demonstrate to be considered viable for your operation?
3. What general criteria would you expect to use in evaluating something like AMASCOT; i.e., what measures of effectiveness or levels of performance would you be looking for?

4. What level of performance would an AMASCOT-type device have to demonstrate to convince you to “go for it”; i.e., what specific criteria and level of performance would be critical in your “go/no-go” decision?

II. Assessment of Operational Test Products and Procedures

1. Did you or someone on your staff make a “1 for 1” comparison of any of the mileage data produced by the device versus your DTRs? Yes_____ No______

   If yes, approximately how many trip-specific data sets were examined? _____

2. On a scale of 1-5 (1 = Unacceptable), how well do you feel the device replicated your official mileage records for the period examined?

3. In your view, how might the Operational Test have been changed to make the vehicle and/or IFTA-style reports produced better reflect your corporate records?

4. On a scale of 1-5 (1 = Unacceptable), how well do you feel the Operational Test fuel-use reports matched your official data?

5. In your view, how might the Operational Test process have been altered to better replicate your actual fuel-use recording/reporting process?

6. As an adjunct to understanding the data on your Mileage and Fuel Use Cost Allocation worksheet:

   a. What computer hardware do you use to process your mileage and fuel-use data?

   b. Is the software you currently use for your mileage and fuel-use reporting commercially available? Yes____ No____

   If yes, what vendor and version are you using? _______________

   c. Is your “mileage and fuel-use” software part of a broader integrated system? Yes____ No____

   If yes, what other applications are part of the total package?

   d. On what basis are your drivers currently being paid?

   Salary___, Hourly____, Actual Miles____, Other Miles ____(Source__________), Other Basis____________________.

e. In what manner is your DTR currently correlated with drivers' payroll?

III. Review the Elements of the AMASCOT "Concept" Model to be Evaluated.
(Copy attached)

IV. Assessment of "Concept" Model Applicability.

1. Assuming that software integration was no problem, on a scale of 1-5 (1 = No Value), how would you rate the potential value of the postulated mileage recording/reporting system for your operation?
2. In your opinion, how might the "Concept" model be changed to better fit the mileage reporting needs of your operation?
3. Do you currently (or plan to eventually) use EDI in your operation?

   Yes_____ No____
4. On a scale of 1-5 (1 = Irrelevant), how would you rate the value of having electronic reporting/funds transfer procedures incorporated as an integral part of the "concept" model?
5. If electronic reporting and funds transfer procedures were to be integrated, what procedural preferences would best fit your needs?
6. Assuming that the process modeled enabled selective electronic auditing, on a scale of 1-5 (1= Totally Unacceptable), how would you feel about submitting to electronic audit on request?
7. How would you visualize that an acceptable electronic audit process might work?
8. In what ways might an electronic audit be viewed as being beneficial?
9. Given that you have been selected for an audit, how would you calculate the dollar value of your savings if an electronic audit were to give you a clean bill of health?

V. Benefit / Cost Implications of the "Concept" Model

The capital costs of the hardware required and the necessary software modifications associated with motor carrier aspects of the "Concept" model are extremely speculative at this point. However, the results of the recent meeting hosted by ITC to consider the subject suggest that the following might be assumed for purposes of this evaluation:

Capital cost of on-board equipment (per unit): w/ Rockwell Sat Com ...$4-500

No or Other Sat Com ... $6-800

Non-sat Download Dev $3-400

Expense of Modified Software ..$1-5000 (Upgrade-Commercially Avail. System)

1. How might your existing procedures change if something like the AMASCOT “Concept” model proved feasible?
2. In what procedural areas might you see some time savings if the “Concept” model were operational? How might time saved be used?
3. Referring to your current cost allocation worksheet, what cost changes might be anticipated if the “Concept” model were operational?
4. On a scale of 1-5 (1 = No Benefit), how would you rate the Benefit/Cost potential of the “Concept” model for your operation?
5. If the “Concept” system were ready for implementation as described, would you likely integrate it? Yes ____ No _____
6. If the “Concept” model were changed to respond to your earlier suggestions, how would it change your 1-5 rating of the Benefit/Cost potential?

End of Interview. Thanks!