September 25, 2000

FINAL

Electronic Intermodal Supply Chain Manifest
ITS Field Operational Test Evaluation Plan

Submitted to:
U.S. DEPARTMENT OF TRANSPORTATION
Dr. Joseph Peters
Mr. Chip Wood
Mr. Lee Jackson

Contract #: DTF861-96-C-00098; SAIC 9811

Submitted by:
SAIC
10260 Campus Point Drive
San Diego, CA, 92121

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An Employee-Owned Company

NOTICE

Comments on this report are welcome, and may be provided to the Evaluation Team in written form via email, fax or mail to:

Mark Jensen
SAIC
10260 Campus Point Drive, MS C1
San Diego, CA 92121
Phone: 858-826-6875 ; Fax: 858-826-9131
Email: jensenm@saic.com

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.0 Introduction

In September 1999, the USDOT-FHWA (Federal Highway Administration) awarded funding for the Electronic Intermodal Supply Chain Manifest ITS Field Operational Test (FOT) to a consortium led by the American Trucking Associations Foundation (ATA Foundation). This FOT is based at Chicago's O'Hare International Airport and its primary focus will be the air cargo component of intermodal freight movements. The FOT will develop, install and test a universal electronic cargo manifest that uses smart cards and biometric technologies for automated transfer and clearance of cargo moving from truck to air.

A previous prototype deployment phase prior to this USDOT-sponsored FOT has been completed. "Phase I" was sponsored by the USDOT-FAA (Federal Aviation Administration) and the State of Illinois, and consisted of establishing a smart card/ biometric-based driver security system to improve the efficiency of truck access to airports for the delivery of air cargo by automating the transfer process which historically consisted of manually photocopying the driver's license for each bill of lading. The Phase I system allowed the driver to communicate his/her identity via a personalized smart card and biometric reading. In addition, each truck trailer was sealed at the point of origin and the seal number was loaded onto the smart card.

For this FOT, the second phase (Phase II) will expand the smart card/ biometric system to include electronic manifests, and broaden its deployment beyond the truck to air cargo interface to include the electronic dissemination of shipment data and status to all involved parties. This will include manufacturers, motor carriers, airlines/air freight forwarders, cargo receivers/ consolidators, and third party logistics providers. The only manual process in Phase II will be the actual verification of the shipment itself during unloading. This will be accomplished by loading key shipment data (via the electronic manifest) onto a driver's smart card at the time of pick-up, and then confirming the same information during the electronic screening process carried out by the airline/air freight forwarder clerk. Additionally, this FOT includes expansion of the system to Newark International Airport after the O'Hare system becomes operational.

In support of the USDOT's intermodal ITS program, an evaluation team lead by SAIC, under the direction of the USDOT Joint Program Office (JPO), was selected in January 2000 to develop and implement an evaluation of the Electronic Intermodal Supply Chain Manifest ITS FOT. The ultimate goal of this evaluation, as defined by the JPO, is to identify "lessons learned" with respect to implementing intermodal ITS technologies for four study areas: system operational processes, technology applications, institutional agreements, and user acceptance. These "lessons learned" will provide guidance to other states, regions, and MPO's involved in planning and implementing similar technologies. It will also provide guidance to the USDOT on the need and market for a national intermodal information systems standards and architecture.

The Evaluation Plan presented here has been developed to serve as a planning and guidance tool from which a successful evaluation effort can be implemented. The Evaluation Plan is typically the first major step in the evaluation life cycle.[1] This document will be followed by the

[1] There is sometimes also a preceding step in the evaluation life cycle with the creation of an Evaluation Strategy document. The Evaluation Strategy document is at a higher level than the Evaluation Plan, and is considered preliminary to the evaluation. In this case, the SAIC Team proposal to the USDOT-JPO in December 1999 contained the Evaluation Strategy for this FOT.

development of Detailed Evaluation Test Plans, which will define the specific work steps required to conduct the four specific evaluation study areas identified above.

In addition to the independent evaluation described in this document, the ATA Foundation, as the system developer and deployer, will be conducting its own "self-evaluation" activities in support of requirements for FAA and the State of Illinois[2]. Throughout the course of this FOT, the Independent Evaluation Team will work closely with the ATA Foundation to ensure that there is no significant duplication of effort, specifically in regards to the data collection efforts. The participants recruited for this test will be voluntarily participating, and every possible effort will be made to minimize the number of requests for data to support the two evaluation efforts. However, it will be necessary for the Independent Evaluation Team to have access to the participants and to the data collection tools developed by the ATA Foundation to ensure that the necessary data is collected and/or validated in support of this independent evaluation. This will be accomplished through close coordination between the two teams as the individual test plans are developed. For example, the survey instruments will be developed jointly and the evaluation team members will share the data collection responsibilities to ensure both teams collect their required data.

2.0 Electronic Intermodal Supply Chain Manifest ITS FOT Project Description

2.1 Introduction

Many existing ITS intermodal programs focus on the seamless shift of freight between modes, most notably the truck-to-rail movement. The Electronic Intermodal Supply Chain Manifest ITS FOT looks at the truck to air intermodal move. The objective of this FOT is to improve the efficiency and security of truck to air cargo operations. Air transport is the fastest growing freight transportation mode today with both volume and revenue projected to double by 2006. Although airfreight comprises only 1% of total freight moved worldwide by weight, it accounts fort 38% of total freight by value. Airfreight can therefore be classified as high value/low density products with a heightened requirement for timely delivery. As air is the most expensive mode of transportation, a shipper must recognize the value in time-savings to justify the added shipping costs. The use of ITS to improve the efficiencies of the modal transfer points can therefore add value to the operation by streamlining the transfer of cargo from truck to air resulting in time savings and improved record keeping for security requirements.

Air cargo is subject to many more restrictions than other cargo due to the fact that nearly 60 percent of air cargo is carried in the bellies of passenger planes. Due to the high potential of serious consequences, air cargo security is held to very high standards. The FAA regulates and mandates proper shipment of air cargo to protect airline passengers and the general public. Security concerns range from theft to terrorism. In addition, the efficiency and tracking of intermodal air cargo is critical to supply chain management and often requires costly national

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2 Integrated Cargo Information and Security System for Intermodal Distribution Channels - Evaluation Plan, ATA Foundation June, 2000.

and international phone calls, overnight document deliveries, and multiple hardware platforms and software programs to communicate with the airlines/airfreight companies and/or the trucking companies serving the air cargo system.

This project will address both the public and private sector concerns identified above. It will develop a secured electronic manifest that allows manufacturers to send cargo information real-time along the distribution channel in advance of pick-ups and deliveries. And the electronic manifest offers a secured identity process through biometric imprints (fingerprint recognition) in addition to the reduction in information errors due to electronic processing at all times. These improvements to the data transfer efficiencies and security steps should add value to the truck to air cargo transport operation.

2.2 System Overview

Phase I of this project was sponsored by the Federal Aviation Administration (FAA) and the State of Illinois, and consisted of establishing a smart card/ biometric-based driver security system to improve the efficiency of truck access to airports for the delivery of air cargo. This was accomplished by automating the transfer process which historically consisted of manually photocopying the driver's license for each bill of lading. The Phase I system allowed the driver to communicate his/her identity via a personalized smart card and biometric reading. In addition, each truck trailer was sealed at the point of origin and the seal number was loaded onto the smart card. This phase also allowed the FAA to review its "known shipper" regulations and protocols. This phase (Phase I) involved over 500 drivers and eleven airlines and/or freight forwarders. This project indicated that biometric identification and smart card systems can provide tangible improvements in air cargo security and greater efficiencies for motor carrier operational processing. It determined that comprehensive training and communication programs must be developed to ensure user acceptance. Additionally it was determined that technology upgrades must be performed regularly to ensure high system performance.

Phase II of this test includes the implementation of a new type of real-time electronic identification system, which will be deployed at Chicago O'Hare International Airport and later at Newark International Airport. The objective of the test will be to facilitate efficient truck to air intermodal movements while increasing the security of the air cargo industry.

All participating drivers will carry biometrically encrypted smart cards. Each card will contain an electronic version of the Commercial Drivers License (CDL), an electronic version of all cargo manifests assigned to the driver, and an encrypted file containing a representation of the driver's thumbprint – allowing all parties along the delivery chain to verify the identity of the driver and contents of the shipment.

Airlines and Freight Forwarders will receive advance notice of approaching deliveries and can compare the master electronic manifest with the information stored in the driver's smart card, after biometrically confirming and recording the identity of the driver.

Cargo Recipients and Freight Consolidators (the end users and/or warehouses of the original shipment), will also be able to receive the secured manifest when the shipment is first released by the shipper, thereby allowing them to track the progress and expected delivery time of the shipment throughout the transit time.

Figure 2-1. FOT Biometric Fingerprint Identification Technology[3]

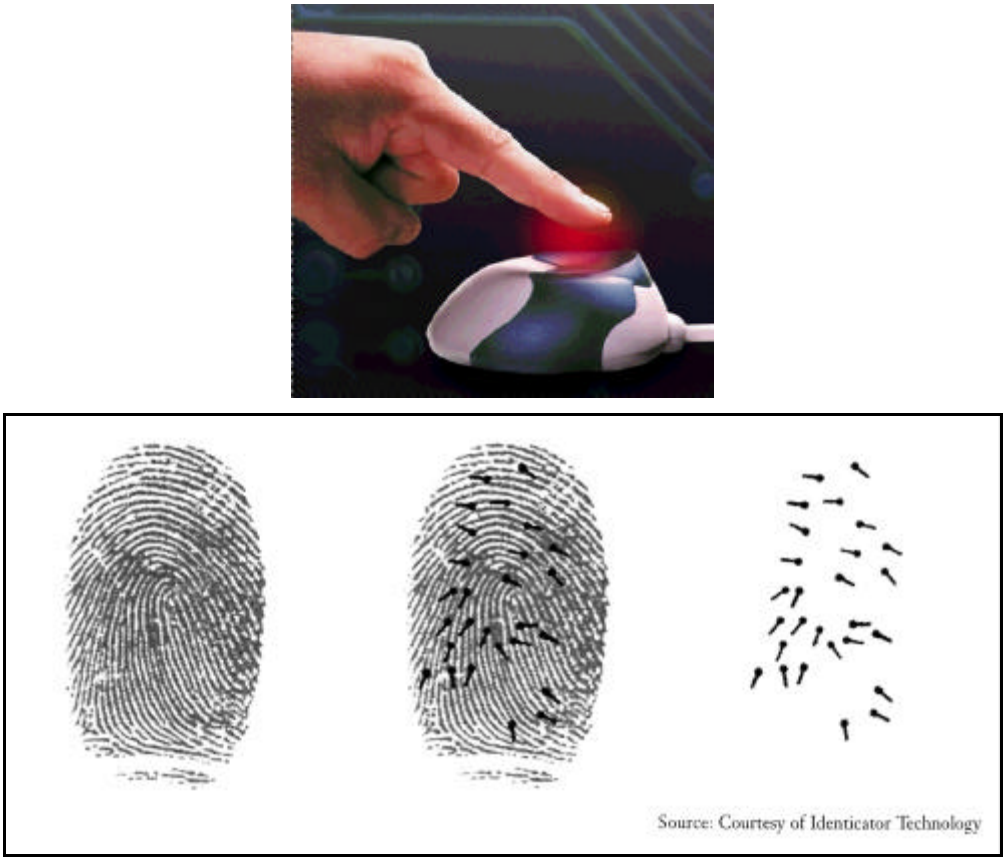
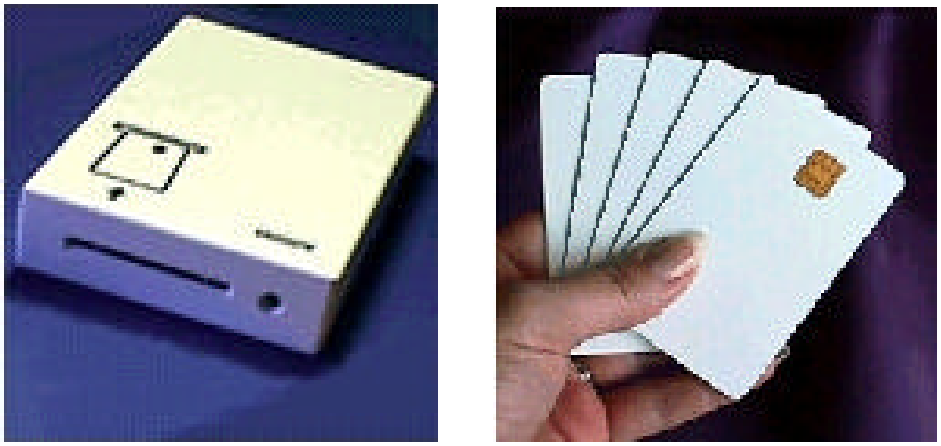


Figure 2-2. Phase 1 Smart Card Reader and Smart Cards



[3] Here, the fingerprint is scanned and converted to a "minutiae" template as shown on the lower graphic at the far right. This represents a mathematical representation of the fingerprint which is easily stored and retrieved in information systems. (This method of fingerprint storage and identification is the most common type in existence.)

It is important to understand how the Phase I system worked since Phase II builds on the success of Phase I. Figure 2-3 illustrates the concept of the FOT for Phase I and the planned concept for Phase II, as well as an overview of the information flow for Phase II.

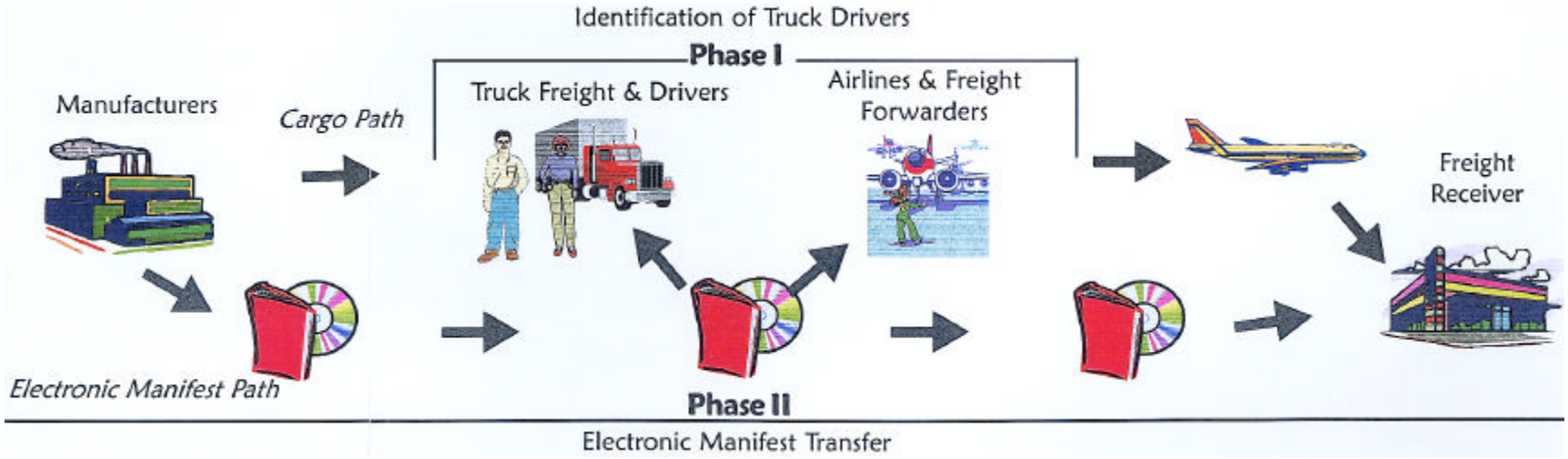
In Phase I, a computer at each of the enrolled trucking companies was equipped with a smart card reader and software. Prior to delivery at the airport the driver placed a numbered seal on the trailer door and entered the seal number and cargo information into the computer. The smart card was then created with the seal and driver information on it. The driver then proceeded to the air cargo loading area and the air cargo attendant read the card along with the driver's thumbprint. The attendant's computer then pulled up a picture of the driver, driver information, and seal number. The computer then displayed an approval, denial or request for additional information. The attendant checked the seal on the container and allowed the driver to proceed to the unloading area.

Phase II builds on the Phase I technologies. Using the truck driver/ cargo access system developed in Phase I, Phase II will integrate a newly developed biometrically secured electronic manifest. When a manufacturer is ready to ship they will call up a specially developed Electronic Data Interface (EDI) –based manifest screen. The manifest is then sent to the arranged carrier. The electronic manifest is then placed on the driver's smart card along with a biometric imprint (thumbprint) of the driver. When entering the airport, airline, or freight forwarder, the driver enters the facility, swipes the smart card and has their thumbprint read. The centralized database instantly confirms, or rejects the driver based on the previously enrolled template information. At this stage the freight forwarder's system compares the cargo manifest from the drivers smart card with the electronic manifest received directly from the manufacturer. If the two manifests compare correctly the driver is admitted to the area for delivery. There are two Phase I components that will change in Phase II. First, the use of seals will be eliminated in Phase II. And second, the driver's photographs will not be loaded onto the smart cards electronically. Instead, they will be physically attached to the card, just like a driver's license.

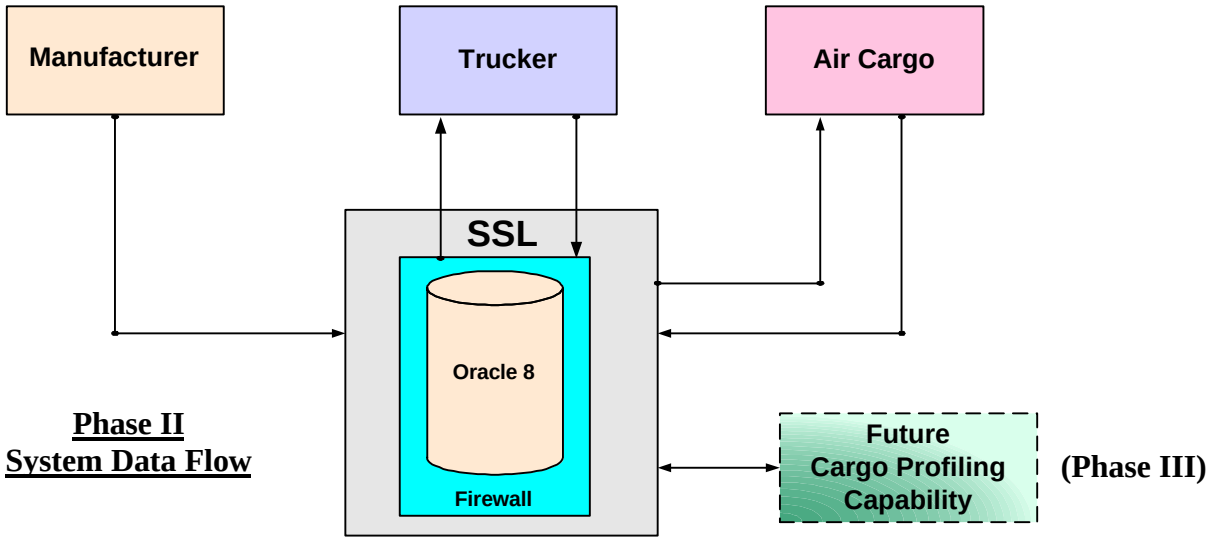
This project has the potential to link to freight activities at the Metropolitan Planning Organization (MPO) level. Suggested methods include providing links to project web sites connecting carriers to Advanced Traveler Information Systems (ATIS) in the Chicago area such as the Gary-Chicago-Milwaukee Priority Corridor project. The GCM ITS Priority Corridor Program is multi-agency program comprised of all of the major transportation agencies in the Corridor, including the state departments of transportation for each of the three states and the Federal Highway Administration. Transportation information provided by an interagency project such as this can enhance freight mobility and this avenue will be explored in this evaluation. One possible measure to implement would be a web link on a project internet page allowing a carrier direct access to ATIS information provided by the GCM Program. Web links can also be provided with email messages sent through the normal course of project activities.

The Phase II system architecture and electronic manifest will build into a planned Phase III project so that future cargo information and security systems can be incorporated. The Phase III Automatic Cargo Profiling concept would analyze standard cargo information cells, make dynamic comparisons between cells and known characteristics of dangerous goods, and provide clearance approval or rejection with "red-flags" for goods requiring additional inspection. Phase III will likely be moving forward at the completion of Phase II with anticipated funding from the U.S. Federal Aviation Administration.

Figure 2-3. Electronic Supply Chain Manifest Concept Overview & System Data Flow



source: ATA Foundaton, March 2000



2.3 Participants and Users

The main participants in this test will include representatives from the private and public sectors. There are three main groups of participants. The first group consists of the participants responsible for developing and deploying the systems. The second group consists of the regulatory agencies responsible for reviewing and approving the FOT components and facilitating the deployment process. The third group consists of the operational participants who are responsible for incorporating the FOT into their operations.

Based on this, the list of participants is extensive and includes the following: the ATA Foundation, Chicago O'Hare International Airport, Illinois DOT, Chicago Area Transportation Study (CATS), FAA Hughes Technical Center, The U.S. DOT, Newark International Airport, 3M Supply Chain Management, SecurCom Inc., Identix, Advanced IT Solutions, the Central States Expedited Carriers Association, the International Air Cargo Association of Chicago, the Illinois Dept. of Commerce & Community Affairs, the City of Chicago Department of Aviation, and the participating trucking companies, manufacturers, airlines, and air freight forwarders. The private industry participants will be recruited as the FOT progresses.

2.4 Schedule

The proposed schedule for this FOT is still under consideration by the ATA Foundation. The weak link in specifying a schedule commitment is the need to recruit trucking companies and manufacturing firms. Before the recruiting begins, the companies must be approved by the State of Illinois, FHWA, and the FAA. This is anticipated to be a time consuming process.

The schedule for the FOT Evaluation will depend on the progress and schedule of the ATA Foundation for the FOT. The current schedule has the ATA Foundation system up-and-running by October 2000. This may or may not include the completion of recruitment process. The SAIC team will update the evaluation schedule as necessary to meet the needs of the overall project success.

3.0 Evaluation Plan

3.1 Evaluation Objectives/Study Areas

At the direction of the USDOT-JPO (ITS Joint Program Office), this evaluation is based on the following four major objectives, which will serve as the main "study areas" for this evaluation:

- Identify improvements in ***Intermodal Freight System Operations*** resulting from ITS technologies;
- Assess the ***Technical Effectiveness*** of the technology applications in fulfilling their stated functions (this is also to include an assessment of implications for the ITS National Architecture and Standards);
- Assess the ***Customer Satisfaction*** expressed by key information users; and
- Identify the key ***Institutional Challenges*** encountered in establishing partnerships and sharing information among public agencies and private businesses.

The ultimate goal of these evaluations, as defined by the JPO, is to identify the "lessons learned" with respect to implementing intermodal ITS technologies for these study areas. These lessons learned will provide guidance to other states, regions, and MPO's for planning and implementing similar technologies, and will also provide guidance to the USDOT on the need and market for an intermodal information systems architecture and standards.

The remainder of Section 3 provides a detailed discussion of the plan for conducting the independent evaluation of the four study areas presented above. As described in Section 1.0, the evaluation activities undertaken in each of the four study areas will be coordinated with the ATA Foundation's "self evaluation" to ensure that there is no duplication of effort in the data collection activities and to validate the data collected by the ATA Foundation. In addition, the data collection activities will be coordinated across the four study areas to limit the number of times participants are contacted for data. For example, personal interviews will be a significant source of data for this evaluation. The voluntary participants will have limited time to donate to our data collection activities. Therefore, the interview guides will be developed to accommodate the collection of all relevant data. This will be discussed in more detail as the individual evaluation test plans are developed later this year.

3.2 Intermodal Freight System Operations Evaluation

In evaluating the introduction of ITS technologies in the Electronic Intermodal Supply Chain Manifest ITS FOT, it is necessary to evaluate the impacts on the overall freight system. For this evaluation, the focus will be to assess the benefits that are derived from the deployed systems to the private and public participants. For example, the benefits to the freight industry may include reductions in delay at airport gateways, productivity increases, security improvements, logistics improvements, and economic benefits. For the public sector agencies, the benefits may include increased security for air cargo, increased efficiency of record keeping in case of an incident, and the ability to collect freight data for planning purposes. These measures characterize the implementations in terms of global intermodal freight measures of improvement and they are quantified in the terms of the overall ITS goals of improvements in Mobility, Effectiveness, Safety, Productivity, and Energy and Environment.

The overall freight system impacts will be evaluated by identifying the changes in operations and information flow between the pre-test conditions and test conditions associated with the deployment of the Phase II electronic manifest system. Section 2.0 of this document provides a detailed description of the overall operational test, and specifically, the Phase II system.

In developing the plan for the freight system operations evaluation, it is important to understand what new capabilities these tests provide the region's shippers and carriers, and how each of these tests will be integrated to form the new service. Phase I of this operational test has already taken place. This tested the use of smart cards, biometric finger print readers, and trailer seals. The evaluation will incorporate the lessons learned in Phase I and the differences in operations between current conditions and Phase II. Phase II introduces the electronic manifest system and maintains use of the smart card and biometric finger print reader technologies.

Figures 3-1 through 3-3 have been developed to illustrate the differences between the existing conditions, Phase I, and Phase II. In Figure 3-2, the green boxes highlight the changes from the existing conditions. In Figure 3-3, the yellow boxes highlight the differences between the Phase I and Phase II processes. For example, Figure 3-1 shows the manual process currently in place for air cargo shipments originating at a shipper's warehouse or plant. In Figure 3-2, the use of

biometric technology for finger print reading is introduced. In Figure 3-3, the electronic manifest is added to the biometric and smart card system. These figures help identify the changes in the system where there is potential for measuring the benefits and costs associated with the new system.

These information/freight flow figures will be referenced and modified as appropriate as the evaluation progresses. It is intended that based on the evaluation results at the end of this study (and possibly elements of the other 3 study areas), that example freight timelines would be created using these flow charts that would clearly show the benefits and costs realized by the ITS solutions at each stage of a typical air cargo movement. The remainder of Section 3.2 describes the details of the system operations evaluation planned for this operational test.

As detailed in Section 2, this field operational test will use smart cards, biometric finger printing technology, and electronic manifest software to facilitate the movement of air cargo shipments from a manufacturer's site to the airport while providing improved security. Each participating manufacturer will be equipped with electronic manifest software, smart card readers and writers, and biometric finger print readers. Each participating motor carrier will be equipped with smart cards and each driver will be registered via biometric technology. Each participating airline and air freight forwarder will be registered via biometrics and will be equipped with biometric and smart card readers as well as the necessary manifest software.

As a shipment departs the manufacturer's dock, the shipment information via the electronic manifest, will be emailed to the key shipment stakeholders, specifically the motor carrier, the air freight forwarder, and airline. This will serve as notification that the shipment has been released. In addition, the shipment will be assigned to the driver via the smart card and biometric finger printing technologies. All of this information is verified upon arrival at the air freight forwarder, and another email is sent recording the transfer of freight from truck to air. This system will enhance the level of communication among the shipment stakeholders resulting in improved operations. In addition, the security of the shipment via use of the smart card and biometric finger printing processes will be enhanced.

Figure 3.1 Pre-Deployment Process

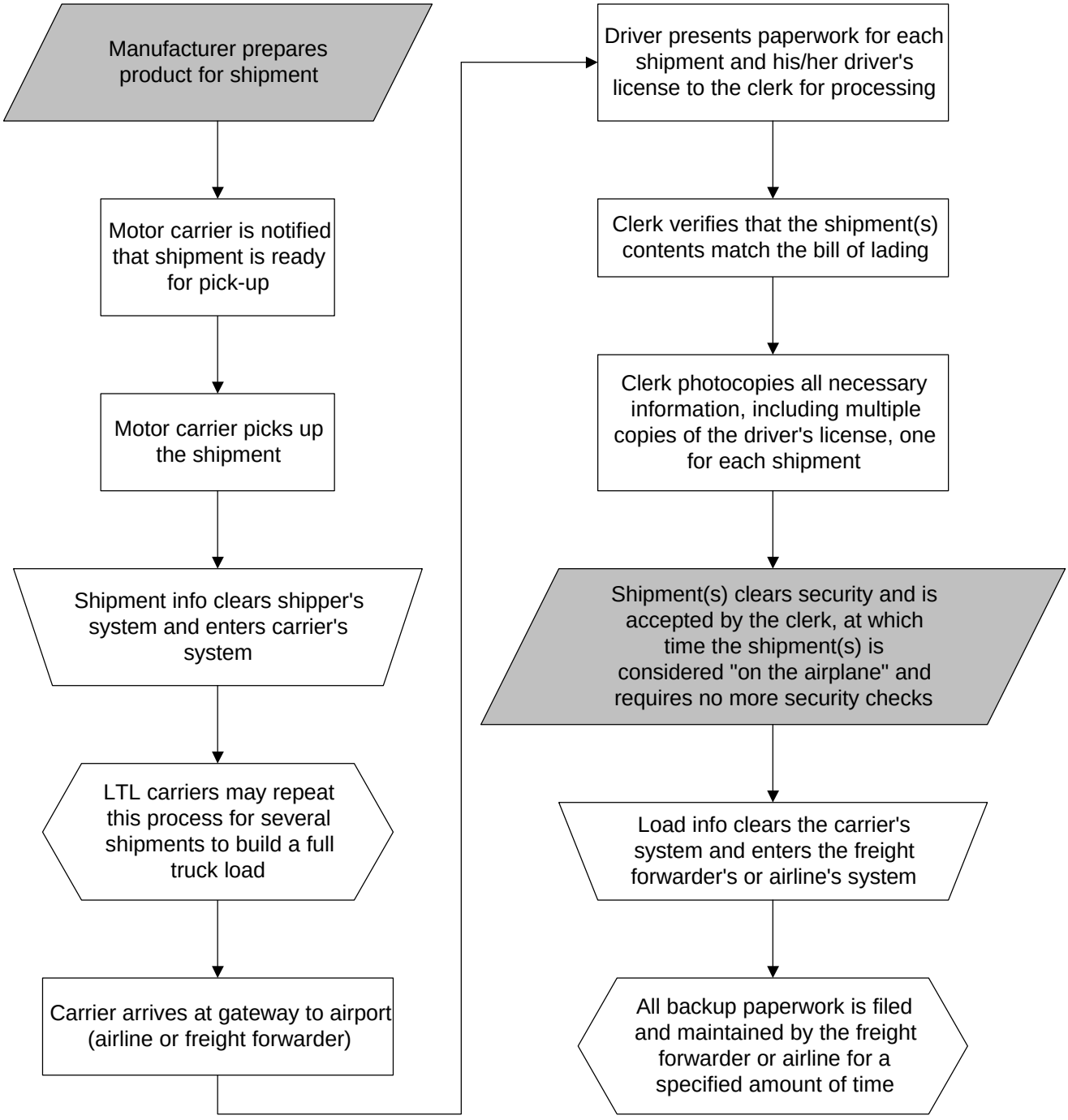


Figure 3.2 Phase I: Deployment Process

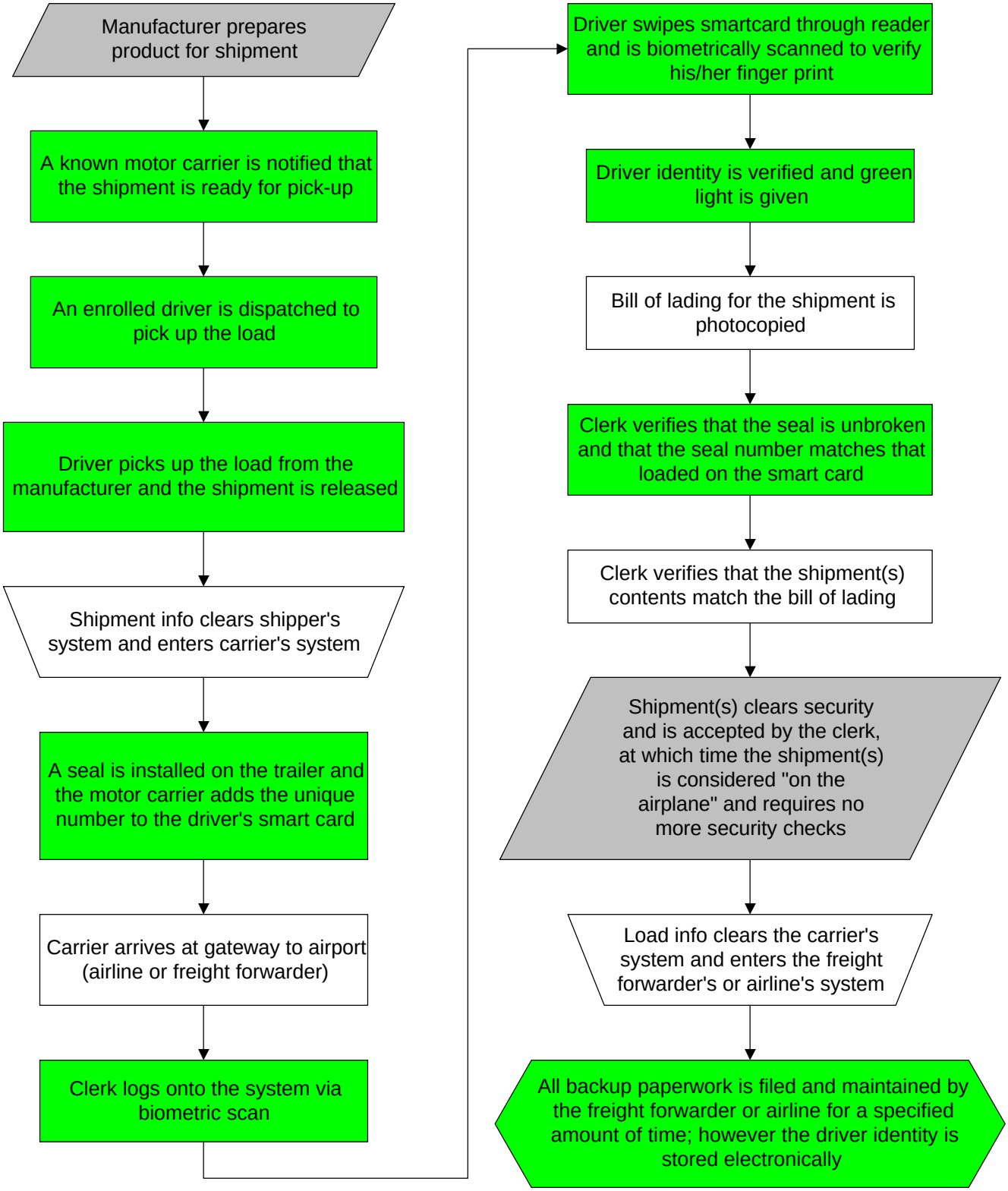
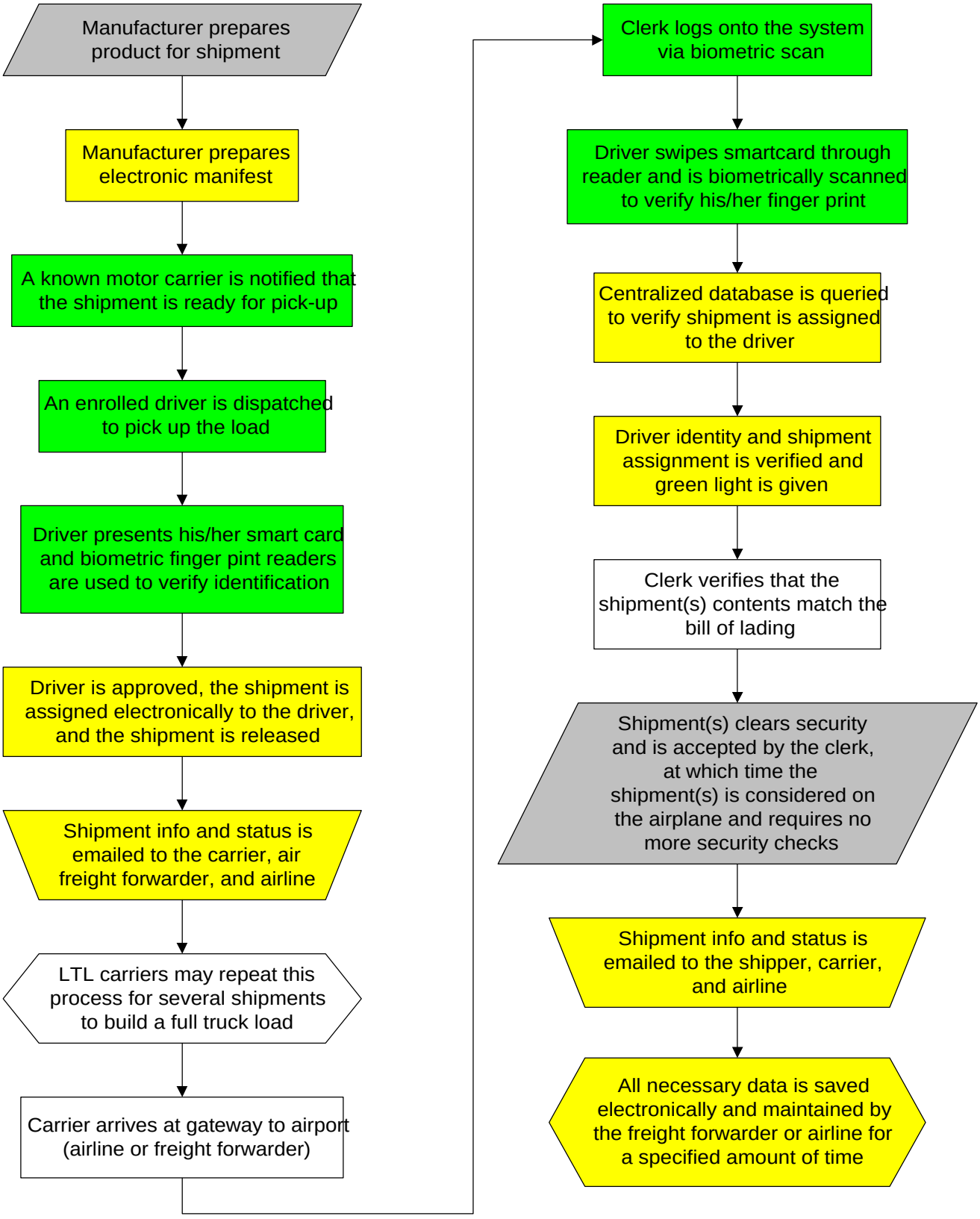


Figure 3.3 Phase II: Deployment Process



Evaluation Approach

The objectives of this field operational test are to provide shippers with the ability to better track their shipments across multiple modes, communicate more efficiently with the transportation service providers, and increase the security of air cargo operations. The specific goals, in order of importance for this evaluation, consist of the following:

- Reduce the processing time associated with the transfer of a shipment from truck to air;
- Improve the accuracy and communication of shipment information among shippers, carriers, intermediaries, and receivers,
- Improve freight logistics management operations;
- Improve the level of security of air cargo operations; and
- Provide connectivity to regional commercial vehicle operations (CVO) ATIS (GCM Corridor)

Table 3-1 summarizes the evaluation approach proposed to address these objectives. It presents the goals, hypotheses, measures of effectiveness, and data requirements. There are multiple references to stakeholder interviews as key data sources for each of the study areas defined at the beginning of this section. In the actual deployment of this evaluation plan, there will be one set of interviews conducted for both "before" and "after" testing with the various stakeholders that collects all the required data for all of the study areas at one time.

Data Collection and Analysis

In order to conduct an effective evaluation of this test, the appropriate set of data, and potential sources of the data, must be defined and identified. Later in the process, detailed data collection plans will be developed that provide a specific scope of work to be completed for this evaluation. At this stage, it is important to describe the methodology that the evaluation team plans to use for this specific activity. As the deployment activities progress, there may be variances in what is actually deployed versus what was planned. The evaluation team will monitor the progress of the deployment and be prepared to modify and adjust the data collection plan as necessary within the available resources.

This plan will address the data components required for this test. The focus of the efforts will be to identify and interview the key participants involved in the development and deployment activities. This will consist of interviewing representatives from the technology development and deployment staff, the ATA Foundation management team, participating shippers, motor carriers, airlines and air freight forwarders, airport personnel, and other key stakeholders. These interviews will collect data on how the system was implemented, how it worked, what the key issues were, how it could have been improved, did it meet expectations, etc. In addition, more quantitative data will be collected. This will include automated system performance reports, and logs maintained by the shippers, carriers, airlines, and air freight forwarders. These will identify actual quantitative changes in the freight operations of the participants, such as change in manifest processing time, change in on-time delivery performance, and change in the queue time at airlines and air freight forwarders during the transfer of shipments from truck to air.

Table 3-1. Intermodal Freight System Operations Evaluation Approach

Goal	Hypothesis	MOE	Data Sources or Requirements	Analysis
Reduce the processing time associated with the transfer of a shipment from truck to air.	Positive identification of drivers and cargo will be made much quicker and with greater confidence.	Change in processing time required at the check in with an airline/air freight forwarder.	Processing time logs, data, and interviews. Time savings data collected and analyzed during Phase I will be a key data source for this component.	Compare processing time for participants vs. control and estimate increased confidence in identification based on qualitative interviews.
Improve the accuracy and communication of shipment information among shippers, carriers, intermediaries, and receivers.	Dissemination of the manifest to key shipment stakeholders will improve estimated time of arrival.	Change in delivery performance due to access to real-time shipment status data.	Interviews with participants to measure accuracy of shipment information and changes in delivery performance.	Comparison of on-time delivery record before and during test, and validation that the real-time shipment status information is accurate.
Improve freight logistics management operations.	Reductions in manifest preparation time will result in cost savings.	Change in time or cost due to automation.	Preparation time for electronically and manually prepared manifests.	Analyze electronically generated manifest vs. manually generated manifests.
Improve the level of security of air cargo operations.	Use of biometric verification and smart cards will increase the level of security.	Perceptions of airline/air freight forwarder staff on change in safety. Change in quality of required record storage.	The biometric security system analysis provided in the Phase I report will be a key data source. Qualitative analysis of check-in operation, including required record keeping via interviews. Review of manual and automated records maintained by airlines/air freight forwarders.	Compare participants vs. control and estimate increased confidence in identification based on qualitative interviews. Compare manual and automated record keeping procedures of airlines/air freight forwarders.
Provide connectivity to regional commercial vehicle operations (CVO) ATIS (GCM Corridor)	Interconnectivity between air cargo and CVO ATIS will be beneficial to the trucking community	Number of referrals (hits) from the FOT web site to the GCM ATIS web site.	Interviews with participants to identify the usefulness of the ATIS. Cooperation with GCM is necessary as it will need to provide the referral information (number of hits related to the FOT).	Compare participants' use of the GCM ATIS prior to the FOT vs. during the FOT. Analyze the usefulness of the GCM ATIS for CVO based on qualitative interviews.

The data collection and analysis activities will incorporate the activities proposed by the ATA Foundation's "self evaluation" plan. Specifically, the evaluation team will make use of the methodologies defined in the ***Integrated Cargo Information and Security System for Intermodal Distribution Channels Evaluation Plan***, prepared by the ATA Foundation. Note that the methodologies defined by the ATA Foundation are primarily relevant to the Intermodal Freight System Operations Evaluation. This is related to the goals of the FOT, which are to develop a system that improves the efficiency and security of truck to air cargo movements. The independent evaluation team also will focus on the institutional challenges and customer satisfaction, as defined in the following subsections. The data collection activities defined for these two additional efforts also will be coordinated with the ATA Foundation's methodologies. The following methodologies defined by the ATA Foundation will be incorporated for this study area:

- *Time/motion study by direct observation of manifest preparation times (manual and electronic)-potential outcome maybe that the manifests are prepared manually, then entered into system. The observations should be conducted at the beginning and completion of the operational test.*
- *Interview or questionnaire of manifest preparers to document process and determine approximate duration times.*
- *Questionnaire of participants to determine approximate turn-around time on manifests. This is to form baseline data for manual submission.*
- *Obtain system transaction reports from carriers currently using EDI for manifest transactions. This is to form baseline data for automated systems.*
- *Obtain transaction reports from electronic manifest services to form "improved" turn around time database.*
- *Questionnaire/interview processors of manifests to document type and frequency of errors, and processes for detecting and rectifying the errors (both currently manual and EDI systems). This is to also determine error tolerances (i.e., percent error rate acceptability and what types of errors require action).*
- *Randomly sample manifests throughout logistics chain to observe variances in content as the manifest moves along.*
- *Establish system filters for error detection within electronic manifest systems and document type and frequency of errors.*
- *Develop dummy error manifests based on combinations of frequency and types of errors defined to determine electronic manifest services detection and notification responses.*
- *Maintain a stream of dummy manifests throughout the system to determine possible manipulation within logistics chain-comparison of manifest content at various points in the chain. Introduce variation to test system ability to detect manipulation.*
- *Throughout operational test of electronic manifest services, administer a questionnaire to participants on a bi-weekly or monthly basis. The questionnaire will ask the participants to detail their use of the system (quantity of transactions or percent of total transactions); and*

to indicate on a Likert scale their perceptions of: convenience; system accessibility and dependability; willingness to use; and productivity improvements.

In addition, as the more detailed individual test plans are developed later this year, the independent evaluation team will work with the ATA Foundation's internal evaluation staff to define and prepare the data collection tools and protocols to ensure that the most effective use of resources is achieved without compromising the validity and integrity of the data or inconveniencing the participants any more than necessary.

3.3 Technical Effectiveness Evaluation

To assess the effectiveness of the technologies and to identify needed system improvements it will be necessary to evaluate the technologies based on an assessment of the actual technical performance of system components in their operating environment. Table 3-2 illustrates the major new technologies introduced from these tests, and provides the corresponding assessments which will be made to evaluate these technologies, both separately, and as an integrated system.

Table 3-2. Technology Effectiveness Evaluation Approach

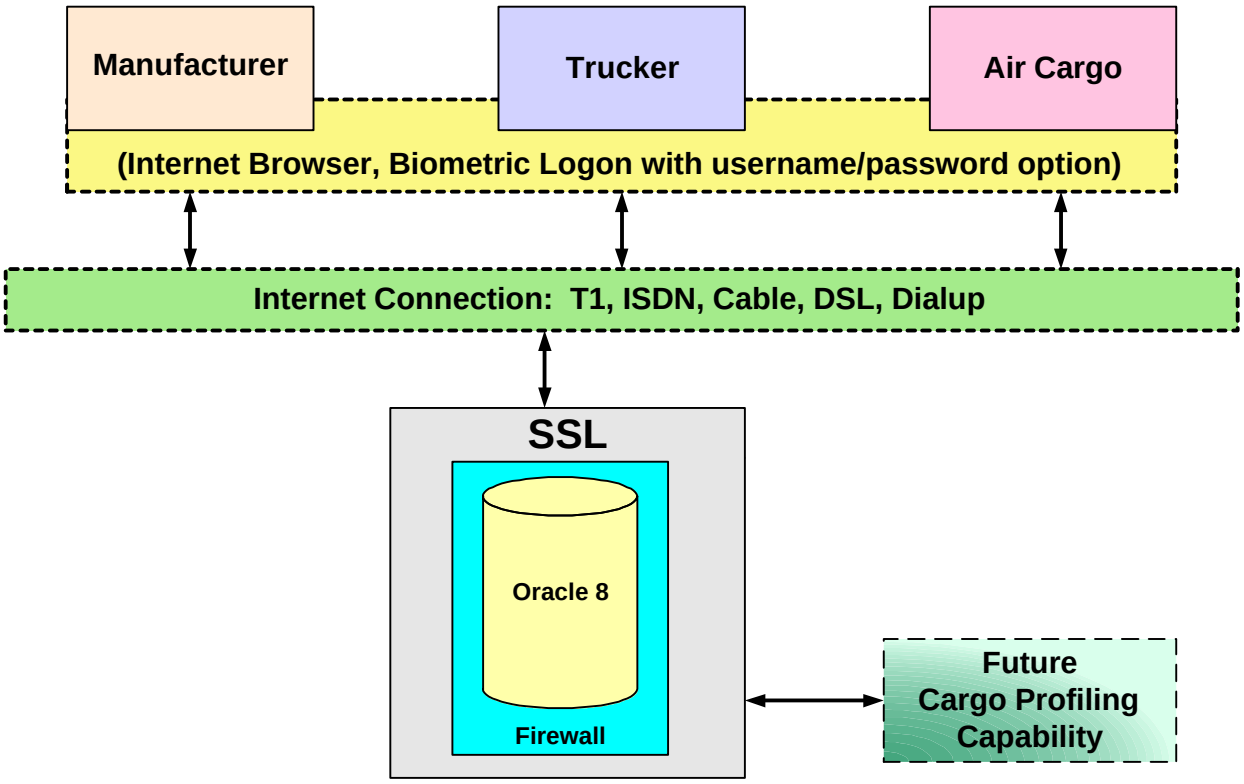
Technologies Introduced	Assessments and Data Sources

• Integrated Air Cargo Information System with Electronic Manifest, Smart Cards, and Biometric Identification	• ATA FOUNDATION System Administration Reporting & Statistics
	  • Positive association of Driver with Electronic Manifest
	  • Overall System Reliability/Availability/Maintainability, including comparison before and after Newark site expansion
	• Assessment of technical performance of hardware and software provided to trucking companies and manufacturers; based on survey instrument

• Electronic Manifest	• Electronic Manifest comparison and transfer error rates between System Electronic Manifest and Smart Card Electronic Manifest; based on System Administration Reporting and Statistics • Comparison of Electronic Manifest technology developed here with other emerging Electronic Manifest developments with regard to potential new standards
• Smart Cards	• Phase 1 Final Report • Smart Card error rates; based on System Administration Reporting and Statistics • Review of National Smart Cards standards development and emerging analogous technologies
• Biometric Fingerprint Identification	• Phase 1 Final Report • Phase 1 Biometric System Evaluation detailed results by U.S National Biometric Test Center • Comparison of False Rejection Rates and False Acceptance Rates of Phase 2 Biometric system with Phase 1 Results (i.e. validation of Phase 2 Biometric system); based on analysis of U.S. National Biometric Test Center • Biometric Standards assessment based on interviews with Dr. F.L. Wayman, U.S. National Biometric Test Center

This table was developed following technical discussions with the ATA Foundation system engineering team. To date, the ATA Foundation Team has provided the Evaluation Team with its Phase 1 Final Report, as well as preliminary information on the proposed Phase 2 system. An overview of the proposed Phase II general system architecture is presented below in Figure 3-4. This system will utilize a Windows NT 4.0 server, and will have at its core an Oracle relational database, similar to that which was deployed under Phase 1. The system will use an Internet-based communications architecture, and remote sites (e.g., truckers, air cargo, manufacturers) will access the system via customized software developed by the ATA Foundation Team. The system engineering team is also currently investigating whether the system should utilize XML or EDI transactions.

Figure 3-4. Phase 2 Proposed System Architecture



This evaluation will rely extensively on the examination of the ATA Foundation Team System Administration Reports. These reports will provide detailed logs of performance data from which analyses of system performance can be developed. The Evaluation Team has already had preliminary discussions with the ATA Foundation Team on its desire to use these reports and to provide inputs to the ATA Foundation Team as to the contents and formats of these reports so that they will be able to provide the necessary information to support the evaluation analyses. The ATA Foundation Team currently has an Action Item to provide the Evaluation Team a baseline set of system administration performance parameters for review and comment.

Where appropriate, results of the Phase 1 Final Report and supporting analyses will be used to support the Technical Effectiveness Evaluation. This is especially true of the biometric

fingerprint identification technology assessment, and to a lesser extent, the smart card technology assessment.

The technical basis for the use of biometric fingerprint identification for this air cargo application was already independently evaluated under Phase 1 by Dr. James Wayman of the U.S. National Biometric Test Center at San Jose State University. Dr. Wayman is an internationally recognized leader in the analysis of biometric technologies. Dr. Wayman utilized a proven methodology to evaluate the Phase 1 system; the methodology involved the use of over 2220 actual biometric data points from the operational Phase 1 system. Regarding the Phase 1 system, Dr. Wayman concluded: [4]

> *In short, we conclude that the error rates for this pilot project are entirely reasonable and acceptable for systems of this type. A full deployment with required use by all drivers should yield operationally acceptable levels of false rejection. False acceptance error rates are completely acceptable and are comparable to 4-digit PIN systems.*

Dr. Wayman's detailed results from the Phase 1 evaluation will be reviewed by the Evaluation Team when they are made available by the ATA Foundation Team, and the Evaluation Team will also interview Dr. Wayman. Appropriate results will be provided in the Evaluation Final Report. Dr. Wayman will be involved to a lesser degree in performing a biometric analysis of the Phase 2 system. Here, the Evaluation Team intends to utilize Dr. Wayman's analysis to validate that the biometric technology implementation in Phase 2 is at least as successful as in Phase 1.

In addition, under the direction of the USDOT-JPO, the Technical Effectiveness Study must also produce a separate **National Architecture Implications Summary Report** which will provide the following:

- An assessment of adherence to the ***ITS National Architecture*** and appropriate ***Standards***
- Potential new architecture components and data exchange methods utilized in these tests which could be considered for a new intermodal component of the ITS National Architecture; i.e., focusing on the potential emergence of technologies, procedures and deployment experience which could lead to the development of Standards for merging the FOT hardware and communications elements with the ITS National Architecture
- An assessment of the technical ability to scale these systems to regional or national levels

Here, with regard to ITS Standards, this FOT presents an opportunity for this evaluation to examine in detail three new standards area of significant interest to the ITS community:

1) ***Electronic Manifests***. This is an emerging technology of which this FOT is one of the first examples of. There is one other related application that U.S. Customs is developing – the Automated Export System (AES) Air Cargo Manifest system will reportedly be completed sometime in 2000. The evaluation will look at these two examples and others if appropriate, and make recommendations concerning the development of a potential Electronic Manifest Standard for the ITS National Architecture.

[4] from: "O'Hare Cargo Security Access System: Testing the Effectiveness of Biometric Smart Card Security," Cooperative Agreement 97-G-036, prepared by the ATA Foundation for the U.S. Federal Aviation Administration – William J. Hughes Technical Center, June 2000.

2) ***Smart Cards***. The smart cards used in Phase 1 and Phase 2 of the FOT's are commercial-off-the-shelf technologies. However, there are currently several major technologies available for smart cards, and no standards have been agreed upon yet by the many industries currently deploying them. A related implementation is the INSPASS Smart Card system being utilized by the U.S. Customs at Newark International Airport for automated entry for international air passengers. The evaluation will examine this and other applicable examples of Smart Card use, and make recommendations concerning the development of a potential Smart Card Standard for the ITS National Architecture.

3) ***Biometric Fingerprint Identification***. A number of biometric fingerprint systems are currently available commercially and are being deployed across the U.S. In examining how the system in this FOT relates to other available biometric fingerprint systems, the Evaluation Team will interview Dr. James Wayman of the U.S. National Biometric Test Center at San Jose State University.[5] Based on this interview and the results of the implementation of biometrics for this FOT, the Evaluation Team will make recommendations concerning the development of a potential Biometric Fingerprint Identification Standard for the ITS National Architecture.

The National Architecture Implications Summary Report will be in a "Case Study" format, and will present conclusions based on the analyses detailed above and the technology assessments described earlier. This report will also contain corresponding results from the other ITS intermodal evaluation being conducted (WSDOT Intermodal Data Linkages FOT).

3.4 Institutional Challenges and Customer Satisfaction Lessons Learned

Based on discussions with USDOT, the Institutional Challenges and Customer Satisfaction evaluation objectives are being combined under a single qualitatively-based "lessons learned" study area. The overall approach to this lessons learned study will be to first make the best use of existing FOT documentation, meeting minutes, surveys and analyses produced by the FOT partners and others to define and incorporate institutional and customer satisfaction data already collected to date (or that the FOT partners plan to collect in the future). Following this, where required, the Evaluation Team will then conduct interviews or administer surveys to the appropriate stakeholder/user groups as necessary to further augment the lessons learned. These data collection activities will be coordinated with the interviews and surveys conducted as part of the intermodal freight system operations study area.

A discussion of the evaluation plan for both the Institutional Challenges and the Customer Satisfaction component of this lessons learned evaluation are presented below.

[5] Ibid. According to Dr. Wayman, in the biometrics industry, Application Programming Interface (API) standards have emerged as the fastest growing area of biometric standards development. By creating an API standard for the biometrics industry, the industry would be able to offer easier substitution of biometric technologies, improved integration of multiple biometrics and the ability to use biometric technology across multiple applications. The API standard would act as a template for all programs to accept biometric technology.

3.4.1 Institutional Challenges Lessons Learned

The Institutional Challenges Lessons Learned Evaluation will focus on the degree to which the FOT improves interagency and public/private cooperation in each region, particularly with respect to information exchange and coordinated operations. In addition, the evaluation will identify non-technical issues that affected the planning and implementation of the operational test, and strategies that were successful (or unsuccessful) in mitigating the impact of these issues. Objectives, hypotheses, MOEs, and analytical tasks for this evaluation are provided in Table 3-3. The specific goals, in order of importance for this evaluation, consist of the following:

- Assess the impact of the FOTs on interagency coordination;
- Assess the impact of the FOTs on public/private coordination; and
- Assess challenges relative to the development of information sharing agreements.

Particular attention in the evaluation will be given to the challenges encountered in establishing information-sharing agreements among these diverse entities. Private sector participants express two major concerns: how data is used, and who has access to data? Public sector participants frequently find it difficult to get agencies that historically have not worked together to begin sharing data. A particular concern here is the sharing of cost information. Additionally, establishing effective public-private agreements can be difficult. Although these are well accepted in concept, partnering between a government agency that provides a service and a private sector entity that is profit-oriented requires the blending of what can be contradictory models. Public agencies often use a consensus-based decision making process while private sector entities respond to market (customer) demands.

Table 3-3. Institutional Challenges Evaluation Approach

Goal	Hypothesis	Measures of Effectiveness	Data Sources or Requirements	Analysis
Assess the impact of the FOTs on interagency coordination.	ITS systems will improve interagency information sharing and enable coordinated planning and operations.	Agency perceived impacts.	Interviews with key public sector agencies involved in each FOT; and review of meeting minutes and other related documentation.	Documentation of findings and lessons learned.
Assess the impact of the FOTs on public/private coordination.	ITS systems will improve public/private information sharing and enable coordinated planning and operations.	Agency and user-perceived impacts.	Interviews with key public sector agencies and private businesses involved in each FOT; and review of meeting minutes and other related documentation.	Documentation of findings and lessons learned.
Assess challenges relative to the development of information sharing agreements	Participants will experience but overcome challenges to establishing information-sharing agreements.	Institutional challenges: successes and, failures	Interviews with key public sector agencies and private businesses involved in the FOT; and review of meeting minutes and other related documentation.	Documentation of findings and lessons learned

The focus of the interviews (and a survey, if that data collection technique is also utilized) will be to address the following questions:

- What type(s) of information needed to be shared? Who needed to have access to this information? What was the intended use of the information?
- Were any institutional challenges or concerns expressed about sharing this information? What were these concerns or challenges? How were these addressed? What type of process was used to resolve these challenges and concerns?
- Was there a cost involved in addressing these challenges and concerns? Who absorbed it?
- If you raised an issue or challenge, were you satisfied with the agreement that was reached? Do you feel your concerns were adequately addressed?
- Did you participate in a public-private partnership during the course of the FOT? How did you feel this worked? Was the partnership an effective vehicle for addressing and resolving issues and challenges? What in particular worked well/did not work well?
- If you were to repeat this process, what would you do differently?
- If you were advising another group of stakeholders about to implement a similar project, what would you say to them about how to resolve institutional challenges and concerns?

These questions will be asked to varying institutional participants, depending on their involvement in the FOT. Potential institutional interview candidates are provided in the following list:

- Federal Aviation Administration (FAA);
- U.S. Department of Transportation (USDOT);
- Illinois Department of Transportation;
- American Trucking Associations Foundation (ATA Foundation);
- Advanced IT Solutions;
- SecurCom, Inc.;
- Identix;
- Chicago O'Hare International Airport;
- City of Chicago Department of Aviation;
- Chicago Area Transportation Study (CATS);
- Illinois Department of Commerce & Community Affairs;
- Advanced Maintenance Systems Ltd (AMS);
- 3M Supply Chain Management;
- Newark International Airport;
- Central States Expedited Carriers Association;
- International Air Cargo Association of Chicago;
- Participating shippers/manufacturers;

- Participating motor carriers;
- Participating airlines; and
- Participating air freight forwarders.

The data collection and analysis activities will incorporate the activities proposed by the ATA Foundation's "self evaluation" plan. The following methodology defined by the ATA Foundation will be incorporated for this study area:

- *Throughout operational test of electronic manifest services, administer a questionnaire to participants on a bi-weekly or monthly basis. The questionnaire will ask the participants to detail their use of the system (quantity of transactions or percent of total transactions); and to indicate on a Likert scale their perceptions of: convenience; system accessibility and dependability; willingness to use; and productivity improvements.*

3.4.2 Customer Satisfaction Lessons Learned

The customer satisfaction lessons learned evaluation will focus on the degree to which the transportation and information needs of "customers" are met by the ITS services. The customers for this FOT are defined here as those who are affected by changes in the intermodal freight system that are brought about by ITS solutions. Customers for the Electronic Intermodal Supply Chain Manifest FOT will include the participating manufactures, motor carriers, air freight forwarders, airlines, and the City of Chicago Department of Aviation. The Customer Satisfaction Lessons Learned technical approach is presented in Table 3-4. The specific goals, in order of importance for this evaluation, consist of the following:

- Identify the perceived benefits of the ITS services to users, and the perceived relationship of these benefits to the costs (financial resources or staff time) required to use the ITS systems;
- Assess user awareness and acceptance of ITS services and information; and
- Assess the ability to use data provided by these ITS systems, including whether the information provided by these systems is being integrated into routing and dispatching and other supply-chain management activities, and including the system capabilities that are of greatest value to customers and the potential system enhancements that would be of greatest value to customers.

The customer satisfaction evaluation will have a major focus on manufacturers, trucking companies, and air freight forwarders/airlines. Particular attention will be given to the subjective perception of the benefits and performance of the systems among these private sector participants. In addition, the evaluation will consider the perceptions of public agencies regarding improvements in security and regulated record keeping.

The experience of the Evaluation Team in previous evaluations has been that standardized questionnaires or data request forms are useful to direct respondents in the collection of existing and readily available data into a usable format. However, personal interviews may also be used to collect information that is not easily quantified in a consistent format or may require follow-up questions for clarification. Interviews are particularly useful in collecting information that may call for the respondent to state an opinion or formulate an estimate based on personal experience. Focus groups may also be considered as an alternative method to gather input from a broader audience.

Table 3-4. Customer Satisfaction Evaluation Approach

Goal	Hypothesis	MOE	Data Sources or Requirements	Analysis
Identify the perceived benefits of the systems to users.	Users will find the ITS systems to be a valuable aid for logistics or transportation management that is worth the cost or time involved in using the system.	User-perceived system benefits . User-perceived system costs.	User interviews, surveys, or focus groups.	Comparison of survey/ interview findings.
Assess user acceptance.	Carriers, drivers, terminal operators, and shippers will be aware of and prefer to use ITS systems.	User-stated awareness of ITS systems. User-stated preference toward using ITS systems.	User interviews, surveys, or focus groups.	Comparison of survey/ interview findings.
Assess ability to use ITS data.	Customers will use the ITS data as part of their decision-making processes. Users will find the ITS data to be accessible, accurate, and secure.	User-stated integration of ITS data into operations User perceptions regarding ease of use. User-perceived change in quality/ accuracy of data. User-perceptions regarding data security. User-stated priorities among system capabilities. User-stated ideas for system enhancements.	User interviews, surveys, or focus groups.	Comparison of survey/ interview findings.

Separate interview formats will be developed for major categories of users (e.g., carriers, shippers, air lines, air freight forwarders, and public agencies). The surveys generally will be conducted via e-mail or facsimile. The interviews generally will be conducted in-person, drawing upon the resources of the site evaluators, although time constraints may require some interviews to be conducted via telephones.

Again, the data collection and analysis activities will incorporate the activities proposed by the ATA Foundation's "self evaluation" plan. The following methodology defined by the ATA Foundation will be incorporated for this study area:

- *Throughout operational test of electronic manifest services, administer a questionnaire to participants on a bi-weekly or monthly basis. The questionnaire will ask the participants to detail their use of the system (quantity of transactions or percent of total transactions); and to indicate on a Likert scale their perceptions of: convenience; system accessibility and dependability; willingness to use; and productivity improvements.*

4.0 Management Plan

4.1 Evaluation Organization

An organizational overview for the conduct of this evaluation is presented below in Figure 4-1. Note here that the SAIC Project Manager reports directly to the USDOT COTR's, Dr. Joseph Peters (USDOT-ITS Joint Program Office), Mr. Chip Wood (USDOT-Office of Intermodalism), and to Mr. Lee Jackson (USDOT-Federal Highway Administration).

Figure 4-1: Evaluation Organizational Overview

EVALUATION MANAGEMENT AND COORDINATION	
Project Manager:	M. Jensen, SAIC
Senior Project Advisor:	L. Grenzeback, CSI
National Coordination:	M. Carter, SAIC
EVALUATION STUDY AREA LEADERS	
Intermodal Freight Sys. Ops Study Lead:	M. Williamson, CSI
Technical Effectiveness Study Lead:	M. Jensen, SAIC
Institutional Challenges & Customer Satisfaction Lessons Learned Lead:	M. Williamson, CSI
EVALUATION DATA COLLECTION AND ON-SITE COORDINATION	
Data Collection Coordination:	E. Flanigan, TranSystems
On-Site Evaluation Coordinator:	Jeffrey Hall, TranSystems

The organizational approach for this project is based largely upon the leadership of the Evaluation Study Leaders. The On-Site Evaluation Coordinator will serve as a support resource to the Study Leaders to assist them in implementing their evaluations at that site, and will also be responsible for implementing many of the evaluation data collection activities under the direction of the Data Collection Coordinator. The Data Collection Coordinator will be the single point of contact for managing all data collection activities under the direction of the Study Leaders. The Data Collection Coordinator will report to the Study Leaders and to the Project Manager. The Project Manager will have the final say in resolving any issues within the Evaluation Team.

4.2 Overview of Evaluation Deliverables

The technical reports that will be developed from this evaluation will be as follows:

- **Evaluation Test Plans**. Following the completion of the Final Evaluation Plan, each Study Leader will be required to produce a detailed Test Plan (e.g., "Electronic Manifest FOT Technical Effectiveness Study Test Plan"). Here, there will be a draft review process with input from both the USDOT and the local FOT partners.
- **Evaluation Final Report**. This will be the comprehensive final report which will document both the methodology and the detailed results of the Electronic Manifest FOT evaluation. This report will consist of six major sections: an Executive Summary, an Introduction section, a Methodology section, a Results section, a Conclusions Section and a Recommendations section. The Methodology and Results sections would each be further divided into four subsections based on the evaluation study (e.g., Technical Effectiveness). The report is expected to be around 50 to 75 pages, with more detailed information on the analyses to be included in Appendices if necessary.
- **National Architecture Implications Summary Report**. This report will be an output of the Technical Effectiveness Study, and will also incorporate inputs from the WSDOT Intermodal FOT. This report will be focus on the potential emergence of technologies, procedures and deployment experience which could lead to the development of Standards for merging the hardware and communications elements from each FOT with the ITS National Architecture.
- **Evaluation Video and Photographic Record**. A video and photographic record of hardware and other visual aspects of the FOT will be developed, using video footage and digital photos that are recorded by the Evaluation Team during the course of the evaluation. Based on the quality and availability of the images collected, recommendations will be made to USDOT regarding the potential format and message for a video that could potentially be developed and distributed in partnership with ITS America, the Intermodal Association of North America, the ATA, or other industry associations.

4.3 Evaluation Schedule

The Evaluation Schedule is provided in Table 4-1 on the succeeding page. The major deliverables are discussed above in Section 4.2.

Table 4-1. Evaluation Schedule

Date	Milestone or Deliverable
August 2000	Presentation of Draft Evaluation Plan to Test Site Participants
September 25, 2000	Final Evaluation Plan
October 15, 2000	Draft Test Plans
November 30, 2000	Final Test Plans
October 2000 to September 2001	Evaluation Data Collection and Analysis Activities
August 2001	Preliminary Results Input to USDOT to Support Planning Activities
October 2001	Draft Evaluation Report
November 2001	Presentation of Draft Evaluation Report to Test Site Participants
November 2001	Preliminary Results Presentation at ITS World Congress
December 2001	Video/Digital Photo Record
December 2001	Draft ITS National Architecture Implications Summary Report
January 2002	End of Evaluation Briefing to Interested Parties at USDOT
January 31, 2002	Final Evaluation Report, Final National Architecture Implications Summary Report