

# Evaluation of the Commercial Vehicle Information Systems and Networks (CVISN) Model Deployment Initiative

to  
U.S. Department of Transportation  
ITS Joint Program Office  
400 7th Street, S.W.  
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# **EVALUATION OF THE COMMERCIAL VEHICLE INFORMATION SYSTEMS AND NETWORKS (CVISN) MODEL DEPLOYMENT INITIATIVE**

**Volume I. Final Report**

**Prepared for**

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## **EXECUTIVE SUMMARY**

The Commercial Vehicle Information Systems and Networks Model Deployment Initiative (CVISN MDI) is funded by the Intelligent Transportation Systems Joint Program Office (ITS JPO) and managed by the Federal Motor Carrier Safety Administration (FMCSA), an agency of the U.S. Department of Transportation (U.S. DOT). The purpose of the CVISN MDI is to demonstrate the technical and institutional feasibility, costs, and benefits of the primary ITS user services for commercial vehicle operations (CVO). As part of its mission to provide strategic leadership for ITS research and deployment, U.S. DOT's ITS Joint Program Office, in cooperation with the FMCSA, commissioned an independent evaluation of CVISN benefits and costs. This report presents the goals, methods, and findings of that evaluation.

CVISN is a collection of information systems and communications networks that support CVO. These include information systems owned and operated by governments, motor carriers, and other stakeholders. The CVISN program provides a framework or "architecture" that enables government agencies, the motor carrier industry, and other parties engaged in CVO administrative, safety assurance, and regulatory activities to exchange information and conduct business transactions electronically. The goal of the CVISN program is to improve the safety and efficiency of CVO.

Current CVISN services and technologies consist of three functions or application areas:

- **Safety Information Exchange** technologies to facilitate the collection, distribution, and retrieval of motor carrier safety information at the roadside. These data help in-transit FMCSR compliance enforcement staff focus scarce resources on high-risk carriers and drivers, in turn helping to reduce the number of crashes involving commercial vehicles.
- **Electronic Screening** systems, which allow commercial vehicles that maintain good safety and legal status to bypass roadside inspection and weigh stations. This saves time and money for participating carriers and allows states to devote more resources toward removing unsafe and noncompliant carriers.
- **Electronic Credentialing** systems for electronic submission, processing, approval, invoicing, payment, and issuance of credentials; electronic tax filing and auditing; and participation in clearinghouses for electronic accounting and distribution of registration fee payments among states.

As a result of the events of September 11, 2001, our nation and, in particular, the U.S. Department of Transportation have focused attention on the need to ensure the security of our transportation system. Over the next decade, an environment in which timely and accurate motor carrier, commercial vehicle, and driver data are shared electronically among authorized stakeholders will be required. The CVISN information and communication systems were originally designed to improve transportation safety and the efficiency of commercial vehicle operations. However, the deployment of these systems presents opportunities to significantly

improve transportation security at the same time. Information sharing is a critical enabler for helping to ensure transportation security while maintaining the efficiency of freight operations. For example, legitimate transporters of hazardous materials will be able to apply for and receive appropriate credentials in a timely manner and operate with minimal delays for roadside screenings and inspections. Also, the sharing of information among states and the federal government will enhance inspection and enforcement activities and allow enforcement personnel to better focus their efforts on the high-risk motor carriers, drivers, and vehicles as well as potential security threats that involve transportation of hazardous materials.

Figure ES-1 depicts the three major CVISN areas and their relationships, as the systems are intended to operate, spanning both the credentials administration and the roadside safety/enforcement areas. The CVISN credentialing technologies include information systems and networks that provide electronic links between motor carriers and state agencies and between the state agencies and various national clearinghouses and databases. At the roadside, CVISN information and communication technologies permit roadside enforcement staff to direct drivers on the highway to either bypass or enter weight and inspection stations. They also provide enforcement staff with up-to-date safety and credentialing information from state or national motor carrier databases.

## OVERVIEW OF KEY FINDINGS

Although certain aspects of this evaluation are based on limited data from early deployments, it is clear that CVISN is a good investment for the United States. CVISN can produce substantial cost savings for states and motor carriers, improve the efficiency and fairness of commercial vehicle operations, and most importantly, save lives. However, to achieve these benefits, CVISN must be deployed nationwide according to consistent standards, and its major systems (electronic credentialing, electronic screening, and safety information exchange) must be fully integrated. Some of the major findings from this evaluation and the implications for future deployment are highlighted below.

### Safety

Deployment of CVISN *safety information exchange* and *electronic screening* technologies has the potential to produce important safety benefits. The CVISN Inspection Selection System (ISS), used in combination with manual prescreening to select commercial vehicles for inspection, was demonstrated in limited field tests to increase the number of out-of-service (OOS) orders issued by 2 percent compared to traditional (without ISS) screening methods. A crash avoidance model estimated that under this type of limited deployment (without electronic screening), the use of ISS would result in 84 fewer commercial vehicle crashes per year nationwide by removing unsafe vehicles and drivers from the roadway. Further analysis demonstrated that if ISS were combined with electronic screening (allowing low-risk carriers to bypass inspections), approximately 600 commercial vehicle-related crashes could be avoided per year, compared with the baseline scenario. Although limited deployment made it impossible to demonstrate that improved enforcement strategies will deter motor carriers and

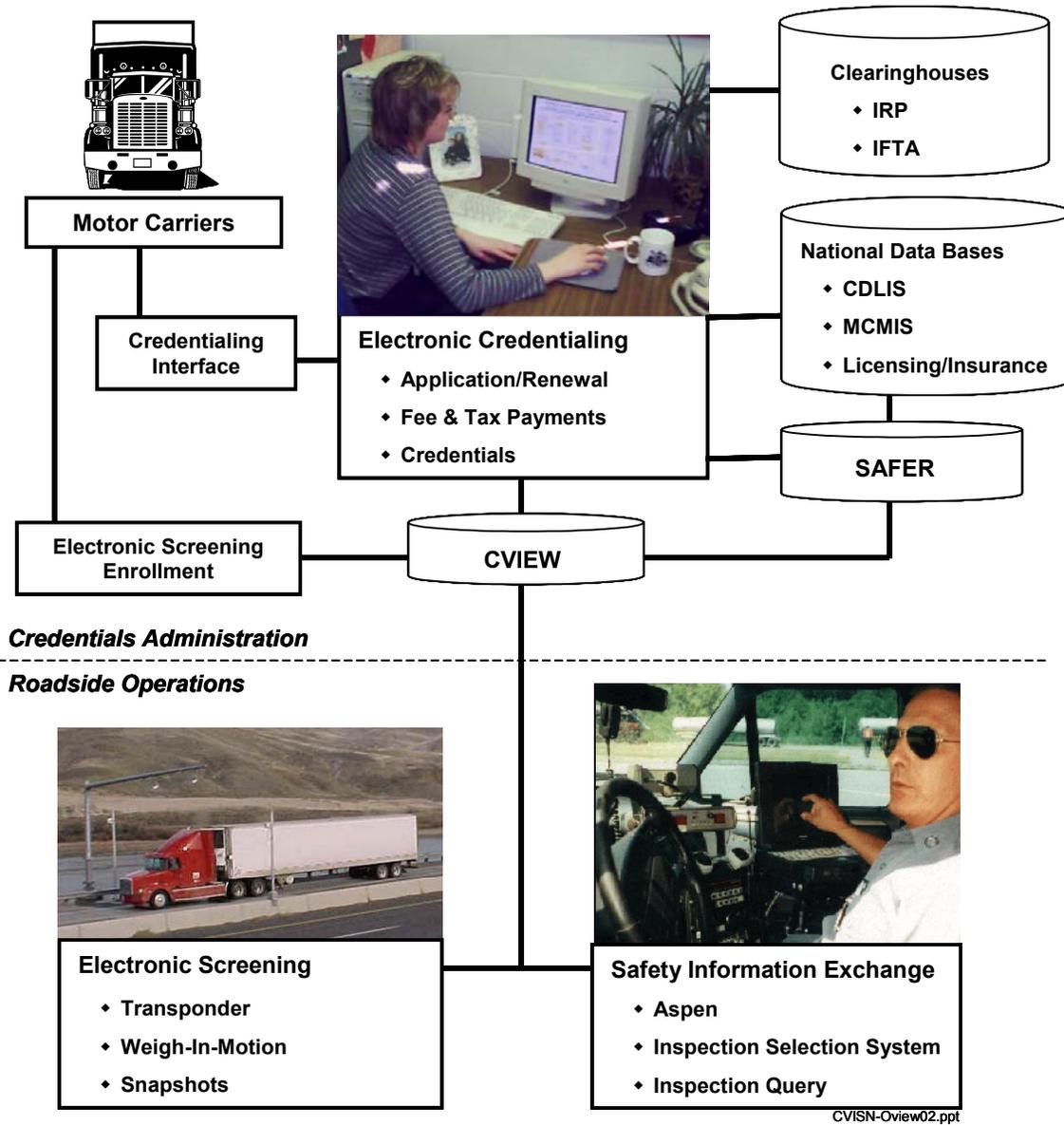


Figure ES-1. Overview of CVISN Functions

drivers from violating safety regulations, the analysis demonstrates that a modest 10 to 25 percent reduction in safety violations could help to avoid between 4,000 and 10,000 commercial vehicle crashes each year. These findings suggest that CVISN safety information exchange and electronic screening technologies can result in significant safety benefits, but only if these technologies are widely deployed, fully integrated, and combined with innovative enforcement and outreach strategies.

## Cost

*Electronic credentialing* could offer substantial cost savings to states and motor carriers, depending on the level of motor carrier participation. Annual operating costs to the states for credentialing can be reduced by almost 35 percent, offsetting the start-up costs to deploy CVISN. The savings, mostly attributable to lower labor costs, is expected to result in some state staff persons becoming available to work on other priority assignments. The analysis in this report focused on International Registration Plan (IRP) and International Fuel Task Agreement (IFTA) credentialing. For *electronic screening* and *safety information exchange* at the roadside, CVISN deployment costs were found to be reasonable when viewed in the context of a state's existing roadside enforcement operations. Electronic screening and safety information exchange do not offer states the direct economic savings and payback that electronic credentialing does, except through improvements in transportation safety.

## Customer Satisfaction

The general awareness throughout the national trucking industry of CVISN-type initiatives is very low — especially among smaller trucking companies. Among the motor carriers and drivers who are aware of these technologies, the major concern is the standardization of rules and procedures across states, and improved differentiation as to which vehicles or firms most merit inspection. State CVO administrators are generally enthusiastic about deploying CVISN, and using safety information exchange technology has become integral to the jobs of most CVO roadside inspectors.

## Benefit/Cost Analysis

Benefit/cost ratios, considering start-up costs, operating costs, and crash avoidance over the expected life of CVISN systems, ranged from 0.6:1 (not economically justified) for a minimal deployment of roadside enforcement technologies to 40:1 (highly beneficial) for full deployment of electronic credentialing. However, the benefit/cost ratios for both types of systems are highly dependent on the level of deployment and the degree to which these systems are integrated within a state and deployed and operated consistently between states.

The remainder of this executive summary describes the status of CVISN deployment across the nation, summarizes the evaluation goals and methods, presents additional findings, and discusses implications of these findings for future CVISN deployment.

## CVISN DEPLOYMENT STATUS

The CVISN MDI began in 1996 with two “prototype” states—Maryland and Virginia—and eight “pilot” states—California, Colorado, Connecticut, Kentucky, Michigan, Minnesota, Oregon, and Washington. The Federal Motor Carrier Safety Administration (FMCSA) developed a three-step strategy for states embarking on CVISN deployment: planning, design, and deployment. In the planning step, a state attends two ITS/CVO training courses and develops an ITS/CVO business plan. For design, a state attends a third training course and participates in a series of three CVISN deployment workshops to complete a CVISN Program

Plan and Top-Level System Design. Once the plan is accepted by FMCSA, a state can proceed with deployment, based upon the availability of federal and state resources. An initial goal of the CVISN Program is to have every state reach an “ambitious but achievable” level of deployment, called Level 1. To accomplish Level 1 deployment, states must

- Establish an organizational framework among state agencies and motor carriers for cooperative system development.
- Create a State CVISN System Design that conforms to the CVISN Architecture and can evolve to include new technology and capabilities.
- Implement all the elements of three capability areas, as described in Table ES-1. These systems must be implemented using applicable architectural guidelines, operational concepts, and standards.

**Table ES-1. CVISN Level 1 Deployment**

<p><b>Safety Information Exchange</b></p> <ul style="list-style-type: none"> <li>- Use of Aspen (or equivalent software for access to centralized safety data) at all major inspection sites</li> <li>- Connection to the Safety and Fitness Electronic Record (SAFER) system so that states can exchange “snapshots” of information on interstate carriers and individual vehicles</li> <li>- Implementation of the Commercial Vehicle Information Exchange Window (CVIEW), or equivalent, system for exchange of intrastate snapshots and for integration of SAFER and other national/interstate data.</li> </ul>
<p><b>Electronic Screening</b></p> <ul style="list-style-type: none"> <li>- Electronic screening at one or more fixed or mobile inspection sites</li> <li>- Readiness to replicate electronic screening capability at other sites</li> </ul>
<p><b>Electronic Credentialing</b></p> <ul style="list-style-type: none"> <li>- Automated processing (application, state processing, issuance, tax filing) of at least International Registration Plan (IRP) and International Fuel Tax Agreement (IFTA) credentials; readiness to extend to other credentials [intrastate, titling, oversize/overweight (OS/OW), carrier registration, and hazardous material (HAZMAT)]. Does not necessarily include electronic payment of fees or taxes.</li> <li>- Connection to IRP and IFTA Clearinghouses</li> <li>- At least 10 percent of transaction volume handled electronically; readiness to sign up more carriers; readiness to extend to branch office where applicable.</li> </ul>

Source: Richeson (2000)

To date, at least four states (Maryland, Virginia, Kentucky, and Washington) have demonstrated Level 1 capabilities in all three areas, and many other states have made significant progress in one or two areas. The CVISN initiative is now being expanded to other states. According to the FMCSA, eight of the 48 contiguous states have been fully funded to achieve Level 1 deployment by September 30, 2003. An additional 30 states have indicated that they expect to complete Level 1 deployment by September 30, 2003, dependent upon receiving FY 2001 federal ITS deployment or state resources to support CVISN deployment. CVISN

deployment Level 2 is currently being defined. The following summarizes the deployment status of CVISN from a national perspective:

**Safety Information Exchange Deployment**

The use of motor carrier and vehicle-specific safety performance data by state agencies conducting roadside inspections has grown significantly in recent years. As of December 1999, 42 states (84 percent) were using Aspen and more than half were connected to the Safety and Fitness Electronic Record (SAFER) system (PTI 2000, Radin 2000). By January 2002, all fifty states and the District of Columbia had access to SAFER and more than half of the states were using SAFER on a regular basis. Also, sixteen states have at least partially implemented CVIEW capabilities for managing information on intrastate carriers. The use of SAFER Data Mailbox to upload inspection reports from the laptop computers to SAFER and download past inspection reports on individual vehicles is also growing.

**Electronic Screening Deployment**

Starting in the early 1990s, field operational tests (FOTs) such as Advantage I-75 (Interstate 75 corridor), HELP/Crescent (I-5 corridor), and Oregon Green Light demonstrated the technical feasibility and time-saving benefits of using electronic screening systems for commercial vehicle operations. In particular, these tests proved that dedicated short-range communication (DSRC) technologies can provide reliable communication between moving vehicles and roadside enforcement operations. However, most of the growth in electronic screening has occurred since the emergence of three programs: HELP (Heavy Vehicle Electronic License Plate) PrePass, NORPASS (North American Preclearance and Safety System), and Oregon’s Green Light. Table ES-2 shows how enrollment is distributed among the three programs.

**Table ES-2. State and Motor Carrier Participation in Electronic Screening Programs**

Numbers of:	Pre-Pass	NORPASS	Green Light
States	21	6	1
Trucks	186,796	15,000	15,000
Companies	7,989	800	1,100

**Electronic Credentialing Deployment**

Although most states are committed to deploying electronic credentialing, these systems have not yet achieved the same level of widespread deployment as have roadside systems. This result primarily stems from the many technical challenges involved in establishing interfaces between new and legacy, or archival, databases and software systems.

To date, four states (Maryland, Virginia, Kentucky, and Washington) have successfully demonstrated Level 1 capabilities for electronic credentialing. These states are now working with a limited number of carriers to test and refine the systems that were developed. Some

additional development is continuing as issues are identified. The experiences of these states, as well as those of the other seven CVISN Pilot states, are being shared with others through mainstreaming efforts and training workshops sponsored by FMCSA.

## **EVALUATION GOALS AND METHODS**

The CVISN evaluation strategy was developed in cooperation with state and federal government agencies and industry partners. During the planning stages of the CVISN MDI, over 100 individuals representing various government and industry organizations participated in an evaluation workshop in which potential benefits and costs were identified and initial evaluation priorities were established. In subsequent meetings with the partners, evaluation priorities were refined and evaluation methods were established. The primary goals of the evaluation project were to document the benefits of CVISN when fully implemented and to conduct a comprehensive benefit/cost analysis to determine if the investments in CVISN are justified.

Because of limited resources and the expectations that most CVISN states would not achieve Level 1 deployment within the timeframe of the evaluation project, it was necessary to focus the evaluation effort on a few states that were expected to make progress at deploying specific CVISN services and technologies. Five states (Connecticut, Kentucky, Maryland, Oregon, and Virginia) were chosen to support the data collection effort. The data obtained from those states were used to extrapolate or extend the results to a national level. It is recognized that since the evaluation effort began, many other states have achieved significant progress at deploying CVISN services and technologies. Their successes are briefly discussed in Chapter 3. However, in keeping with the primary goals of the evaluation, this report focuses on projecting the benefits of CVISN in the areas of safety, cost savings, and customer satisfaction and conducting a comprehensive benefit/cost analysis of CVISN at full deployment. The goals and methods established for each study area were presented in an evaluation plan (Battelle 1998) and are summarized below.

### **Safety Benefits Methods**

The safety benefits analysis addressed four research questions:

- What is the impact of CVISN on the numbers of crashes, injuries, and fatalities involving large CMVs?
- What is the impact of CVISN on rates of driver and carrier compliance with Federal Motor Carrier Safety Regulations (FMCSR)?
- To what extent does CVISN help roadside safety enforcement officials identify high-risk commercial vehicles and motor carriers?
- To what extent does CVISN help roadside safety enforcement officials identify OOS violators?

Because safety benefits could not be measured directly (e.g., by comparing the number of truck-related crashes before and after deployment), a crash avoidance probability model was developed. Direct measurement was impractical given the scope of this study, the limited, evolutionary deployment of CVISN, and the relative rarity of truck crashes in a fixed time period. The model predicts the number of crashes avoided under various scenarios, each defined by specific assumptions concerning the future deployment of CVISN. The analysis relied on several inputs including historical rates at which out-of-service (OOS) orders were issued, national crash/injury/fatality rates involving large trucks, and probabilities that certain OOS conditions will contribute to a crash. Estimates of these inputs were obtained from the literature or from data collected in several special studies conducted in states that previously deployed, or were in the process of deploying, CVISN safety information exchange and electronic screening technologies. Connecticut, Kentucky, and Oregon participated in the safety benefits analysis.

### **Cost Analysis Methods**

The cost analysis (a precursor to the more formal benefit/cost analysis also performed in the CVISN MDI evaluation, and discussed below) considered three major cost-related questions:

- What are/were the baseline costs associated with CVO processes prior to CVISN technology deployment?
- What are the one-time start-up costs to the states to deploy CVISN systems, and what are the key drivers or major elements contributing to those costs?
- What recurring (annual) capital and labor, operating, and maintenance costs do states incur as they use CVISN technologies, and what are the key drivers or major elements contributing to those costs?

Cost data were obtained in a series of on-site, in-person interviews with state agencies and with motor carriers participating in electronic credentialing programs. The main emphasis in the cost study was state government (i.e., transportation and public safety/enforcement agency) operations, costs, and potential savings.

Actual dollar values for start-up (non-recurring) and annual (recurring) costs to the states were reported, and compiled to determine realistic unit costs for various elements required in baseline (pre-CVISN) and post-CVISN commercial vehicle operations. This approach made it possible to determine CVISN deployment costs and the costs to perform commercial vehicle operations at various levels of deployment.

Although cost data were obtained for most of the major components of CVISN used in credentialing and roadside operations, the data collection effort was limited to the few states that had sufficient experience with the deployment and operation of these systems. Most of the credentialing cost data came from two states, Kentucky and Maryland, and the majority of the cost information for CVISN electronic screening and safety information exchange services came from Connecticut, Kentucky, and Virginia. The primary sources of information on motor carrier

credentialing costs were the few carriers that were among the first to participate in electronic credentialing in Kentucky.

In addition to the unit cost breakdowns by discrete cost elements, statewide deployment scenarios were projected, based on extending the known unit costs to a typical state's scale of operation.

### **Customer Satisfaction Measurement Methods**

To measure customer satisfaction with CVISN, several surveys and other measures were planned and carried out. These included

- A national motor carrier survey
- A driver survey
- Interviews with state CVO administrators
- Surveys and focus groups with state CVO inspectors.

A mail survey of motor carriers was designed to be representative of the trucking industry throughout the contiguous 48 states. A stratified random sample of motor carrier firms was selected from the mid-1999 records of firms in the federal government's MCMIS Census database. By design, the stratified sample contained much higher proportions of larger firms and ones with registered home addresses in five "CVISN focus" states: Connecticut, Kentucky, Maryland, Oregon, and Virginia. Several rounds of surveys resulted in a final total of 158 completed responses for quantitative and qualitative analysis.

A *qualitative* survey was conducted with 61 truck drivers intercepted at large rest/refueling stops located adjacent to major truck routes in Connecticut and Kentucky. These two states have implemented significant electronic credentialing initiatives, and have been the focus of other, complementary evaluation activities. Sample quotas were set to ensure the representation of owner-operators and of drivers employed by firms of varying sizes. Using in-depth, semi-structured personal interviews, all of the respondents were asked about roadside safety and weight inspections. The owner-operators were also asked about electronic credentialing methods.

Less formal methods were used for evaluating the satisfaction of state CVO administrators with CVISN technologies. Evaluation contractor staff participated in many meetings, conferences, and other forums, where the attitudes of state administrators and other CVISN stakeholders were directly solicited and discussed in detail.

Attitudes and opinions of state motor carrier inspectors regarding the use of CVISN roadside enforcement technologies were addressed through focus groups and a formal survey conducted as part of a separate DOT-sponsored evaluation of the I-95 Corridor Coalition and SAFER Data Mailbox FOTs (Battelle 2000). Over 50 inspectors from six eastern states

(Connecticut, Maryland, New Jersey, New York, Pennsylvania, and Rhode Island) participated in the focus groups, and approximately 370 inspectors from these states completed formal questionnaires. Topics included background information, system usage, satisfaction, and perceived benefits.

### **Benefit/Cost Analysis Methods**

The formal benefit/cost analysis (BCA) performed in the CVISN MDI examined the ratio of benefits to costs. The primary benefits of CVISN included

- Roadside Enforcement Benefits
  - Crashes avoided
  - Transit-time savings [including operating and maintenance (O & M) and air and noise pollution]
- Electronic Credentialing Benefits
  - Operating cost savings to states
  - Operating cost savings to carriers
  - Inventory cost savings to carriers.

The costs included

- Roadside Enforcement Costs
  - One-time start-up costs to states
  - Replacement capital costs to states in future years
  - Increased operating costs to states
  - Increased operating costs to carriers
  - Increased out-of-service (OOS) costs to carriers
- Electronic Credentialing Costs
  - One-time start-up costs to states
  - Replacement capital costs to states in future years.

Three scenarios for roadside enforcement and two scenarios for electronic credentialing were developed to provide a context in which to understand the balance of costs and benefits across a system's life cycle. The analysis was performed by projecting the costs and benefits of deploying CVISN on a national scale based on measured costs and benefits obtained from the earliest deployments of CVISN.

Benefits were analyzed in the areas of safety, efficiency, productivity, mobility, and energy/environment. The cost of CVISN for the purpose of this BCA consists of the one-time start-up costs and the on-going costs of CVISN programs, including equipment replacement at appropriate intervals. More specifically, these CVISN costs include the incremental capital and operating costs of the hardware and software, including computers and electronic data communications, and labor and administrative overhead costs for performing the functions associated with CVISN.

## **FINDINGS**

### **Safety Benefits Results**

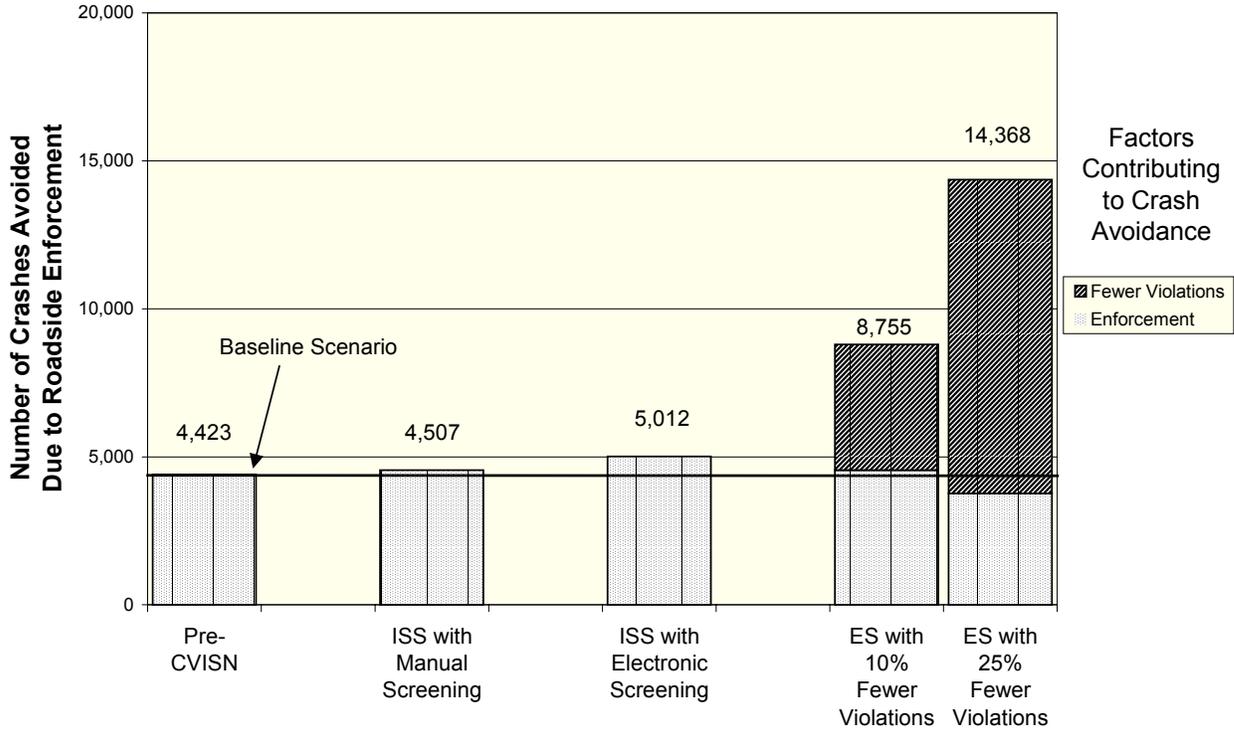
Various CVISN technology deployment scenarios were derived from the hypotheses that CVISN roadside enforcement technologies are expected to have two types of impacts related to roadside safety:

- A. The “direct” benefit of improved targeting of enforcement activities on high-risk carriers resulting in more OOS orders for the same number of inspections performed
- B. The “indirect” benefit of increased compliance with motor carrier safety regulations resulting from stricter enforcement.

The impacts of CVISN technologies on roadside enforcement operations were evaluated through special studies conducted in participating states. The following results, obtained from CVISN pilot states, provide useful insight into these effects; however, the degree to which these results are statistically representative of future deployments could not be determined:

1. A study of roadside inspection selection strategies at four Connecticut inspection sites [two using the CVISN Inspection Selection System (ISS) and two without ISS] demonstrated that using ISS, in combination with manual prescreening, to select commercial vehicles for inspection increases OOS orders by approximately 2 percent for the same number of inspections, i.e., a 2 percent increase in inspection efficiency.
2. Analysis of this same inspection selection strategy under the added assumption that “low-risk” carriers would be permitted to bypass the inspection sites, demonstrates that electronic screening, with full participation by all low-risk carriers, could increase inspection selection efficiency by more than 11 percent. That is, they will issue 11 percent more OOS orders for the same number of inspections performed.
3. A two-year study was conducted in Oregon to determine if the deployment of roadside screening and safety information exchange technologies would affect safety compliance rates in the state. The study was unable to demonstrate that CVISN roadside deployment will increase compliance with safety regulations. However, this may be due to the limited scope of the study or delays in the deployment of the safety information exchange technologies (Aspen and SAFER) in Oregon.

These estimated and assumed effects of CVISN deployment, along with results from the literature, were applied to a crash avoidance model to predict the numbers of truck-related crashes and associated injuries and fatalities that would be avoided under each of the above roadside enforcement scenarios. Results of this analysis are illustrated in Figure ES-2.



**Figure ES-2. Estimated Number of Truck-Related Crashes Avoided Under Various CVISN Deployment Scenarios and Assumptions**

We began by estimating the benefits of roadside enforcement operations without CVISN. According to the analysis, 4,423 truck-related crashes are avoided each year because states conduct more than 2 million roadside inspections and remove unsafe vehicles from the roadway. This pre-CVISN situation represents the baseline scenario against which we compare various post-CVISN deployment scenarios. For example, if all inspections nationwide were performed using ISS with manual pre-screening, as is currently done at two Connecticut sites, and achieve the same 2 percent improvement in inspection selection efficiency, the number of crashes *avoided* due to roadside enforcement is estimated to increase by 84 crashes to 4,507. This represents a “CVISN benefit” of 84 crashes avoided. A similar analysis estimated that the 11 percent increase in inspection efficiency resulting from having low-risk carriers enroll in electronic screening would result in 589 fewer crashes nationwide, because more inspections would be focused on high-risk carriers. Assuming that targeted enforcement will result in improved compliance with safety regulations, the model illustrates the potential safety benefits that can be realized. If, for example, we assume a 10 percent reduction in safety violation rates, it is estimated there will be 8,755 avoided crashes, which, compared to the baseline scenario, corresponds to a CVISN benefit of 4,332 fewer crashes. Similarly, if we assume a 25 percent

reduction in violation rates the CVISN benefit would be 9,945 fewer crashes. However, to date there is no evidence that such a reduction in safety violation rates will occur.

The crash avoidance analysis demonstrates that CVISN deployment has the potential to produce important safety benefits. However, unless there is also a significant improvement in the compliance with motor carrier safety regulations, either due to the deployment of CVISN or some other increase in roadside enforcement activities, CVISN will make only minimal contributions to FMCSA's goal of reducing the numbers of injuries and fatalities by 50 percent by 2010. For example, in 1998, approximately 127,000 persons were injured in truck-related crashes. However, the numbers of additional injuries avoided under the CVISN deployment scenarios shown in Figure ES-2 were estimated to be 26 (using ISS with manual pre-screening), 181 (using ISS with electronic screening), and 1,335 to 3,063 (using ISS, electronic screening, and 10 to 25 percent reduction in violation rates).

The report discusses a number of uncertainties associated with this analysis. The most significant concern involves the accuracy of literature-derived crash causation probabilities, which are based on limited data. However, FMCSA recognizes that certain improvements to crash data collection and analyses are needed.

### **Cost Analysis Results**

Electronic credentialing could offer states substantial cost savings, depending on the level of motor carrier participation. Up-front investments averaging \$700,000 were required for one state to deploy an end-to-end IRP credentialing system. However, annual operating costs to the states, which ranged from \$63 to \$138 for each carrier account administered by the state before CVISN, can be reduced by almost 35 percent. For the additional investment of \$65,000 to add a system for end-to-end processing of IFTA credentials, states could realize greater annual cost savings.

For electronic screening at the roadside, the one-time capital cost to deploy basic screening equipment (automatic vehicle identification, or AVI; and weigh-in-motion, or WIM) at a single weigh station was reported by Kentucky to be \$150,000. Upgrading this site further to electronic snapshot capability was reported to cost nearly \$375,000, above and beyond the \$150,000 for basic screening equipment. Annual capital replacement costs and annual operating costs would increase by approximately \$75,000 per site to support full CVISN electronic screening.

For Safety Information Exchange at the roadside, a statewide upgrade to Aspen capability was reported by Connecticut to cost the state \$31,000 for infrastructure upgrades, plus \$4,800 for equipment and training for each enforcement unit (one patrol car and one officer or inspector). Upgrading to wireless telecommunication and SAFER mailbox capability adds an additional cost of \$1,000 per unit. Statewide deployment of CVIEW or equivalent, which could be used to support both electronic credentialing and roadside enforcement activities, was reported by Kentucky to cost \$325,000. Accompanying increases in annual capital and annual operating costs (again assuming no change in the state's labor costs for enforcement patrol officers/inspectors following CVISN deployment) were reported to be approximately \$88,000 per state and approximately \$1,400 per mobile unit.

Motor carriers participating in pilot tests of electronic credentialing reported saving between 60 and 75 percent of their costs for credentialing, with minimal start-up costs. The reported time savings to the motor carriers is also substantial, at greater than 60 percent. One of the best benefits of electronic credentialing is the capability for carriers to print their own credentials without waiting for the mail or traveling to the state agency offices. This enables carriers to put new vehicles into operation more quickly.

The cost estimates reported in this document have important limitations: only a few states have enough experience with CVISN to provide adequate data for this analysis. Thus, the study focused on those states with the most advanced deployment of the system or that were expected to make significant progress in deploying CVISN for credentialing and/or roadside enforcement operations. The methodology for analyzing and presenting the cost information acknowledges that each participating state has unique characteristics and policies. No attempt was made to determine if these costs are applicable to other states.

Several other factors hindered the collection and analysis of cost data. For example, computers, infrastructure, and facilities are often maintained (and, thus, their operating costs are accounted for) by agencies that may be different from those engaged in the CVO functions. Second, operation and maintenance costs are often lumped together with other cost items, making it difficult to isolate those costs directly related to credentialing and other CVO functions. Reasonable assumptions were made, as documented in the report.

### **Customer Satisfaction Results**

The motor carrier survey analysis led to the following main conclusions:

- The general awareness throughout the national trucking industry of CVISN-type initiatives is very low.
- Relatively few firms collect or analyze data about their roadside inspections. However, the survey respondents' estimates of the mean amount of time involved per inspection (19 minutes for size/weight checks and 45 minutes for safety checks) are quite similar to earlier estimates from the ATA Foundation survey.
- The levels of satisfaction expressed with current roadside check procedures were generally lower than for credentialing, despite the fact that (on a per firm basis) the amount of reported time involved per year was considerably less. However, there seems to be significant agreement that the *types* of roadside checks made are appropriate.
- Responses to questions about electronic screening methods expressed concerns about cost-effectiveness for the company and expansion of state regulation.

The qualitative survey of truck drivers suggests the following conclusions:

- There was fairly universal condemnation of two practices that drivers regarded as inherently unsafe. The first is the setting up of temporary inspection sites at the side of the road, pulling over trucks for inspection. The second is the long waiting lines (tailback) of trucks at scalehouses extending back out onto the highway.
- Other changes that would improve inspections from the drivers' viewpoint include more standardization of rules and procedures across states (or greater cross-state coordination of inspection findings), and improved differentiation as to which vehicles or firms most merit inspection.
- Approximately half of 59 drivers interviewed had some personal experience of electronic screening. *PrePass* was much better known than other electronic screening systems.
- Among the drivers with personal experience of electronic screening, the opinions about it were markedly positive, in net. Time savings were the primary reason.
- On average, the 19 owner-operators in our sample each spent 11.9 person-hours per year and paid a little over \$340 per year in costs to obtain credentials and permits.

Among state CVO administrators, safety information exchange technology is believed to facilitate the inspection process and help focus inspection resources on high-risk carriers (i.e., those with poor safety records). Almost all states are deploying Aspen or equivalent software because state safety officials recognize that the use of safety information at the roadside enhances the inspection process and helps inspectors focus on high-risk carriers. Although most states are committed to deploying electronic credentialing, these systems have not yet achieved the same level of widespread deployment as seen with roadside systems.

State CVO inspectors participating in interviews and focus groups reported the following:

- Using Safety Information Exchange technology has become integral to the jobs of most roadside inspectors. This technology can save time and improve the speed and accuracy of data reporting. Other benefits reported include greater credibility with the motor carriers.
- ISS is perceived to help inspectors identify high-risk carriers.
- Computer-based inspections are seen to represent a significant improvement over previous, paper-based systems, making the work of inspectors more efficient.

### **Benefit/Cost Analysis Results**

Table ES-3 summarizes the results of the BCA for the six CVISN scenarios evaluated. These calculations used a 7 percent discount rate over a period of 25 years, as discussed in Chapter 8. All costs are rounded to the nearest million dollars, and expressed as U.S. dollars in 1999.

For the three roadside enforcement scenarios, the benefit/cost ratio (BCR) ranges from 0.62 to 5.0, depending on the scenario. For the simplest roadside enforcement scenario, RE-1, which is the upgrade to Aspen without electronic screening, the BCR is less than 1.0, showing that Aspen by itself is not justified on the basis of economics alone. For the roadside enforcement scenarios that involve electronic screening (RE-2, RE-3, and RE-3\*), the BCRs increase considerably, as do the present values (NPVs) of the net benefits of these improvements. For Scenario RE-2, which assumes no change in compliance behavior, the NPV is over \$2.5 billion. With improved compliance behavior (assumed hypothetically), which is an important objective of these systems, the increase in the NPV is truly impressive, totaling nearly \$6 billion for Scenario RE-3\* and over \$10 billion for Scenario RE-3. Therefore, the systems involved in the two roadside enforcement scenarios that include electronic screening and travel time savings to carriers are economically well justified, even with the use of the more stringent 7 percent real discount rate.

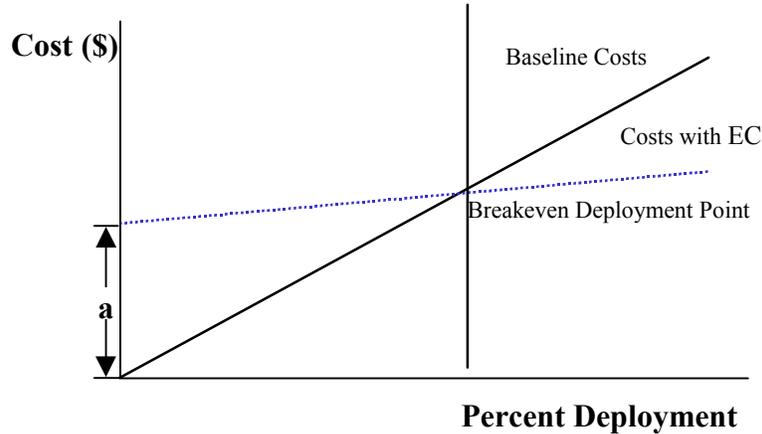
**Table ES-3. Summary of CVISN Benefit/Cost Analysis Results**

Scenario	\$, in Millions (rounded)			Benefit/Cost Ratio
	Total Benefits	Total Costs	Net Present Value	
RE-1. Upgrade to Aspen only	69	112	-43	0.62
RE-2. Electronic screening with no change in safety violation rates	5,301	2,636	2,665	2.0
RE-3. Electronic screening with a 25 percent reduction in safety violation rates	12,995	2,601	10,394	5.0
RE-3*. Electronic screening with a 10 percent reduction in safety violation rates	8,379	2,622	5,757	3.2
EC-1. Electronic credentialing in states without VISTA	558	45	513	12.5
EC-2. Electronic credentialing in states with VISTA	339	8	331	40.4

The electronic credentialing scenarios are characterized by huge BCRs. For Scenario EC-1, the benefit/cost ratio is 12.5, meaning that the total benefits of electronic credentialing for states not using the third-party Vehicle Information System for Tax Apportionment (VISTA) are more than 12 times as large as the total costs. For states using VISTA, i.e., states in which aspects of credentials administration are managed via a private contractor service (Scenario EC-2), the BCR is over 40. Therefore, the electronic credentialing elements of CVISN easily pass the important BCR criterion for determining whether such systems are economically justified.

The BCA results for electronic credentialing are strongly influenced by the level of deployment (i.e., percent of accounts/transactions handled electronically), as shown schematically in Figure ES-3. There is a breakeven deployment percentage, at which the BCR will equal 1.0 (i.e., the costs of EC will equal the baseline or pre-EC costs). It is important to note that the ratios shown for electronic processing of IRP credentials assume 100 percent

deployment of CVISN technology and full adoption of the system by all motor carriers operating in a state. Such deployment may be some years in the future.



**Figure ES-3. Costs of Electronic Credentialing With and Without CVISN**

Where a = one-time statewide start-up costs to deploy EC.

For EC in states currently operating without VISTA, the breakeven deployment size in percentage terms is less than 10 percent. This is easily seen from Table ES-3 when it is considered that the total costs are start-up and replacement capital costs that are fixed statewide, while the cost saving benefits vary linearly with the number or percent of carriers using EC. Thus, the line representing “Costs with EC” in Figure ES-3 is really flat. For Scenario EC-1, the breakeven percentage deployment (equal to the inverse of the BCR) is 8 percent at a 7 percent real discount rate. Similarly for EC in states with VISTA (Scenario EC 2), the break-even percent deployment is only 2.5 percent. At deployments above these levels, electronic credentialing is economically justified with rapidly increasing BCRs, reaching the BCRs shown in Table ES-3 at 100 percent deployment.

### IMPLICATIONS OF FINDINGS

For Congress or the U.S. DOT, who are concerned with the relative costs and benefits of investments in Intelligent Transportation Systems, the CVISN benefit/cost analysis (Chapter 8) presents a comprehensive economic comparison of costs (including start-up and recurring costs) versus the value of the total benefits. The analysis was performed by projecting the costs and benefits of deploying CVISN on a national scale based on measured costs and benefits obtained from the earliest deployments of CVISN. Other stakeholders, such as states and motor carriers, are concerned with costs to their own organizations and the way in which CVISN impacts their operations. To illustrate how the benefits and costs vary under different levels and types of

deployment, our analysis was performed for two different scenarios involving electronic credentialing and three scenarios for roadside enforcement.

While there may be some uncertainties related to certain start-up costs or the small numbers of states and motor carriers that were able to provide useful cost information, the analysis of credentialing operations demonstrates that electronic credentialing is a worthwhile investment. Even at 50 percent deployment (i.e., 50 percent of credentialing transactions handled electronically), the benefits (i.e., cost savings) exceeded the costs by factors of 6 to 20, depending on certain operating features. Furthermore, the benefit/cost ratio is expected to be even larger once states deploy electronic credentialing for special permits. Our analysis considered only the IRP and IFTA credentialing operations because cost information related to special permits, such as oversize/overweight and HAZMAT, were not available. But most believe that costs to deploy the additional systems will be relatively small because the special permit systems are built as add-in modules based on the IRP infrastructure, while the benefits can be substantial—especially to the motor carrier who requires fast turnaround on such applications. The analysis assumed a hypothetical instantaneous deployment.

Even though electronic credentialing has demonstrated the *potential* for significant cost savings, much needs to be done before these cost savings can be realized. Although there is a strong commitment from states to deploy electronic credentialing, only three or four states have achieved any level of success. This is because of the many technical challenges in integrating diverse computer systems. Also, the solution in one state might not be applicable to another because the systems differ from state to state. Nevertheless, some of the software systems developed for one state have found applications in other states.

Another factor affecting the success of electronic credentialing is the recruitment of motor carriers. The CVISN motor carrier survey (Chapter 7) suggests that most carriers are receptive to the idea of end-to-end electronic credentialing. But questions remain about how the carriers will communicate with the states electronically. One of the major architecture issues under consideration by the states, as well as FMCSA, is whether to use computer-to-computer interfaces between the state and motor carriers or a web-based person-to-computer interface. Currently, there are three distinct approaches that are being pursued: a web-based system that uses a standard internet browser to connect to the states' web site to submit and retrieve credential applications and responses, a stand-alone personal computer (PC)-based program called a Carrier Automated Transaction (CAT) system, and a system that involves making special modifications or upgrades to existing fleet management systems to communicate directly with state registration systems. It appears that all three types of solutions may be needed to meet the needs of a diverse population of motor carriers.

The benefit/cost analysis of CVISN roadside enforcement technologies demonstrates the need to integrate safety information exchange and electronic screening technologies. Three scenarios were presented and analyzed. The first scenario, representing an actual deployment involving the use of Aspen and ISS in combination with manual prescreening of trucks, produced a benefit/cost ratio of 0.6. Although this implies that the economic benefit of such a deployment does not justify the costs, it is important to understand that this scenario represents only a partial deployment of CVISN roadside enforcement technologies.

From a development perspective, it makes sense to think of safety information exchange (i.e., laptop computers, Aspen, ISS, SAFER Data Mailbox, CVIEW) and electronic screening (i.e., DSRC, transponders, AVI) as separate systems. However, these systems are designed for integrated application. In particular, it is not practical to use ISS to select vehicles for inspection without some automated means of identifying vehicles and making decisions. Our analysis of Connecticut's experience using ISS with manual pre-screening (the motivation for Scenario RE-1) demonstrated that inspection selection efficiency (number of out-of-service orders per 100 vehicles inspected) increased by 2 percent over pre-CVISN methods. It was estimated that deploying this type of system nationwide would reduce the number of truck-related crashes by only 84 crashes per year.

On the other hand, our simulation of using ISS in combination of with electronic screening (Scenario RE-2), which assumes that all low-risk carriers (determined by FMCSA's SafeStat rating system) enroll in the electronic screening system and will be permitted to bypass inspection sites, demonstrates that the inspection selection efficiency could be increased by greater than 11 percent. It was estimated that this type of deployment would eliminate 589 crashes per year.

The benefits of CVISN roadside enforcement technologies could be greatly enhanced in two ways. The first method was illustrated in Scenarios RE-3 and RE-3\*. If motor carriers and drivers became aware that the states have significantly increased their ability to target inspections on high-risk carriers and drivers, the carriers might invest more in vehicle maintenance and the drivers might improve their compliance with safety regulations in order to avoid inspections and (more importantly) out-of-service orders. Although to date there is no evidence that this deterrence effect will occur, our analysis demonstrates that hypothetical reductions in violation rates of between 10 to 25 percent, along with the use of ISS and electronic screening, will help avoid between 4,000 and 10,000 crashes.

The second way in which CVISN benefits could be enhanced is by improving the quality of data and analysis algorithms upon which inspection selection decisions are based. In initiating the Large Truck Crash Causation Study (LTCCS), FMCSA recognizes that new information is needed to understand the mechanisms that cause truck crashes. It is anticipated that data from the LTCCS can be used to identify the types of vehicle defects and driver violations that are responsible for large numbers of crashes. This will make it possible to develop more advanced inspection selection algorithms that can target carriers based on their compliance with these more relevant risk factors.

## **FUTURE DATA NEEDS**

Additional benefit and cost data are needed to promote and expand the deployment of CVISN. This information is needed to evaluate further investments at national and state levels. As CVISN technologies mature and expand and more efficient solutions are developed, cost and benefit information will need to be updated and new analyses performed to help participating states forecast their costs and cost savings. Also, it is important to obtain cost data from many

different states in order to provide more accurate cost information to states with different infrastructure and organizational structures.

Additional kinds of data are also needed to demonstrate that CVISN technologies are having the desired safety impacts where they are deployed. Examples of roadside enforcement data that are needed to document CVISN benefits include vehicle and driver OOS rates for motor carriers in different safety risk categories, electronic screening bypass rates, and trends in safety compliance rates as CVISN becomes more widely deployed.

Examples of deployment tracking data that may be useful include numbers of

- Carriers participating in electronic credentialing
- Different types of credentials that can be processed electronically
- States participating in IRP and IFTA clearinghouses
- Carriers/trucks enrolled in electronic screening programs
- Inspectors using Aspen or equivalent to conduct inspections
- Vehicles screened using the Inspection Selection System.

## **ORGANIZATION OF THIS REPORT**

The main body of this report (Volume I) is arranged in nine chapters as follows:

1. Introduction
2. Services and Technology
3. Deployment Status
4. Evaluation Goals and Approach
5. Safety Benefits
6. Costs
7. Customer Satisfaction
8. Benefit/Cost Analysis
9. Discussion.

In addition, an appendix in Volume II presents supporting information and detailed data that resulted from the evaluation.

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- **Battelle:** Darlene Wells, Jennifer Holdcraft, Art Greenberg, Nancy Coburn, Chris Cluett, Louise Glezen, and Bennett Pierce
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## **Abbreviations**

The following abbreviations are used in the CVISN MDI Evaluation Report (Volume I) and its appendices (Volume II). Some of the abbreviations are fairly standard across the commercial vehicle industry, and others are particular to a single state or to this report alone.

### **ABBREVIATION DEFINITION**

AAMVA	American Association of Motor Vehicle Administrators
ANSI	American National Standards Institute
ARTS	Advanced Rural Transportation System
ASTM	American Society for Testing and Materials
ATA	American Trucking Associations, Inc.
AVI	Automated vehicle identification
AVIS	Automatic Vehicle Identification System
BCA	Benefit/cost analysis
BCR	Benefit/cost ratio
BNMCS	Baseline national motor carrier survey
CAT	Carrier Automated Transaction
CDLIS	Commercial Driver's License Information System
CDPD	Cellular digital packet data
CFR	Code of Federal Regulations
CH	Clearinghouse
CI	Credentialing interface
CMD	CVIEW Data Mailbox
CMV	Commercial motor vehicle
CO	Carbon monoxide
CO2	Carbon dioxide
CV	Commercial vehicle
CVIEW	Commercial Vehicle Information Exchange Window
CVISN	Commercial Vehicle Information Systems and Networks
CVO	Commercial vehicle operations
CVSA	Commercial Vehicle Safety Alliance
DMV	Department of Motor Vehicles
DOT	Department of Transportation
DPS	Department of Public Safety
DSRC	Dedicated short-range communications
EB	Eastbound
EC	Electronic credentialing
EDI	Electronic data interchange
EPA	Environmental Protection Agency
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FMCSR	Federal Motor Carrier Safety Regulations
FOT	Field Operational Test

FRA	Federal Railroad Administration
FTA	Federal Transit Administration
FTE	Full-time equivalent
GES	General Estimates System (National Automotive Sampling System)
GHG	Greenhouse gas
GL	Green Light (Oregon)
GVW	Gross vehicle weight
HAZMAT	Hazardous materials
HELP	Heavy Vehicle Electronic License Plate
ICC	Interstate Commerce Commission
ID	Identification [also Insufficient data]
IEEE	Institute of Electrical & Electronics Engineers
IFTA	International Fuel Tax Agreement
IRP	International Registration Plan
ISS	Inspection Selection System
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITE	Institute for Transportation Engineers
ITS	Intelligent Transportation System [formerly IVHS]
JHU/APL	Johns Hopkins University Applied Physics Laboratory
JPO	Joint Program Office (USDOT)
LPR	License plate reader
LTCSS	Large Truck Crash Causation Study
LTL	Less-than-truckload
MACS	Mainline Automated Clearance System
MCMIS	Motor Carrier Management Information System
MCSAP	Motor Carrier Safety Assistance Program
MCTB	Motor Carrier Transportation Branch (Oregon)
MDI	Model Deployment Initiative
MMDI	Metropolitan Model Deployment Initiative
MVA	Motor Vehicle Administration
NFSS	National Fleet Safety Survey
NGA	National Governors' Association
NHTSA	National Highway Traffic Safety Administration
NOx	Nitrogen oxides
NPV	Net present value
O and M	Operating and maintenance
OCR	Optical character recognition
ODOT	Oregon Department of Transportation
OMB	Office of Management and Budget
OMC	FHWA Office of Motor Carriers (became FMCSA)
OOS	Out of service
OS/OW	Oversize/overweight
PC	Personal computer
PIQ	Past inspection query
PM10	Particulate matter < 10 microns in diameter

POE	Port of entry
RE	Roadside enforcement
ROC	Roadside operations computer
ROG	Reactive organic gas
RPC	Regional processing center
RSPA	Research and Special Programs Administration
SAFER	Safety and Fitness Electronic Record
SAFESTAT	Safety Status Measurement System
SCA	SAFER-CVIEW application
SDM	SAFER Data Mailbox [also abbreviated as SDMB]
SIE	Safety information exchange
SM	Safe miles
SOx	Sulfur oxides
SSRS	Single State Registration System
TA	Temporary Apportioned
TCP/IP	Transport control protocol/Internet protocol
TEA-21	Transportation Equity Act for the 21st Century
TL	Truckload
TRB	Transportation Research Board
USDOT	United States Department of Transportation
VIN	Vehicle identification number
VISTA	Vehicle Information System for Tax Apportionment
VMT	Vehicle miles traveled
VNTSC	Volpe National Transportation Systems Center (U.S. DOT)
VOC	Volatile organic compound
VOT	Value of time
WB	Westbound
WD	Weight-distance
WIM	Weigh in motion [scale]
XML	Extensible markup language

## CHAPTER 1. INTRODUCTION

CVISN (Commercial Vehicle Information Systems and Networks) is a collection of information systems and communication networks used by government agencies, motor carriers, and other stakeholders involved in commercial vehicle operations (CVO). CVISN services and technologies consist of

- **Safety Information Exchange** technologies to facilitate the collection, distribution, and retrieval of motor carrier safety information at the roadside. These data help enforcement staff focus scarce resources on high-risk carriers and drivers, in turn helping to reduce the number of crashes involving commercial vehicles.
- **Electronic Screening** systems, which allow transponder-equipped commercial vehicles that maintain good safety and legal status to bypass roadside inspection and weigh stations. This saves time and money for participating carriers and allows states to devote more resources toward removing unsafe and noncompliant carriers.
- **Electronic Credentialing** systems for electronic submission, processing, approval, invoicing, payment, and issuance of credentials; electronic tax filing and auditing; and participation in clearinghouses for electronic accounting and distribution of registration fee payments among states.

Other intelligent transportation systems (ITS) of interest in the area of CVO include (1) fleet and freight management systems, which are private-sector ITS/CVO initiatives, and (2) electronic commerce (e-commerce), which promises to have a great effect on CVO in the years ahead. However, CVISN is concerned only with the three roadside and credential administration systems discussed above.

Commercial vehicles are defined at 49 CFR as those used for interstate or intrastate commerce to transport passengers or property. Such vehicles are greater than 10,001 pounds gross vehicle weight, or are designed to transport more than 16 passengers, or transport federally regulated hazardous materials in quantity requiring placarding. In general, the focus of CVISN has been on the motor carrier industry, heavy trucks in freight hauling service, and the government agencies that regulate the operation of such vehicles.

In 1996, the United States Department of Transportation (USDOT) sponsored the CVISN Model Deployment Initiative (CVISN MDI) to demonstrate the technical and institutional feasibility, costs, and benefits of CVISN user services and to encourage further deployment. The initial participants included two prototype states (Maryland and Virginia) and eight pilot states (California, Colorado, Connecticut, Kentucky, Michigan, Minnesota, Oregon, and Washington). CVISN services and technologies are expected to improve highway safety, simplify government administrative credentialing operations, enhance productivity, and reduce delays for safe and legal carriers. An important component of the CVISN MDI is an independent evaluation of these benefits as well as the costs to deploy and maintain the systems on a national level.

Currently, all 50 states and the District of Columbia are in various stages of CVISN planning and deployment. Most states are still in the planning and development stages. Therefore, the evaluation approach taken was to estimate benefits and costs of CVISN under various deployment scenarios using results from studies conducted in the states that were among the first to successfully deploy specific CVISN services. Results from these focused studies were used in various analyses, including a safety benefits model and comprehensive benefit-cost analyses, to estimate the future benefits and costs of CVISN when it becomes more widely deployed.

The remainder of this chapter presents a brief background on USDOT's ITS program; the history of the CVISN MDI; and an overview of the scope, expectations, and organization of this evaluation.

## 1.1 INTELLIGENT TRANSPORTATION SYSTEMS

The national ITS program, managed by USDOT, was formally established by the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) and further supported by the Transportation Equity Act for the Twenty-first Century (TEA-21) of 1998. The ITS program promotes the development and application of electronics, communications, and information systems to improve the efficiency and safety of surface transportation systems. ITS technology has been evolving over the last 15 years with deployment in field tests, in pilot applications, and in state and local transportation systems.

In 1995, USDOT produced its national ITS program plan, covering 1995 to 2015, which describes USDOT's program organization and outlines the Department's role in promoting the development and deployment of ITS.

The goals of the national ITS program are to

- Improve the *safety* of the nation's surface transportation system
- Increase the operational *efficiency* and capacity of the surface transportation system
- Enhance the personal *mobility* and the convenience and comfort of the surface transportation system
- Enhance present and future *productivity*
- Reduce *energy and environmental costs* associated with traffic congestion
- Create an environment in which the development and deployment of ITS can flourish.

These broad goals were intended to represent aspirations across ITS user services in three application areas: metropolitan transportation, rural transportation, and CVO.

ISTEA also empowered the ITS Joint Program Office (JPO) of USDOT to provide strategic leadership for ITS research, development, testing, and deployment. Working with the federal agencies responsible for various surface transportation modes [the Federal Highway Administration (FHWA), the Federal Transit Administration (FTA), the National Highway Traffic Safety Administration (NHTSA), the Federal Railroad Administration (FRA), the Research and Special Programs Administration (RSPA), and the Federal Motor Carrier Safety Administration (FMCSA)], the JPO provides guidance on investment decisions and program activities, promotes coordination among public and private partners, focuses programs and activities on deployment, and facilitates the assessment of ITS programs.

A Field Operational Test (FOT) program was established to conduct formal tests of ITS services, functions, and technologies in “real world” conditions. As specified by ISTEA and TEA-21, each FOT requires formal evaluations to determine how well the technologies work and to document their benefits and costs. Two types of evaluations can be performed: the participating organizations can perform a self-evaluation using guidelines provided by the JPO, or an independent evaluator may be selected by the JPO, in consultation with the participating organizations.

In 1996, the USDOT announced several new initiatives aimed at accelerating the deployment of ITS. The Metropolitan Model Deployment Initiative (MMDI) in four U.S. metropolitan areas (New York, Phoenix, Seattle, and San Antonio) will showcase deployment of an integrated ITS infrastructure. As many as nine distinct ITS services for metropolitan applications are being deployed in each of the four MMDI sites. The USDOT also initiated the Advanced Rural Transportation Systems (ARTS) program to plan and deploy ITS technologies in rural settings. The ARTS strategic plan was developed in 1996, and a model deployment program began in 1997. The third major initiative, aimed at promoting the deployment of ITS services in the area of CVO, is the CVISN MDI.

## **1.2 CVISN MODEL DEPLOYMENT INITIATIVE**

The CVISN MDI began in 1996 as a cooperative agreement among the USDOT; two “prototype” states, Maryland and Virginia; and eight “pilot” states, California, Colorado, Connecticut, Kentucky, Michigan, Minnesota, Oregon, and Washington. The FMCSA (formerly the Office of Motor Carriers of the FHWA) developed a three-step strategy for accomplishing the goal of the MDI: planning, design, and deployment. This strategy remains in place today for other states embarking on CVISN deployment.

In the planning step, state officials attend two ITS/CVO training courses and the state develops an ITS/CVO business plan. To support CVISN program design, state officials attend a third training course and participate in a series of three CVISN deployment workshops to complete a CVISN Program Plan and Top-Level System Design. Once the plan is accepted by FMCSA, a state can proceed with deployment, based upon the availability of federal and state resources. The goal of the CVISN MDI is to have each state reach an “ambitious but achievable” level of deployment, called Level 1, in each of the three technology areas shown in Table 1-1 (Richeson 2000). To accomplish Level 1 deployment, states must

- Establish an organizational framework among state agencies and motor carriers for cooperative system development
- Create a State CVISN System Design that conforms to the CVISN Architecture and can evolve to include new technology and capabilities
- Implement all CVISN elements using applicable architectural guidelines, operational concepts, and standards.

**Table 1-1. CVISN Level 1 Deployment**

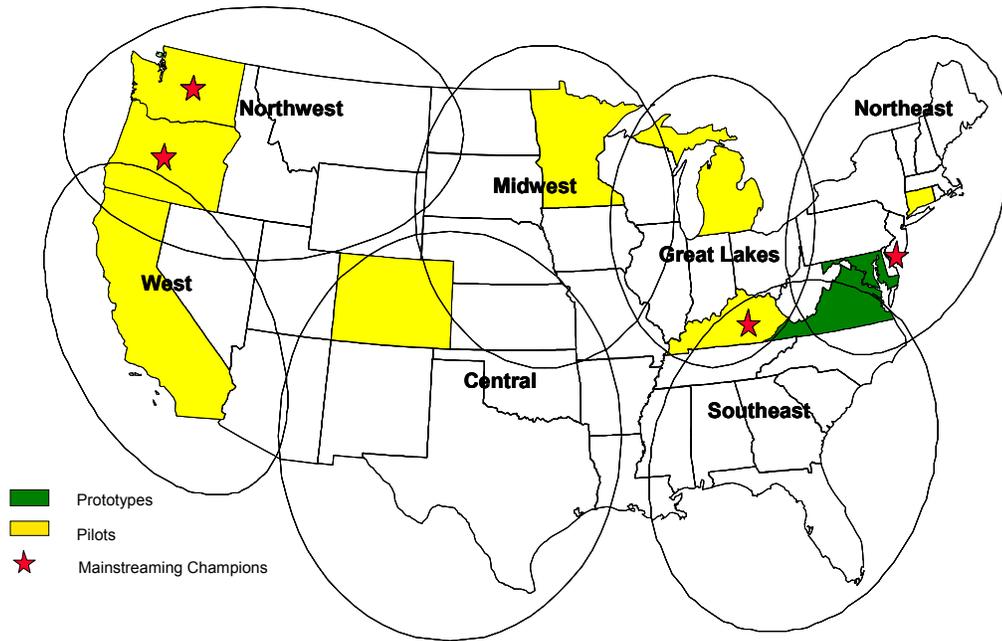
<p><b>Safety Information Exchange</b></p> <ul style="list-style-type: none"> <li>- Use of Aspen (or equivalent software for access to centralized safety data) at all major inspection sites</li> <li>- Connection to the Safety and Fitness Electronic Record (SAFER) system so that states can exchange “snapshots” of information on interstate carriers and individual vehicles</li> <li>- Implementation of the Commercial Vehicle Information Exchange Window (CVIEW), or equivalent, system for exchange of intrastate snapshots and for integration of SAFER and other national/interstate data.</li> </ul>
<p><b>Electronic Screening</b></p> <ul style="list-style-type: none"> <li>- Electronic screening at one or more fixed or mobile inspection sites</li> <li>- Readiness to replicate electronic screening capability at other sites</li> </ul>
<p><b>Electronic Credentialing</b></p> <ul style="list-style-type: none"> <li>- Automated processing (application, state processing, issuance, tax filing) of at least International Registration Plan (IRP) and International Fuel Tax Agreement (IFTA) credentials; readiness to extend to other credentials [intrastate, titling, oversize/overweight (OS/OW), carrier registration, and hazardous material (HAZMAT)]. Does not necessarily include electronic payment of fees or taxes.</li> <li>- Connection to IRP and IFTA Clearinghouses</li> <li>- At least 10 percent of transaction volume handled electronically; readiness to sign up more carriers; readiness to extend to branch office where applicable.</li> </ul>

Source: Richeson (2000)

To date, four states (Maryland, Virginia, Kentucky, and Washington) have demonstrated capabilities for Level 1 deployment in all three areas. However, many others have made significant progress in one or two areas. Currently a total of 38 states have indicated that they expect to achieve Level 1 deployment by September 30, 2003, dependent upon receiving federal ITS deployment or state resources. CVISN deployment Level 2 is currently being defined.

In addition to its oversight role, FMCSA participates directly in system development (e.g., Aspen, CVIEW software systems) and provides technical and project management assistance to states through the Johns Hopkins University’s Applied Physics Laboratory (JHU/APL). Also, to help promote the deployment of CVISN, USDOT sponsored the CVO mainstreaming program to help states and the motor carrier industry work together to find common approaches to the development and deployment of CVISN services. Regional “mainstreaming champions” were recruited to develop policies, plans, and agreements to

expedite the regional deployment of CVISN. The CVISN prototype, pilot, and mainstreaming champion states are shown in Figure 1-1.



**Figure 1-1. Prototype, Pilot, and Mainstreaming States**

### 1.3 OVERVIEW AND SCOPE OF THE CVISN MDI EVALUATION

The intent of the CVISN MDI evaluation effort was to furnish information to USDOT, Congress, states, public interest groups, the motor carrier industry, and others on the desirability of making CVISN investments and corresponding enhancements to national, state, regional, and local transportation programs. As such, the evaluation had to permit comparisons and the development of priorities among alternative investments within the FHWA's ITS program and between ITS and non-ITS programs. For this reason, the evaluation includes a comprehensive benefit/cost analysis (BCA) to determine the economic worth of CVISN deployments. However, it is equally important to document other benefits associated with the national ITS/CVO goals and to learn as much as possible about how CVISN changes the nature of CVO. Thus, an evaluation strategy was developed to meet the data needs of BCA as well as the information needs of various stakeholders (states, motor carriers, federal agencies).

The first step in developing the evaluation strategy for CVISN was to identify the key innovative features that would be deployed in one or more states, along with the major benefits that were expected to result from their deployment. Key features and anticipated benefits of CVISN-enhanced roadside enforcement (safety information exchange and electronic screening) and credentials administration technologies were established in collaboration with various CVISN stakeholders. Initial priorities were established during the CVISN Planning and Evaluation Workshop (January 1997) involving more than 100 participants from state governments, USDOT, and industry. It was agreed that the evaluation project would be

organized around three study areas: safety, costs, and customer satisfaction. Safety was established as the number one priority.

The second step in the evaluation strategy was to identify a subset of states that were most likely to deploy the key features during the timeframe of the evaluation. As discussed earlier, the pace of CVISN deployment varies considerably from state to state. In 1997 some states were on the verge of deploying certain CVISN components, while other states expected their planning activities to continue for some time. Another concern was that some of the supporting systems (e.g., IRP and IFTA clearinghouses, SAFER, CVIEW, and Aspen) were not fully developed. After considerable review, five states (Connecticut, Kentucky, Maryland, Oregon, and Virginia) out of the 10 prototype and pilot states were selected to support the evaluation data collection effort. Each of these five states was expected to achieve Level 1 deployment status in at least one of the three CVISN user service and technology areas. The bulk of state-specific data and information in this report were drawn from these five states.

#### **1.4 ORGANIZATION OF THIS REPORT**

As shown below, Chapters 2 through 4 present program background, detailed objectives, research goals, priorities, approaches, and methods. Chapters 5 through 9 present results and implications, drawn mainly from the subset of five states selected to support data collection.

- Chapter 2 contains a detailed description of the CVISN services and technologies.
- Chapter 3 summarizes the deployment status of CVISN nationwide and in the 10 pilot and prototype states
- Chapter 4 lists the evaluation goals, measures, and hypotheses and describes the technical approach of the evaluation. Anticipated benefit and evaluation priorities, initially established at the Planning and Evaluation Workshop, were refined by establishing measures and hypotheses for each of the goal areas and developing detailed data collection and analysis plans to test the hypotheses.
- Chapter 5 presents an estimate of CVISN safety benefits. Estimated safety benefits include the number of crashes that may be avoided and number of lives saved when CVISN roadside services (safety information exchange and electronic screening) are more fully deployed. Chapter 5 also presents additional details on the direct impacts of CVISN on roadside enforcement activities.
- Chapter 6 details actual and estimated costs to deploy and maintain or operate CVISN systems compared to the baseline systems in place prior to CVISN deployment, and the potential cost savings that can be realized by states and motor carriers.
- Chapter 7 presents the results of customer satisfaction studies, drawn from surveys, interviews, and focus groups with motor carriers, drivers, roadside inspectors, and state administrators.

- Chapter 8 extends the results from Chapters 6 and 7 on safety and cost—supplemented with information from the literature—to build a comprehensive benefit/cost analysis (BCA) from a national perspective. The BCA determines the net economic worth of CVISN deployments.
- Chapter 9 presents the evaluation team’s perspective on the major factors that might influence the future success of CVISN and summarizes the team’s findings relative to the current status of CVISN deployment. The chapter also identifies some potential impediments to the further deployment of CVISN.

Appendices in Volume II present further background information and detail on some topics covered in this report.

## **1.5 REFERENCES**

CVISN Planning and Evaluation Workshop. Johns Hopkins University Applied Physics Laboratory, January 1997.

ISTEA (Intermodal Surface Transportation Efficiency Act of 1991). Public Law 102-240, December 18, 1991.

Richeson, K.E., Introductory Guide to CVISN, POR-99-7186 Preliminary Version P.2, Laurel, Maryland, February 2000.

TEA-21 (Transportation Equity Act for the 21st Century). Public Law 105-178, June 9, 1998.

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## **CHAPTER 2. CVISN SERVICES AND TECHNOLOGY**

This chapter provides information on the purposes of the Commercial Vehicle Information Systems and Networks (CVISN) program, the services it is designed to deliver, and the technologies that are being developed and deployed to support CVISN capabilities in the states. The emphasis is on system design and the eventual capabilities of these systems. Chapter 3 presents current information on actual state deployments of CVISN systems in their as-built configurations. Much of the information presented in this chapter was derived from various planning documents prepared by The Johns Hopkins University Applied Physics Laboratory on behalf of the FMCSA. These are listed in Section 2.4, References. Additional information about CVISN technologies, including detailed technical descriptions and planning documents, can be found at <http://www.jhuapl.edu/cvisn/>.

### **Overview of CVISN**

CVISN is composed of three major services: Safety Information Exchange, electronic screening, and credentials administration. Other intelligent transportation systems (ITS) commercial vehicle operations (CVO) services now in development or evaluation stages (such as Hazardous Material Incident Response, International Border Crossing, and Intermodal Transportation) are not a part of the CVISN MDI.

Safety Information Exchange (SIE) includes electronically recording, storing, and downloading vehicle inspection data, issuing citations if appropriate, and exchanging safety data quickly and conveniently among agencies within a state and among other states.

Electronic screening involves screening transponder-equipped vehicles at fixed sites (e.g., weigh stations) and mobile sites to confirm that vehicles are safe, are at proper weight, have appropriate credentials, or have not been placed out of service. Electronic screening systems are intended to perform this screening in such a way that safe, compliant trucks can proceed on the highway without stopping, while potentially unsafe or noncompliant trucks can be pulled in for closer inspection and confirmation of proper operating credentials.

Credentials administration (credentialing) includes a combination of carrier and state government systems. Electronic credentialing systems will automate the complete credential life-cycle process. All aspects of the interstate commercial vehicle credentialing process will be integrated to include electronic submittal of applications, automated processing and cross-checking of applications, automated fee calculation and invoice transmittal, electronic fee payment, and automated issuance and printing of credentials. Credentials administration also encompasses and integrates with systems that electronically share data among states (also known as “base-state” agreements), including the International Registration Plan (IRP) and International Fuel Tax Agreement (IFTA) clearinghouses. In addition, credentials administration encompasses electronic filing and payment of interstate commercial vehicle fuel taxes.

## **2.1 SAFETY INFORMATION EXCHANGE SERVICE AND TECHNOLOGIES**

Safety Information Exchange is the electronic exchange of safety data along with supporting credential information, related to carriers, vehicles, and drivers involved in CVO. The enforcement community, including state administrative offices and the state highway patrol, use the information to make better-informed decisions about which vehicles to inspect at roadside and who should receive credentials and permits based on safety performance history. It helps focus inspection on high-risk carriers.

The Safety Information Exchange capability includes:

- Automated collection of information about safety performance;
- Automated collection of credentials information to augment safety information;
- Improved access to carrier, vehicle and driver safety and credentials information; and
- Updates of carrier and vehicle snapshot information.

Design elements include state and federal commercial vehicle credential and safety administration-related offices, roadside check stations (fixed and mobile), and information exchange systems (MCMIS, SAFER, SAFETYNET, and state CV Information Exchange Window (CVIEW)).

The primary safety-related information systems and networks include the Safety and Fitness Electronic Records System (SAFER), Commercial Driver License Information System (CDLIS), and Motor Carrier Management Information System (MCMIS). Figure 2-1 illustrates the main components and relationships in Safety Information Exchange.

### **SAFER**

SAFER stands for the Safety and Fitness Electronic Records system maintained at the Volpe National Transportation Center under contract by FMCSA. SAFER is an interactive database, operating at the national level. It is the primary source of safety-related information shared among states. SAFER uses carrier information from existing government motor carrier safety databases. Currently, it consists of interstate carrier data and several states' intrastate data.

The primary function of SAFER is to provide users timely, electronic access to safety and credential data via one or more wide-area network communication links. SAFER provides standardized carrier, vehicle, and driver (future) data (snapshots and reports) containing safety and credentials information. SAFER stores and distributes inspection reports and carrier and vehicle snapshots. It also supports distribution among states of carrier profile reports, compliance review data, accident data, and enforcement citations.

Because it can provide this information to authorized users within a few seconds of a user's request, SAFER should increase the efficiency and effectiveness of roadside inspections. It can provide this carrier, vehicle, and driver safety and credential information to fixed and mobile roadside inspection stations. SAFER automatically records vehicle inspection data,

exchanging safety data among agencies within a state and among other states. Subscribers can request that specific “snapshots” be sent to them automatically when substantial changes occur.

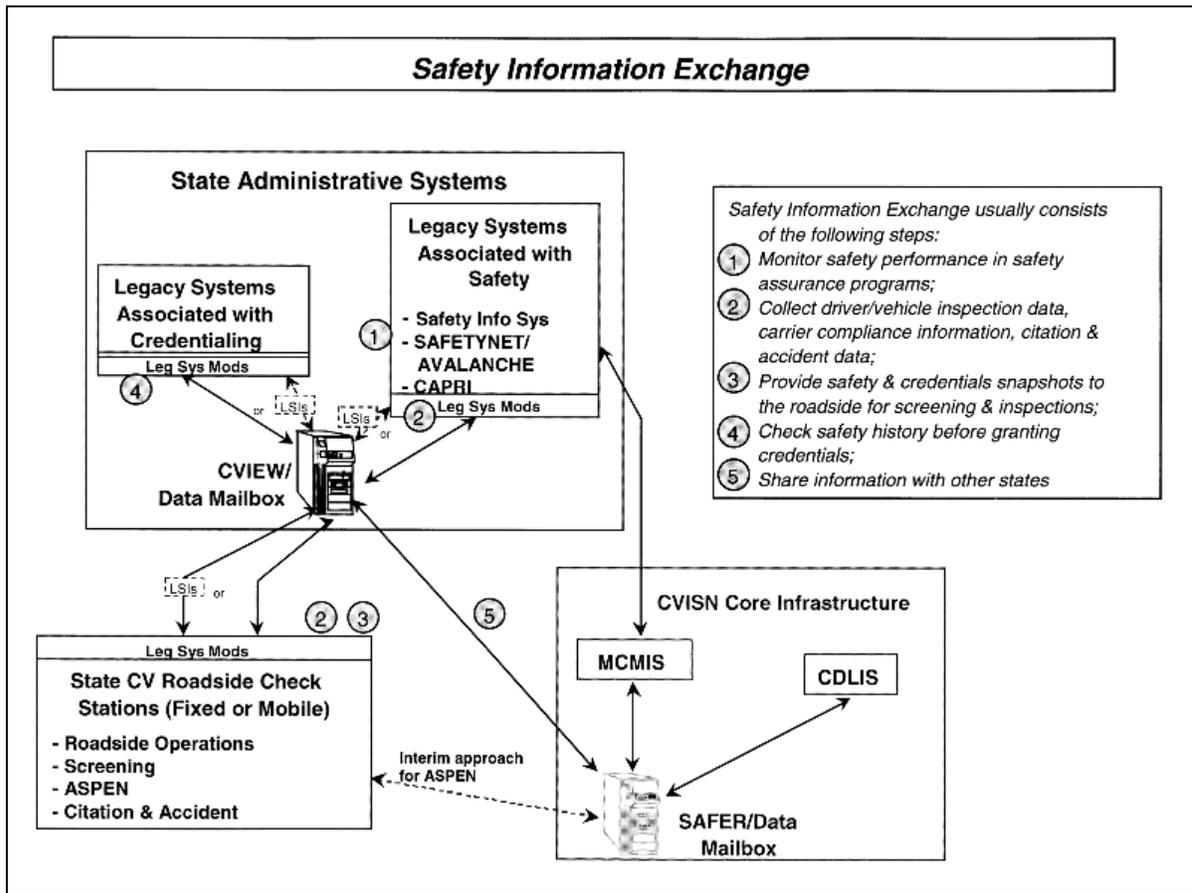


Figure 2-1. Safety Information Exchange Relationships

Source: Johns Hopkins University Applied Physics Laboratory planning documents, adapted in Orban, Brand, Amey, and Kinatader, “CVISN Model Deployment Initiative Draft Summary Evaluation Plan.”

The summary safety record of a vehicle is called a “snapshot,” a concise electronic record of a carrier’s identification, size of fleet, information on types of commodities transported, and safety record, including a safety rating (if any), a roadside out-of-service (OOS) inspection summary, and crash information. It can include carrier compliance review reports, safety inspections, citations, credentials, and tax information. State inspectors will record safety inspection records using Aspen and will upload this data on a daily basis to their respective state systems to add to a vehicle snapshot.

### Aspen

Aspen refers to the software applications that reside on the client system for recording and transmitting inspections electronically. States can decide to use Aspen, developed by the

FMCSA, or some equivalent system. Laptop computers with Aspen are deployed at roadside for inspections.

The Aspen system or its equivalent needs to support the following functions:

- Recording inspection data electronically;
- Transmitting electronically inspection reports to SAFER, either directly or via CVIEW or its equivalent;
- Retrieval electronically of inspection reports from SAFER, either directly or via CVIEW or its equivalent; and
- Downloading of carrier snapshots via subscription processing to support the ISS.

The Inspection Selection System (ISS) is a component of Aspen. It was developed in response to a 1995 Congressional mandate that called for the use of prior carrier safety data to guide the selection of commercial vehicles and drivers for roadside inspections. The system was developed in a cooperative effort between the Upper Great Plains Transportation Institute and the FMCSA. ISS displays an inspection prioritization score of 1 to 100 and also provides an inspection recommendation and suggested areas of noncompliance based on previous inspections. ISS also contains a full page of carrier statistics that is valuable to inspectors at the roadside. The initial inspection selection algorithm, developed in 1995, was primarily based on a carrier's history of out-of-service (OOS) violations. The next-generation algorithm, ISS-2, was introduced in 1999 and is not yet fully implemented. ISS-2 is based on the more comprehensive SafeStat algorithm that broadens the criteria and focuses in large part on crashes.

The ISS is normally installed on a hand-held notebook or laptop computer utilizing the Aspen driver/vehicle inspection software. When an inspector is ready to conduct an inspection, the DOT or ICC number can be entered into the software and the computer then displays pertinent carrier information and the current ISS inspection value. The system is not vehicle-specific but provides a score for the carrier for which the particular truck is operating. A recommendation is given for inspection based on the value of the score. Where the ISS is used to select vehicles for inspection, several vehicles will usually be rated and the vehicle with the highest value will be selected for inspection.

## **CVIEW**

The FMCSA developed the CVIEW system as a data exchange mechanism that is operated on the state level. Although it operates like SAFER, it is operated by the state, allowing greater control and increased flexibility regarding interfaces with state legacy systems. More importantly, CVIEW is used to exchange both intrastate and interstate snapshots of vehicles within the state and connects to SAFER to exchange interstate snapshots. CVIEW communicates directly with the state roadside system (Aspen) and several legacy credentialing and safety information systems within the state.

## **MCMIS**

The Motor Carrier Management Information System (MCMIS) is a national system run by FMCSA to consolidate and process motor carrier safety data from sources throughout the US. MCMIS contains safety records of active intrastate and interstate motor carriers, safety and compliance reviews, and roadside inspection records and crash records. MCMIS also carries a Safety Fitness Rating based on algorithms that evaluate all of a carrier's safety data. It supplies carrier ID and safety data history for each interstate carrier via the SAFER system to the Aspen ISS.

### **Integration of Systems**

SAFER works on a national level. CVIEW performs this function on a state level. The delivery of interstate safety, registration, and taxation information to the roadside may be handled by an interstate clearinghouse, such as MCMIS, the International Registration Plan (IRP), and the International Fuel Tax Agreement (IFTA), and distributed via SAFER.

MCMIS supplies SAFER information to prioritize vehicles for inspection at the roadside. This update of information occurs on a weekly basis. SAFER will also create CDs with snapshots of carrier and later vehicle safety data that can be distributed to all Aspen sites within a state.

### **SAFER Data Mailbox (SDM)**

The SAFER Data Mailbox (SDM) facilitates the exchange of information between roadside inspection sites and administrative centers by acting as a temporary repository for data files and messages. Inspection data from the roadside will be transmitted from Aspen to SAFER via the SDM. Information is stored in the SDM for forty-five days. Through SDM, states can retrieve stored inspection data. The roadside agency applies to SDM for the information via the Past Inspection Query (PIQ). SM transmits inspection reports directly from the roadside to the SAFER system and conversely retrieves previous inspection reports by performing a Past Inspection Query (PIQ) on individual vehicles and drivers. The SDM was originally developed to help identify trucks that violate out of service (OOS) orders. Aspen units communicate directly to CVIEW or SAFER using wireless connections, such as cellular, cellular digital, and/or satellite technology.

## 2.2 ELECTRONIC SCREENING SERVICES AND TECHNOLOGIES

Electronic screening provides the capability to automatically screen transponder-equipped commercial vehicles as they approach weigh stations. Safety data, as well as size, weight, and credentials information about the vehicle and its associated carrier, are checked. Vehicles that are safe and legal can continue traveling, without slowing down or stopping, while those vehicles that are unknown to the system, or those requiring further attention, can be instructed to pull into the weigh station for inspection.

There are two types of electronic screening operations: fixed-site (scalehouse screening) and mobile operations screening. Fixed-site screening uses CVISN systems to prevent unnecessary inspections and delays of vehicles. Fixed-site screening accesses information about carriers, vehicles, and drivers. Mobile-site screening is similar except the equipment can be moved to others sites within the state.

### Technology and Data

In electronic screening, data snapshots about carriers and vehicles are exchanged between SAFER and CVIEW and also sent to roadside systems using ANSI (ASC) X12 EDI transaction sets. TS 285 is used for exchange of snapshots and snapshot segments.

SAFER, as described in Section 2.1, collects and distributes data snapshots. It is part of the CVISN core infrastructure. The snapshot data contain information about the carrier and vehicle to support safety with accident, inspection and violation summaries, credentials administration, and electronic screening.

Some of the following technology is used in electronic screening:

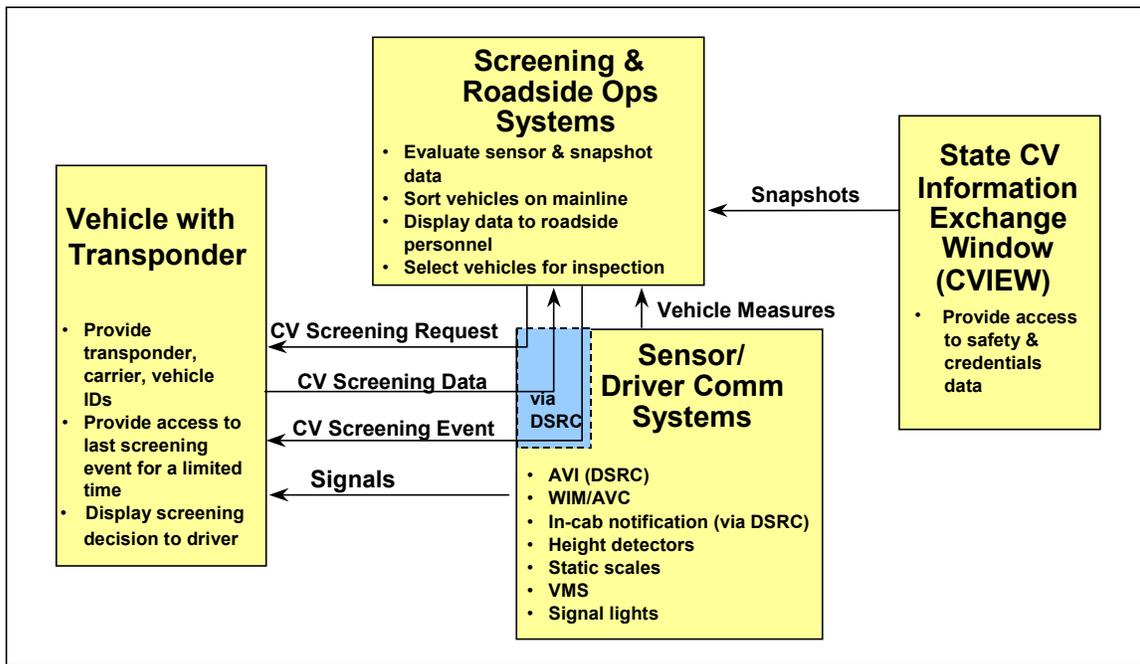
- *Mainline Screening* screens commercial vehicles without stopping them at an inspection site. A vehicle sensor placed up the road from an inspection site reads a transponder on the vehicle and identifies the carrier, vehicle, and driver. In some cases, the sensor may also read the last screening event.
- *Sorter Lane Screening* screens vehicles that have pulled off into an approach to the scalehouse. Sorter lane screening also reads the vehicle sensor. Sort lane screening typically is used in conjunction with WIM and license plate readers.
- *Weigh-in-Motion Equipment (WIM)* equipment calculates gross commercial vehicle weight as well as per axle weight when a vehicle travels over the equipment placed in the road surface. WIM can be incorporated in either mainline or sort lane screening.
- *Dedicated Short-Range Communications Equipment (DSRC)* transponders are installed in participating motor carrier trucks. DSRC equipment is an automated vehicle identification (AVI) technology used to identify vehicles on the mainline (highway) and in sorter lanes (at the weigh station). DSRC transponders on trucks transmit to DSRC sensor equipment at roadside. The transponder transmits ID numbers for the carrier, vehicle, driver, and, in the future, perhaps load type

identifiers. This DSRC equipment provides reliable communication between a moving vehicle and a roadside enforcement site.

The DSRC configuration that has been employed is the American Society for Testing and Materials (ASTM), version 6, active tag. A new standard is being developed for truck transponders, but it is currently undergoing validation testing. It is not known when the new standard will be deployed.

- *License Plate Reader/Optical Character Recognition Systems* scan and recognize a vehicle's license plate number and transmit this to the screening computer. Low reliability troubles these readers.

States can set specific criteria to decide whether a truck should pull into an inspection site for closer examination or bypass it. Screening criteria often include vehicle weight, axle weight, carrier safety rating, vehicle OOS citations, improper credentials, and delinquent tax payment. Figure 2-2 illustrates the systems and checks available for screening vehicles in motion, on the ramp, or at a static scale/inspection facility.



**Figure 2-2. Roadside Systems Technology to Support Electronic Screening and Inspections**

Source: CVISN Guide to Electronic Screening

### Enrollment

Before participation in electronic screening, a motor carrier must enroll in the electronic screenings program offered by each state in which it operates and have a transponder installed on

each vehicle. This transponder establishes a direct link between the transponder ID and the vehicle identification number (VIN). Vehicle data snapshots contain a transponder ID field to record this information. Access to the transponder ID data is restricted to only those states requested by the motor carrier. All preclearance systems are currently using the same type of transponder and transponder ID data are currently accessible by any system. Motor carriers with a NORPASS or Green Light transponder can approach any state and request to enroll the transponder ID number in that state's preclearance system. Carriers with PrePass transponders are subject to a transponder usage policy that restricts them to using their transponder in only those states with the PrePass preclearance system.

### **Electronic Screening Algorithm**

The four major components of the recommended electronic screening algorithm are

- Safety of the carrier and vehicle safety history from snapshots
- Credentials screening based on specific credential violations
- Random selection factor to pull in randomly a selected percentage of vehicles
- Weight and size.

Pull-in is recommended even if only one component fails bypass.

### **Programs and Interoperability**

Experts agree that the success of electronic screening depends on the interoperability of equipment from state to state. For the electronic screening to work, a vehicle must be able to operate with the same equipment and under similar rules as it travels from state to state. Carrier involvement in electronic screening is heavily dependent on solving interoperability issues among states as well as defining bypass criteria.

The Intelligent Transportation Society of America CVO Technical Committee adopted both the ITS/CVO Interoperability Guiding Principles and the Fair Information Principles for ITS/CVO. These guidelines advise jurisdictions to disclose fully electronic screening practices and policies, especially involving enrollment criteria, transponder ID standards, price, and screening standards.

Three systems currently enable trucks to participate in electronic screening: Heavy Vehicle Electronic License Plate (HELP) PrePass, NORPASS, and Oregon Green Light. A general description of these systems is presented below. Their deployment status, including numbers of participating states and carriers in each program, is discussed later in Section 3.2.

HELP PrePass is the largest North American electronic screening program. PrePass uses private capital to build the infrastructure for automatic vehicle identification (AVI), and then recovers those costs through user fees to the carriers for each site bypassed. PrePass assists participating states in recruiting and enrolling carriers, manages pre- and post-enrollment verification checks of carriers, and provides transponders for vehicles.

NORPASS is the second system. NORPASS has been deployed at existing weigh and inspection stations in several states in the U.S. and various Canadian provinces. The NORPASS transponder administrator manages the enrollment of carriers and performs periodic validations of carrier status. The participating states are responsible for building the AVI infrastructure. The program is currently in a period of transition and development. Interoperability between NORPASS and PrePass is available to the extent that NORPASS transponders can be used in PrePass states. To use PrePass, NORPASS carriers must complete a PrePass application and must pay the same fee PrePass carriers pay, plus a verification charge.

The Oregon Department of Transportation administers the Green Light Mainline Preclearance System. A total of 21 weigh stations in Oregon are equipped with high-speed WIM devices and transponder readers. The Green Light system allows the state to perform a quick check of each participating truck's size, weight, height, and carrier credential and safety status at highway speeds.

### **2.3 ELECTRONIC CREDENTIALING SERVICES AND TECHNOLOGIES**

Electronic credentialing supports electronic transactions between carriers and governments via electronic data interchange (EDI) and/or the Internet (electronic filing of IRP or IFTA). It uses software to send credential applications to the state and to receive in return electronic notification of credentials status. It also provides for review of such credentials. When possible, credentials are returned electronically. Electronic payment is an option associated with electronic credentialing. Electronic credentialing also supports states/regions in the administration of credentials, collecting and distributing taxes and fees, and in storing and distributing credentials-related data. States will provide credential information to enforcement officials at roadside through SAFER data snapshots.

States must collect fees from operators, and apportion and transfer those fees to other states, according to state agreements. As part of electronic credentialing, clearinghouses were designed into the system to support these state agreements. The clearinghouses centralize financial reconciliation mandated by the base agreements among states. They also facilitate other information exchanges, such as audits and reporting databases. The IFTA Clearinghouse went into operation in July 2000. Only a few states were participating at that time. The IRP Clearinghouse is fully operational with about 70 percent of the IRP jurisdictions planning to participate.

Key operational concepts for credentials administration are:

- Electronic credentialing and tax filing
- State administrative processes supported by electronic information exchange
- Base state agreements supported electronically
- National electronic access to interstate credentials information
- Access to data
- Ability to correct errors
- Fees paid electronically

- Electronic access to administrative processes available from public sites
- Status information available electronically to qualified stakeholders
- Carrier audit selection through electronic scans and records
- Paperless electronic records become primary and paper secondary.

CVO credentials that could be obtained electronically are:

- IFTA
- IRP
- Intrastate registration
- Carrier registration
- OS/OW permits
- HazMat permits
- Titles
- Electronic screening enrollment.

Figure 2-3 shows the generic design template used by the states in setting up their electronic credentialing systems. The CVISN system implementation in a given state can vary depending on the nature and make up of the existing (legacy) computer system a state is using at the time of CVISN deployment. States can choose, for example, to link or group various credentialing functions to best meet the needs of their constituents and their legacy system data structure.

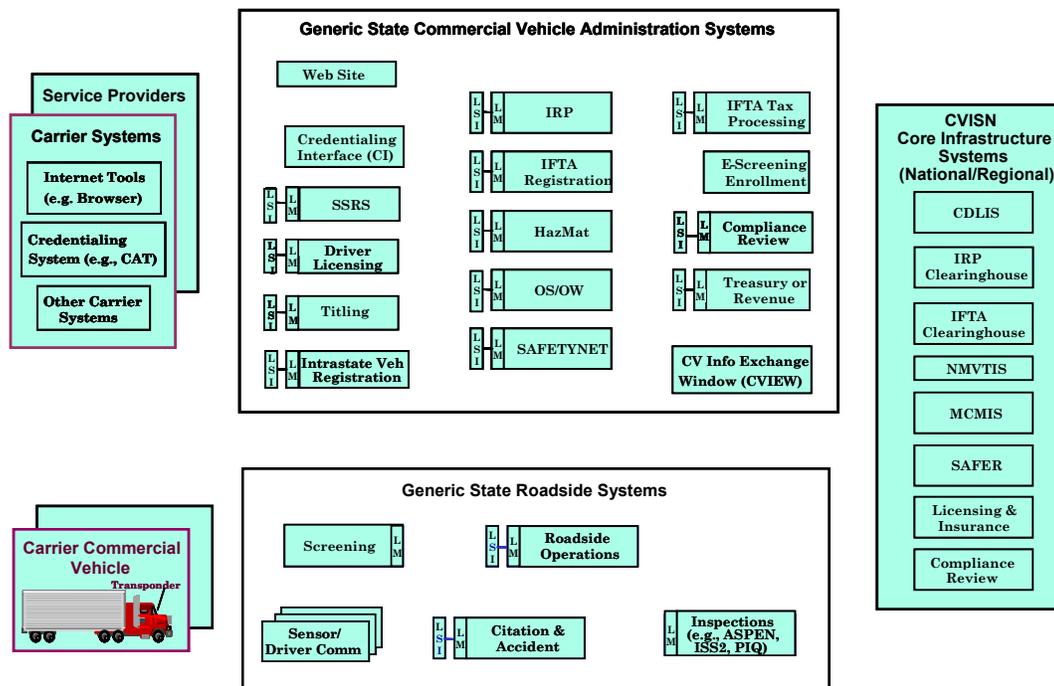


Figure 2-3. Generic State Design Template

Source: CVISN Guide to Top Level-Design

## **Technology**

Each state must decide on a data communication standard for electronic credentialing. Some prefer electronic data interface (EDI) because it is well established. Others prefer extensible markup language (XML) because XML is more appropriate for web applications.

Many CVISN Model Deployment Initiative states implemented an X12 EDI interface, using the CAT and CI model for carrier-state transactions. Some states have deployed credentialing web sites. Some have determined that both interface methods are necessary to meet customers needs. Those states are implementing both a web site and some type of computer-to-computer interface. FMCSA recommends surveying stakeholders to determine whether both methods would be appropriate.

A Carrier Automated Transactions (CAT) system allows a motor carrier or service provider to enter credentials applications through a PC. Applications travel to the state credentialing interface (CI). States in the Model Deployment Initiative are sponsoring the development of a CAT for their carriers. A variation of the CAT system that might be appropriate for large carriers is to create a CAT module for an existing fleet management system. The module would perform the same functions as the CAT, except the processing would be integrated with other existing capabilities. For CAT and CI systems developed to date, messages are formatted according to ANSI X12 EDI standard. XML is an alternative, but, so far, no CAT software implementing XML is currently available to carriers.

In the short term, FMCSA recommends that carriers and states use X12 EDI for computer-to-computer interfaces. It has a 20-year history of consensus on data semantics and is used by many firms. However, FMCSA recommends exploring XML as an alternative. It may prove to be cheaper to implement than EDI. In the future, there may be off-the-shelf software to support electronic credentialing.

States exchange information about credentials through the SAFER snapshots. Many CVISN Model Deployment Initiative states elected to build a state CVIEW from the FMCSA product. This generic CVIEW supports an EDI interface for snapshot updates. Some states are talking about developing regional CVIEWs to update snapshots with credential information.

Standardized EDI or Web transactions can allow:

- Carriers to file for credentials from their offices
- States to process applications automatically
- State to exchange information electronically to support base state agreements.

Standardized transactions support fee payments among payers, payees, and financial institutions.

Some states develop their own in-house credentialing systems, while others engage the services of a third-party provider to support the credentials administration function. The Vehicle Information System for Tax Apportionment (VISTA) is such a third-party system, offered by Lockheed Martin IMS (Teaneck, New Jersey). VISTA provides a computer system interface

between state credentialing administrators and the state's registration database. Approximately 20 states (including Ohio and Tennessee) currently use the VISTA program for processing their IRP credentials. An alternate third-party credentialing service is provided by R.L. Polk & Co. (Southfield, Michigan). The service, known as COVERsnet®, which stands for Commercial Vehicle Registration System, is used by 10 states for IRP credentialing and by six states for IFTA credentialing.

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## **CHAPTER 3. CVISN DEPLOYMENT STATUS**

Since 1991, the U.S. DOT has sponsored numerous field operational tests (FOTs) to demonstrate new ITS technologies for commercial vehicle operations and encourage their deployment. The CVISN MDI supports the overall USDOT emphasis on improving safety and efficiency in transportation. Specifically, the FMCSA has set the goal of reducing deaths and injuries from truck and bus crashes by 50 percent by the year 2010. One of the main purposes of CVISN is to increase highway safety by targeting, identifying, and removing unsafe vehicles from service until they are in compliance with safety regulations. CVISN roadside and electronic credentialing technologies are expected to improve safety by providing state and federal enforcement officials with electronic access to timely and accurate motor carrier information.

The evaluation of the CVISN MDI—by collecting and presenting safety, cost, and other program information—also supports the goal of the U.S. Congress (as stated in TEA-21) of having CVISN deployment completed in a majority of states by September 30, 2003. CVISN provides the system architecture and standards for data management to support deployment efforts in the states.

Early tests demonstrated the technical feasibility of certain information system and networking technologies, which have evolved into technologies used for completing CVISN deployment. When the CVISN Model Deployment Initiative (MDI) began in 1996, the Federal Motor Carrier Safety Administration (FMCSA), formerly the Office of Motor Carriers, developed a three-step strategy to assist states in CVISN deployment. This strategy was discussed in Section 1.2.

States participating in the Model Deployment Initiative included two “prototype” states – Maryland and Virginia – and eight “pilot” states – California, Colorado, Connecticut, Kentucky, Michigan, Minnesota, Oregon, and Washington. At least four of these states (Maryland, Virginia, Kentucky, and Washington) have demonstrated Level 1 capabilities in all three areas, and many other states have made significant progress in one or two areas (Radin 2000; PTI 2000). The CVISN initiative is now being expanded to other states. According to the FMCSA, eight states have been fully funded to achieve Level 1 deployment by September 30, 2003. An additional 30 states have indicated that they expect to complete Level 1 deployment by September 30, 2003, dependent upon receiving FY 2001 federal ITS deployment or state resources to support CVISN deployment.

Thus far, the most successful CVISN component, as demonstrated by widespread deployment, is the use of laptop computers for Safety Information Exchange at the roadside. Wireless connection to SAFER, electronic screening with DSRC, and end-to-end electronic processing of international registration plan (IRP) credentials have also been successfully deployed in some states and will likely enjoy widespread deployment as technical and institutional issues are resolved.

Most CVISN states are relying on voluntary participation of motor carriers in electronic screening programs, which use dedicated short-range communication (DSRC) for vehicle identification and communication between roadside information systems and the driver. The other components of electronic screening—CVIEW and participation in clearinghouses—show promise, but technical and institutional issues still need to be resolved. The use of license plate readers for automated vehicle identification has not been as successful because of low reliability.

The following sections describe the progress states are making toward achieving CVISN Level 1 deployment in each of the three technology areas. In each section, we provide a national perspective, followed by brief updates from the ten pilot and prototype states.

Table 3-1 shows the deployment status of CVISN technologies across the U.S., in all of the technology areas.

**Table 3-1. CVISN Deployment Status by State (as of January 2002)**

CVISN Status	Funding Status	State	PRISM State	Safety Info. Exchange			Electronic Credentialing				E-Screening	
				ASPEN (or equivalent)	SAFER	CVIEW (or equivalent)	End-to-End IRP	IRP Clearinghouse	End-to-End IFTA	IFTA Clearinghouse	At one or more fixed/mobile sites	Use SAFER/CVIEW Snapshots
Level 1 in FY '01	Funded	Kentucky	Yes	I	A	I	I	I	I	I	NORPASS	T
		Maryland		I	A	I	I	I	I	I	T-NORPASS	T
		Virginia		I	A	I	I	I	I	I	T	T
		Washington		I	A	Q	P	I	P	I	NORPASS	T
Level 1 in FY '02	Funded	California		Q	E	I	P			P	I	PrePass
		Colorado	Yes	I	A							PrePass
		Minnesota	Yes	I	A	I	P	I	I			T-NORPASS
Level 1 in FY '03	Funded	Connecticut	Yes	I	A						I	T-NORPASS
		Michigan		I	E	I					I	
Step 3, Deployment	Funded	Alaska		I	A							
		Arizona	Yes	I	A	P		I				PrePass
		Georgia	Yes	I	A			I			I	NORPASS
		Iowa	Yes	Q	E							PrePass
		Montana		I	A	P		I				PrePass
		Nebraska		I	A			I				PrePass
		New York		I	A	P		I			I	

Table 3-1. CVISN Deployment Status by State (as of January 2002) (Continued)

CVISN Status	Funding Status	State	PRISM State	Safety Info. Exchange			Electronic Credentialing				E-Screening		
				ASPEN (or equivalent)	SAFER	CVIEW (or equivalent)	End-to-End IRP	IRP Clearinghouse	End-to-End IFTA	IFTA Clearinghouse	At one or more fixed/mobile sites	Use SAFER/CVIEW Snapshots	
Step 3, Deployment	Partially Funded	Florida		I	A							PrePass	
		Idaho		I	E	P		I		I		NORPASS	
		Indiana	Yes	I	A					I		PrePass	
		Kansas		I	A			I				PrePass	
		Louisiana	Yes	I	A	P				I		PrePass	
		Massachusetts		I	A					I			
		Mississippi		I	A			I		I		PrePass	
		Missouri		I	E								
		New Jersey	Yes	I	A			I		I			
		New Mexico	Yes	I	E	P		I				PrePass	
Step 3, Deployment	Partially Funded	North Carolina		I	A			I			T-NORPASS		
		Ohio		I	E			I		I		PrePass	
		Oregon	Yes	I	E							OR Gr. Light	
		South Carolina	Yes	I	E								
		South Dakota	Yes	I	A								
		Tennessee	Yes	I	E	P						PrePass	
		Utah	Yes	I	A	P						NORPASS	
		Wisconsin		I	E	P					I		
Step 2, Design	Partially Funded	Illinois		I	E							PrePass	
		Nevada		I	E			I		I		PrePass	
		North Dakota		I	E								
		Oklahoma		I	E							PrePass	
		Texas		Q	E			I					
		West Virginia		I	E			I				PrePass	
		Wyoming		I	E						I	PrePass	

Table 3-1. CVISN Deployment Status by State (as of January 2002) (Continued)

CVISN Status	Funding Status	State	PRISM State	Safety Info. Exchange			Electronic Credentialing				E-Screening	
				ASPEN (or equivalent)	SAFER	CVIEW (or equivalent)	End-to-End IRP	IRP Clearinghouse	End-to-End IFTA	IFTA Clearinghouse	At one or more fixed/mobile sites	Use SAFER/CVIEW Snapshots
Step 1, Planning	Partially Funded	Alabama		I	E						PrePass	
		Arkansas		I	E			I		I	PrePass	
		Delaware		I	A							
		Dist. of Columbia		I	E							
		Hawaii		I	E							
		Maine	Yes	I	E			I		I		
		New Hampshire		I	E			I		I		
		Pennsylvania	Yes	I	A					I		
		Rhode Island	Yes	I	E					I		
		Vermont	Yes	I	A				I		I	

Key:  
 I = Implemented  
 Q = Equivalent System  
 A = Active User  
 T = Demonstrated Technically  
 P = Partially Implemented  
 E = Enrolled User

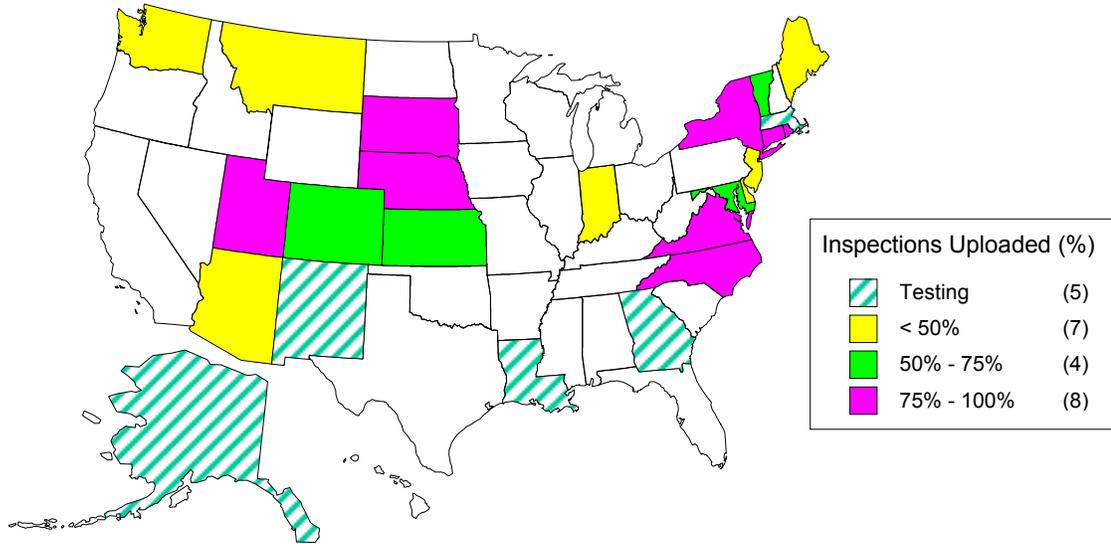
### 3.1 SAFETY INFORMATION EXCHANGE DEPLOYMENT STATUS

CVISN Level 1 deployment for Safety Information Exchange is defined as

- Use of Aspen (or equivalent software for access to safety data) at all major inspection sites
- Connection to the SAFER system so that states can exchange “snapshots” of information on interstate carriers and individual vehicles
- Implementation of the CVIEW (or equivalent) system for exchange of intrastate snapshots and for integration of SAFER and other national/interstate data.

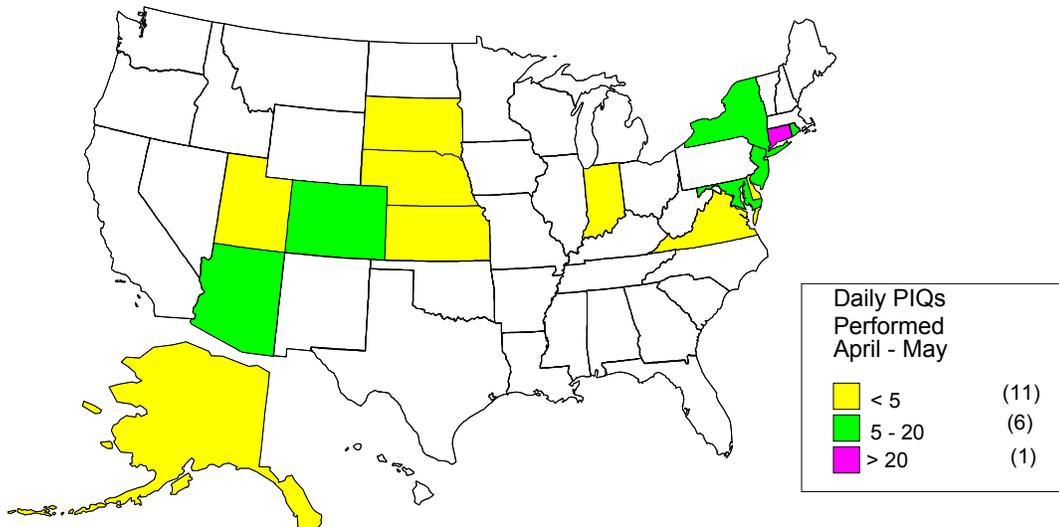
The use of motor carrier and vehicle-specific safety performance data by state agencies conducting roadside inspections has grown significantly in recent years. As of December 1999, 84 percent of states were using Aspen and more than half were connected to the SAFER system (PTI 2000, Radin 2000). The use of SAFER Data Mailbox to upload inspection reports from the laptop computers to SAFER and download past inspection reports on individual vehicles is also

growing. Currently, more than 1,200 inspections are uploaded to SAFER from approximately 24 states, as shown in Figure 3-1. Some of these inspections are being uploaded directly from roadside locations using wireless communication.



**Figure 3-1. States Uploading Safety Inspection Results to SAFER – by Percent of State Inspections**

The states that have developed or are testing wireless communication systems are able to query SAFER and download past inspection results on individual trucks that were inspected within the past 60 days. Currently there are approximately 50 past inspection queries (PIQs) performed each day by inspectors in 7 states, shown in Figure 3-2.



**Figure 3-2. States Performing Past Inspection Queries (PIQs) from the Roadside – by Average Number Performed Per Day During April and May 2000**

A key factor in the future of roadside enforcement activities involves the deployment of CVIEW or equivalent systems. The purpose of CVIEW is to integrate interstate and intrastate carrier safety data, driver and vehicle information, and a variety of carrier credentials and insurance data. The FMCSA has sponsored and funded the development of CVIEW to facilitate state-level exchange of inter- and intrastate carrier, vehicle, and driver safety and credential data to support electronic screening operations and to allow states greater control and flexibility for establishing interfaces with internal state legacy systems. The FMCSA will continue to fund development and maintenance support of CVIEW through Version 3.0, which includes all of the capabilities required for CVISN Level 1 deployment. After that, the FMCSA will not continue supporting CVIEW development, due to funding limitations. After that, states that elect to develop a CVIEW system based on the FMCSA-sponsored model will be required to assume responsibility for CVIEW enhancement and maintenance operations.

### **Deployment Status of Safety Information Exchange in Prototype and Pilot States as of 2000/2001**

*California* plans to utilize an integrated CI/CVIEW platform to obtain safety information. This safety information will be provided to roadside enforcement officers through a query to CVIEW. This system is scheduled to be operational by December 2001. California provides inspection data to SAFER via the standard SafetyNet connection and will not change with full CVISN deployment. The state currently uses a system called CAVIS, which is a functional equivalent to ASPEN. The system is installed in all fixed inspection facilities. A wireless version of the system is being tested under an FMCSA grant to provide access to mobile road inspectors.

*Colorado* has completed many of the elements of Level 1 compliance, including distribution of safety information to the roadside, electronic collection of inspection data from the roadside and uploading to SAFER, and electronic clearance at fixed and/or mobile sites. The state is not currently connected to SAFER for snapshots, although inspectors are using SAFER to retrieve safety ratings. They also do not currently use EDI or CVIEW. Aspen is used at 18 inspection sites and in 10 mobile units for the port of entry, as well as in the State Patrol's MCSAP units.

*Connecticut's* commercial vehicle enforcement personnel at fixed and mobile roadside inspection sites utilize laptop and desktop computers for the exchange of safety information. The client application software on the computers includes Motorola software, ASPEN 32, ISS2, PIQ32, and CAPRI. The computers, using connections over a CDPD network and a TCP/IP protocol, communicate wirelessly with an MDT Server and with SAFER. The MDT Server contains Motorola Messaging Switch application software. This software provides TML connections (dial-up) for access to CDLIS, Connecticut On Line Law Enforcement Communications Teleprocessing (COLLECT) System connections (SNA over IP) for accessing NCIC, NLETS, and Connecticut DMV mainframe data, peer-to-peer messaging, device security/authentication access, user security/authorization access, transactions processing management, and, for MCSAP inspections and Compliance Reviews, file transfers. SAFER provides enforcement personnel with access to ISS carrier data "snapshots" and, using the SAFER Data Mailbox, PIQ data queries. For the submission of safety reporting information, the MDT Server connects, via a LAN, to a BLIZZARD Communications Server. The BLIZZARD

Communications Server uploads inspection reports, via a WAN, to the SAFER Data Mailbox. The Communications Server also connects, using a LAN, to a SAFETYNET Server that contains SAFETYNET 2000 software. The SAFETYNET Server uploads inspection reports and compliance reviews to SAFER using a WAN. SAFER uploads SAFETYNET data, including the reports and reviews, to MCMIS using FTP.

Connecticut is evaluating vendor responses to its *RFP for CVISN and PRISM Information Systems and Consultant Services*. Vendor responses have been received for the development of a CVIEW and CVIEW interfaces with the MDT Server, national systems, including SAFER, and Connecticut's credentialing systems. These integration services will provide Connecticut enforcement personnel with access to safety snapshot data, including PRISM MCSIP data, up-to-date Connecticut credentials snapshot data, and snapshot data for credentials issued in other jurisdictions. These services will also allow Connecticut to submit Connecticut credentials information, such as IRP registration data and IFTA status, from CVIEW to SAFER for use by other jurisdictions.

**Kentucky** has implemented SAFER to provide updates for interstate carriers and vehicle snapshots. In addition, users receive snapshots from SAFER for interstate operators. Kentucky is using EDI and CVIEW to interact and interface with SAFER, and is in the process of upgrading to CVIEW version 2.2. Aspen is used at all weigh stations and inspection sites, which is networked for access to state systems. There are currently 17 weigh stations on communications network sites, and 40 to 50 percent of all inspections are done electronically. In addition, SafetyNet 2000 has been installed.

**Maryland** has met all major areas of safety information exchange deployment, including the implementation of CVIEW to provide updates for interstate carrier and vehicle snapshots, EDI to interact with SAFER for snapshot updates, Past Inspection Queries (PIQs) to access SAFER safety history data, and Aspen to capture inspection results at all inspection sites. CVIEW (Version 2) is installed and operational. The percentage of inspections collected by the Aspen system has been increasingly rapidly.

**Michigan** has connected to SAFER to provide segment updates, and users will get snapshots from SAFER for interstate operators. The state has acquired some use of the Aspen system but not CVIEW.

**Minnesota** is in the early stages of Level 1 CVISN deployment. The state has created a task force to reengineer the crash data reporting system. This will include the incorporation of MUCC data elements into the data standard, establishing data interchange standards with local agencies, sponsoring the development of a pilot application to capture data at the point of collection, and rebuilding the back-end data management system. Establishment of the SAFER/CVIEW connection continues to be a key issue. Minnesota's current plan is to use PPTP over the Internet once the security issues are overcome. In addition, the implementation of SafetyNet 2000 is being scheduled.

**Oregon's** truck safety inspectors use computers with the Inspection Selection System (ISS) to target high-risk trucks. Laptops with Aspen software record the details of more than

half of all inspections. Because most of its data originates in electronic form, Oregon has been successful at achieving speedy uploads of information to the national SafetyNet databank. Also, because of its reliance on ISS and because it has assigned a U.S. DOT number to all intrastate carriers, Oregon has had very low “non-match” error rates when submitting information to SafetyNet (source: [www.odot.state.or.us/trucking/its/cvisn/briefing.htm](http://www.odot.state.or.us/trucking/its/cvisn/briefing.htm)).

**Virginia** is one of two prototype states involved in the CVISN deployment initiative. They are also one of the states to implement all aspects of the Level 1 CVISN deployment. The Virginia State Police have results that prove that technology has assisted in improving highway safety. Virginia has purchased new laptop computers, printers, vehicle mounts, and related equipment based on the guidelines and specification from the Field Systems Group, FMCSA. This upgrade of equipment will provide the capability to operate the new generation of ASPEN and related software in the 32-bit configuration for the next 3-4 years. In addition, this upgrade will increase our Inspection Selection System capability, will improve access to SAFER, and will allow connection to CVIEW for snapshot data on drivers, vehicles, and carriers direct from roadside. These enhancements will increase the efficiency and effectiveness of commercial vehicle inspections and enforcement activities, improve highway safety, and keep Virginia in the forefront as a CVISN compliant state.

**Washington** has connected to SAFER and inspectors are effectively using the safety ratings and vehicle snapshots in conjunction with their high-speed WIM. Users get snapshots from SAFER for interstate operators. The state uses EDI and CVIEW to interface with SAFER, and Aspen is being used at all major inspection sites. CVISN has been fully deployed at five sites and will be expanded to five more interstate sites during the next two years.

### **3.2 ELECTRONIC SCREENING DEPLOYMENT STATUS**

CVISN Level 1 deployment for electronic screening is defined as

- Electronic screening at one or more fixed or mobile inspection sites
- Readiness to replicate electronic screening capability at other sites

Starting in the early 1990s, FOTs such as Advantage I-75 (Interstate 75 corridor), HELP/Crescent (I-5 corridor), and Oregon Green Light demonstrated the technical feasibility and time-saving benefits of using electronic screening systems for commercial vehicle operations. In particular, these tests proved that DSRC technologies can provide reliable communication between moving vehicles and roadside enforcement operations. However, most of the growth in electronic screening has occurred since the emergence of three programs: HELP (Heavy Vehicle Electronic License Plate) PrePass, NORPASS (North American Preclearance and Safety System), and Oregon’s Green Light. Currently over half the states in the United States and more than 9,000 motor carrier fleets are participating in such electronic screening programs. Furthermore, total truck enrollment in the three programs has grown by approximately 100 percent per year for the past few years. Current enrollment stands at

approximately 200,000 trucks, which is a small fraction of the 7.2 million trucks in the U.S. Table 3-2 shows how enrollment is distributed among the three programs.

**Table 3-2. State and Motor Carrier Participation in Electronic Screening Programs**

Numbers of:	Pre-Pass	NORPASS	Green Light
States	21	6	1
Trucks	186,769	15,000	15,000
Companies	7,989	800	1,100

The *PrePass* electronic screening system is operated by HELP, Inc., a non-profit partnership between motor carriers and government agencies. According to HELP, the mission of PrePass is to “develop and deploy advanced technology systems to create a cooperative operating and regulatory environment which improves the efficient and safe movement of commercial vehicles and the performance of highway systems” (PrePass).

PrePass has seen substantial growth in the numbers of operational trucks, sites, and motor carriers enrolled in the system since 1996, as shown in Table 3-3. Currently active at 149 locations, another 72 sites are committed to be deployed.

**Table 3-3. PrePass Growth 1996 to 2000**

Year	Numbers of		
	Operational Trucks	Sites	Motor Carriers
1996	4,632	10	262
1997	27,995	29	690
1998	62,114	55	1,696
1999	110,445	87	3,026
2000	164,881	135	7,255
2001	186,769	149	7,989

Source: [www.prepass.com](http://www.prepass.com)

The *NORPASS* system of electronic screening has been deployed at weigh and inspection stations in six states in the U.S. (e.g., Georgia, Kentucky, North Carolina, Idaho, Washington, and Utah) and various Canadian provinces. The program is currently in a transition stage. Two states have recently signed up to serve as system administrators, providing electronic vehicle identification database services and marketing support for NORPASS: Washington State for the western region and Kentucky for the eastern region. Interoperability is available to the extent that NORPASS transponders can be used in PrePass states. NORPASS has 25 operational sites and about 15,000 commercial vehicles with transponders.

Oregon’s *Green Light* system for electronic screening is discussed below in the State section.

## Deployment Status of Electronic Screening in Prototype and Pilot States as of 2000/2001

**California** has 35 inspection facilities equipped to handle E-Screening. The system utilized is the HELP, Inc., PrePass System. The state plans to implement the use of ISS2 as its on-highway performance criterion for interstate carriers by December 2001. Intrastate carriers will continue to utilize an off-highway safety criterion in lieu of ISS2 until such time as a USDOT number can be assigned to intrastate carriers. California plans to use CVIEW snapshot information for enrollment and verification processes.

**Colorado** has 16 AVI sites and 9 WIM sites currently in operation. One additional WIM site will be implemented after major road construction is completed in the area. Electronic screening is not based on SAFER/CVIEW, but Colorado provides PrePass with the state's credential database information on a monthly basis. The state supports the enrollment of Colorado-based motor carriers in its own and other states' electronic screening programs, but the enrollment data are not shared with other states through snapshots.

**Connecticut** has made significant, widespread efforts in electronic screening. WIM, AVC, and AVI system hardware/software and fiber optic cabling have been installed at the Union, Connecticut, Weigh and Inspection Station. Model MACS screening software has been installed on the scale house computer, and MACS Central software, for entering enrollment data into Model MACS, has been installed in the MCSAP Office. Unit testing of the components has been completed and integration testing has begun. Modifications for accepting data from the WIM screening component and for providing screening capabilities in multiple (right most and center lane) highway lanes are being completed. Acceptance testing will begin after the integration testing is completed.

Connecticut is evaluating vendor responses to its RFP for the development of a CVIEW and a CVIEW interface with Model MACS. This integration will enable CVIEW to electronically provide up-to-date carrier/vehicle credentials/safety data, including IRP registration information, OS/OW permitting data, and IFTA status, to the Model MACS screening software.

**Kentucky's** electronic screening system is not based on SAFER/CVIEW snapshots because of limitations of CVIEW version 1.6.8, which the state is currently working with. As Kentucky obtains and migrates to CVIEW 2.2, users will download directly to the roadside screening computers and receive data from various sources. In addition, Kentucky has contracted with a transponder administrator to enroll carriers in the screening program. The screening enrollment data will be shared with other states through snapshots when CVIEW 2.2 is functional.

**Maryland** has deployed all major aspects of electronic screening, including the implementation of screening systems at the Perryville Truck and Weigh Inspection Station and the use of SAFER/CVIEW snapshots for screening decisions. Maryland's electronic screening program uses the FMCSA-recommended DSRC standards, and will distribute an integrated CVO tag that can be used for both electronic screening and electronic toll applications in the Northeast region. Distribution of the first 50 tags is under way.

**Michigan** has implemented electronic screening at one or more fixed or mobile sites, but the state is undecided in the remaining areas of the electronic screening process.

**Minnesota's** electronic screening accomplishments include the reopening of the St. Croix weigh station. The transfer of the station computer and operator consoles to the testbed at the truck center for final integration testing will be followed by final installation at the St. Croix weigh station facility. Definition of a transponder registration process still remains an issue.

**Oregon's** electronic screening program is called Green Light. This system has demonstrated the time-saving benefits of using electronic screening systems for commercial vehicle operations. Oregon Green Light shows that DSRC technology can provide reliable communication between moving vehicles and roadside enforcement operations. Currently, more than 15,000 trucks and 1,000 fleets are using this system in Oregon. Between January and October 2000, more than 500,000 trucks bypassed weigh stations using DSRC transponders through Oregon's Green Light program. Across the state, 21 weigh stations are equipped with high-speed WIM devices and transponder readers. The Green Light system allows the state to perform a quick check of each participating truck's size, weight, height, and carrier credential and safety status. This system is constructed and administered by the Oregon Department of Transportation. Oregon offers preclearance to motor carriers at no charge. (source: [www.odot.state.or.us/its](http://www.odot.state.or.us/its))

**Virginia** is planning to implement electronic screening at several sites, with screening based on the SAFER/CVIEW snapshots. The Stephens City weigh station on I-81 was the first weigh station in Virginia to incorporate the infrastructure, data resources, and concepts proposed in the CVISN architecture. The Stephens City Level I prototype demonstrated the ability to electronically distinguish between illegal/high-risk vehicles and legal/safe vehicles using weigh-in-motion on a ramp.

The second site located at the Suffolk Weigh station on Route 58 uses weigh-in-motion scales on the mainline. Currently, this technology focuses on weight; however, plans are to enhance the screening to include safety and credential data by the end of the year. Transponders were installed in 55 Walmart contractor trucks (HUDD) and the program went live in early September.

Due to roadway construction in northern Virginia, the installation of a mainline weigh-in-motion electronic screening system slated for the Dumfries weigh station is being rescheduled. Three additional weigh stations (Alberta, Bland, and Sandston) are providing full Motor Carrier credentialing services.

**Washington** currently has five functional electronic screening sites out of 16. The other 11 sites are expected to become functional in the next four years. Screening is based on the SAFER/CVIEW snapshots. The state supports the enrollment of its carriers in other electronic screening programs such as NORPASS, Border Crossing, Green Light, and PrePass. Enrollment data are shared with other states through a regional database and CVIEW.

### **3.3 ELECTRONIC CREDENTIALING DEPLOYMENT STATUS**

CVISN Level 1 deployment for electronic credentialing is defined as

- Automated processing (application, state processing, issuance, tax filing) of at least international registration plan (IRP) and international fuel tax agreement (IFTA) credentials; readiness to extend to other credentials (intrastate, titling, oversize/overweight carrier registration, and hazardous material)
- Connection to IRP and IFTA clearinghouses
- At least 10 percent of transaction volume handled electronically; readiness to sign up more carriers; readiness to extend to branch offices where applicable (Richeson 1999).

Although most states are committed to deploying electronic credentialing, these systems have not yet achieved the same level of widespread deployment as have roadside systems. This result primarily stems from the many technical challenges involved in establishing interfaces between new and legacy, or archival, databases and software systems.

To date, four states, Maryland, Virginia, Kentucky, and Washington, have successfully demonstrated Level 1 capabilities for electronic credentialing. These states are now working with a limited number of carriers to test and refine the systems that were developed. Some additional development is continuing as issues are identified. The experiences of these states, as well as those of the other seven CVISN Pilot states, are being shared with others through mainstreaming efforts and training workshops sponsored by FMCSA.

States implementing electronic credentialing will need to decide (1) what data communications standards and policies should be adopted, and (2) which type of software system (specialized computer programs or web applications) are preferred by and acceptable to motor carriers. The first issue is focused on which of two standards should be used for data transmission: electronic data interface (EDI) or extensible markup language (XML). The updated CVISN architecture specifies ANSI X 12 EDI for computer-to-computer interfaces, in the near term. However, FMCSA is starting to explore the use of XML in place of the EDI standard. Although EDI is the standard for financial transactions, some believe that that XML may be more appropriate for web applications.

Originally, the CVISN architecture focused solely on the use of specialized computer-to-computer (also called PC-based) software, such as the CAT system. Several states have developed stand-alone CAT systems for larger carriers. However, it is expected that eventually these systems will be implemented as modules in the carriers' fleet management software systems. Also, there has also been interest in developing web-based systems that allow smaller carriers to conduct credentialing business through the Internet. The key advantage of this approach is that any carrier with access to a web browser can participate in electronic credentialing. Discussions with motor carriers and credentialing software developers suggest

that all three approaches (stand-alone CAT, CAT module, and web-based system) will be needed to satisfy the variety of needs within the motor carrier industry.

The International Registration Plan (IRP) and International Fuel Tax Agreement (IFTA) clearinghouses, which are being developed to facilitate distribution of registration funds and tax revenues among states and provinces, are still in the early stages of deployment. The IRP clearinghouse currently has more than 25 states actively participating. The IFTA clearinghouse has data on hand from 18 participating jurisdictions, and agreements in place for four more.

### **Deployment Status of Electronic Credentialing in Prototype and Pilot States as of 2000/2001**

**California** plans to implement POS processing of IRP and IFTA credentials through the development of a PC CAT and an integrated CI/CVIEW platform. Contracts have been awarded for the PC CAT (April 2000) and the integrated CI/CVIEW (October 2000) platforms. Implementation for these systems is scheduled for the fourth quarter of 2001. The state is currently participating in the IFTA Clearinghouse but not in the IRP Clearinghouse.

**Colorado** has not automated the processing of IRP or IFTA credentials. Colorado will provide a web-based interface for electronic credentialing with the carriers. The state is not currently participating in the IRP or IFTA clearinghouses, although they are planning for training soon. Colorado has replaced the outdated System 36 computers, created a new Port of Entry Business System, and gathered with various agencies of the federal government and the motor carrier community to share information. It is anticipated that electronic credentialing will be completed within several months.

**Connecticut** is evaluating vendor proposals for development of a CI/CVIEW, CVISN/PRISM-compliant IRP and OS/OW Systems, and CI/CVIEW interfaces with credentialing systems. CI/CVIEW will allow carriers to electronically submit applications for IRP, IFTA, and OS/OW credentials, pay for the credentials, and receive the operating credentials. CI/CVIEW will allow authorized Connecticut users access to the credentials data. Connecticut-based IFTA carriers will utilize the Internet-based electronic filing system application for quarterly tax returns currently under development by the New York State Department of Taxation and Finance. Connecticut has notified the IRP Clearinghouse of its intention to join and has begun development of its implementation plan. A letter of commitment was scheduled to be sent to the Clearinghouse in 2001.

Connecticut began its participation in the IFTA Clearinghouse in November 2000, providing the Clearinghouse with IFTA demographic information through the Regional Processing Center (RPC). Connecticut provides IFTA transmittal information using a frame relay system between the RPC and the Clearinghouse. Connecticut accesses Clearinghouse demographic data by various methods including using Clearinghouse-supplied software for connecting to the frame relay system at the RPC, using an Internet browser-based interface, and using FTP for downloading the Clearinghouse “revoked, suspended, and inactive” file. Connecticut also reviews transmittal data by using the Clearinghouse-supplied software for connecting to the frame relay system at the RPC and by using an Internet browser-based interface.

**Kentucky** currently has pilot carriers performing electronic credentialing for IRP transactions via the InterCAT system. The state intends to extend permanent credential issuance to some carriers in the next few months. In addition, Kentucky has electronic credentialing for IFTA registration and tax filing. The InterCAT system transmits transactions via e-mail to the Kentucky CI. Along with this EDI interface, Kentucky is developing a web application for IRP. This product is currently used in five pilot carrier offices for acceptance testing, and is scheduled to be provided to a large number of carriers in 2001. The state participates in the IRP and the IFTA clearinghouses. Less than 10 percent of the IRP or IFTA credentialing volume is being processed electronically at this time.

**Maryland** has partially automated the electronic processing of IRP credentials using a “turn and type” approach. This capability currently processes approximately 8 percent of the IRP credentialing volume. With the delivery of a new IRP back-end system, IRP electronic credentialing support will expand to provide fully automated, EDI (computer-to-computer) and web-based interfaces to motor carriers operating in Maryland. Maryland has chosen to deploy IFTA registration services, which have been previously partially automated, via a web site that is currently under development.

**Michigan** has yet to perform any automation for the processing of IRP or IFTA credentialing. The state has decided to provide person-to-computer (web-based) interfacing for electronic credentialing with the carriers. They are currently not participating in either the IRP or IFTA clearinghouses, and there is no automated processing of IRP or IFTA credentialing, although two meetings have been held with the IRP clearinghouse project team to initiate efforts to connect to the clearinghouse. Michigan is gathering data to support their deployment efforts.

**Minnesota** has finalized the design specifications for the data transfer between the CVIEW and the interstate vehicle registration legacy system, and work on the interface is proceeding. In addition, a complete software demonstration was given to representatives of IFTA. Planned activities include final integration and user acceptance testing on the new IFTA back-end system, the IFTA legacy system interface, the interstate carrier registration legacy system interface, and the intrastate vehicle registration interface. In addition, production-mode electronic credentialing with a selected group of pilot carriers is also planned. Work on the International Registration Plan (IRP) legacy system (VISTA) regarding the development and implementation of a CVISN interface is also ongoing.

**Oregon** stopped work related to electronic credentialing in 1998 because of the need to correct for Year 2000 date problems in existing systems. Oregon is now formulating its plans for “E-Government” that would include electronic credentialing. State agencies are currently testing internet systems for transacting business. Because the stage is set for a centralized infrastructure for Oregon E-Government, the state Motor Carrier Division is not developing its own separate business solutions. The agency is, however, upgrading computer systems and planning to offer online business services. It has also conducted a survey of trucking companies to gauge the level of interest in the computerization of business transactions. In the March 2000 survey, it found 70 to 80 percent of the largest companies operating in Oregon, and 40 to 50 percent of predominantly smaller Oregon-based companies, either definitely would or probably would

conduct their trucking related business online if they could (source: [www.odot.state.or.us/trucking/its/cvisn/briefing.htm](http://www.odot.state.or.us/trucking/its/cvisn/briefing.htm)).

**Virginia** has automated processing for both IRP and IFTA credentials. Virginia's web-based system (WebCAT) for IRP, IFTA, and Virginia Motor Fuels Road Tax transactions was fully deployed in February 2001. As of May 31, 2001, 142 customers were enrolled in WebCAT. These 142 customers represent 98 IRP fleets, 108 IFTA accounts, and 19 Virginia Motor Fuel Road Tax accounts. As of the same date, 144 transactions had been processed using WebCAT. These transactions involved 812 IRP vehicles and the issuance of 162 IFTA or Virginia Motor Fuel Road Tax decals.

**Washington** has an automated electronic credentialing process for IRP and IFTA through the use of MVS Express. The state is providing a real time interface, through a web-based interface, for the purchase of credentials, monetary exchange, and, in some instances, self issuance of vehicle license plates. Washington participates in the IRP and IFTA Clearinghouses.

### **3.4 REFERENCES**

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## **CHAPTER 4. EVALUATION GOALS AND APPROACH**

This chapter describes the process by which the CVISN evaluation goals and associated hypotheses were developed and summarizes the technical approach that was undertaken. A complete discussion of the evaluation planning process, including additional information on the evaluation goals and approach is contained in the CVISN MDI Summary Evaluation Plan (July 1998). Additional details, including the designs of specific studies that were carried out in the areas of safety, costs, and customer satisfaction, are provided in Chapters 5, 6, and 7, respectively. The approach to benefit/cost analysis (BCA) is described in Chapter 8. Supporting information appears in the appendices (Volume II).

### **Purpose and Scope of the Evaluation**

The purpose of the CVISN MDI was to demonstrate the technical and institutional feasibility, costs, and benefits of the primary ITS user services for commercial vehicle operations (CVO) and to encourage further deployment of these services. As required under the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), the evaluation of CVISN was undertaken to furnish information to U.S. DOT, Congress, states, public interest groups, and others on the desirability of making CVISN investments and corresponding enhancements to national, state, regional, and local transportation programs. In particular, it is important to document benefits associated with the national ITS/CVO goals and to learn as much as possible about how CVISN changes the way in which commercial vehicle operations are carried out. In addition, the results must permit comparisons between, and aid in developing priorities among, alternative investments within the U.S. DOT's ITS program and between ITS and non-ITS programs. For this reason, the evaluation included a comprehensive BCA to determine the economic worth of CVISN deployments. Thus, the expected outcomes of the evaluation projects are

1. Analyses and documentation of the outcomes and benefits of CVISN deployment that are of interest to various stakeholders
2. A rigorous BCA to determine the net economic benefits of CVISN deployment on a national level.

The measures for which data were needed, both for the analysis of outcomes and benefits and as input to the BCA, were established by considering the potential changes to the transportation system, identifying groups impacted by the changes, and obtaining their input on potential benefits and costs. Section 4.1 describes the process undertaken to develop the evaluation strategy and priorities, and Section 4.2 presents the specific objectives and methods within the four main study areas, safety, cost, customer satisfaction, and benefit-cost analysis.

#### 4.1 EVALUATION STRATEGY AND PRIORITIES

To develop the evaluation strategy, the interests of stakeholders or customers had to be considered early in the planning process. First we identified the “customer” groups affected by the deployment of CVISN:

- Motor Carriers
- State governments
- Law enforcement agencies
- Shippers/receivers
- Members of the public
- Federal government.

In January 1997, the CVISN Planning and Evaluation Workshop was held at The Johns Hopkins University, with more than 100 participants representing law enforcement, IRP and IFTA credentials administrators from states and industry, and federal employees involved in CVO. The workshop consisted of break-out sessions focusing on CVISN deployment plans, expected changes to CVO, and potential benefits of CVISN. The benefits identified by the participants were grouped under the five ITS goal areas as follows:

##### *Safety*

- Fewer crashes involving trucks
- Increased personal safety of the motoring public

##### *Efficiency (increased throughput or capacity)*

- Increased throughput at inspection sites
- Increased throughput of credentialing process

##### *Productivity (cost savings, revenue increases, increased output)*

- Reduced time, cost, and uncertainty in credentialing
- Reduced cost of inspections
- Transit time reduced by bypassing inspection sites

- Transit time reduced by shorter stops at inspection sites
- Reduced accident costs
- Decreased tax and fee evasion
- More equitable treatment in paying taxes and fees
- Transit time decreased as a result of fewer crashes
- Reduced accident cleanup costs

### ***Mobility***

- Reduced cost of goods movement to shippers/receivers and the public
  - Decreased goods movement transit time and increased reliability of delivery schedules to/from shippers/receivers
- Increased cargo safety and security
- Reduced highway delays to public from fewer accidents

### ***Energy/Environment***

- Reduced energy consumption of trucks
- Reduced environmental impacts of trucks.

To help establish priorities, participants in the workshop were asked to rate the potential benefits according to their perceived importance. This was done after considering both the value of the benefits and the potential magnitude of the benefits. As shown in Figure 4-1, all of the groups participating in the workshop rated safety benefits the highest priority and efficiency benefits the second highest. Mobility, productivity, and energy/environment, in that order, were rated lower. Recall, however, that the relative importance of these benefits, as assigned by the participants, is inherently linked to their assessment of the potential for achieving these benefits.

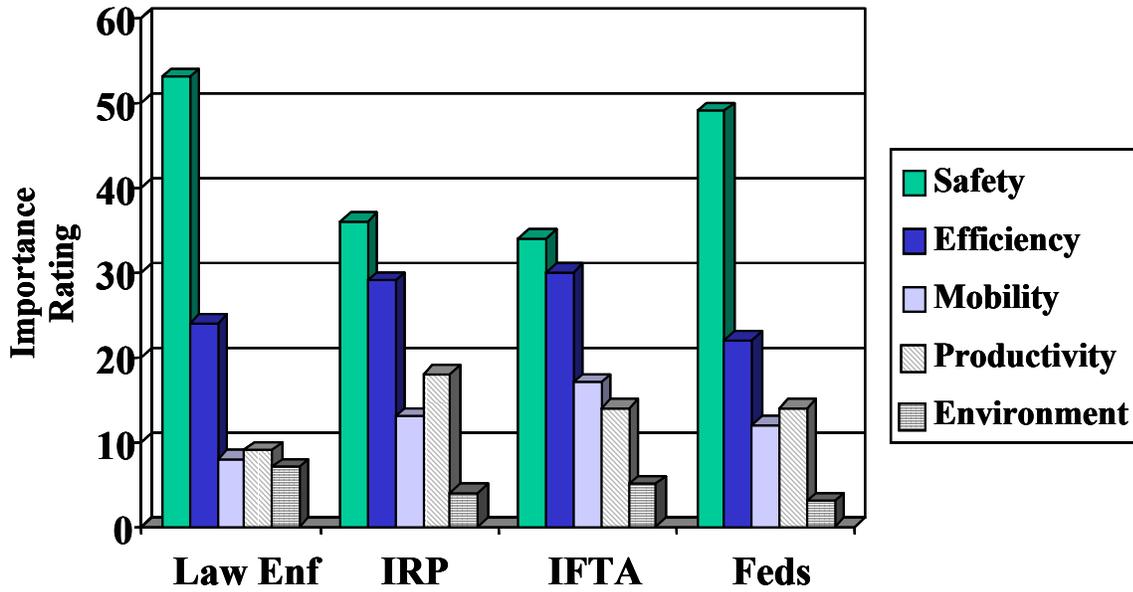


Figure 4-1. Rating of Evaluation Goals by CVISN Workshop Participants

According to the workshop participants, demonstrating safety benefits is the number one priority. The ultimate safety benefits of CVISN roadside enforcement systems are reduced numbers of truck-related crashes, injuries, and fatalities. Efficiency, also cited as an important benefit during the workshop, is usually considered to be part of the safety and productivity benefits. Improved mobility and reduced energy and environmental costs were considered to be of relatively less importance.

The next step was to organize these benefits according to the features of CVISN that the states were planning to deploy. Key features and anticipated benefits of CVISN-enhanced *roadside enforcement* (safety information exchange and electronic screening) and *credentials administration* are highlighted in Tables 4-1 and 4-2, respectively. Although electronic screening and safety information exchange consist of different technology systems, they are sometimes treated together (and referred to as “roadside enforcement”) because the systems work together to benefit roadside enforcement practices and to improve efficiency for safe and legal participating carriers.

**Table 4-1. Key Features and Anticipated Benefits of CVISN Roadside Enforcement Deployments**

<b>Key Features</b>	<b>Anticipated Benefits</b>
Mainline screening with dedicated short-range communication (DSRC) and weigh-in-motion (WIM) capability	Time and cost savings and increased customer satisfaction for registered carriers. Improved targeting of high-risk carriers.
Sorter lane screening at weigh stations using license plate reader (LPR), optical character recognition (OCR), automated vehicle identification (AVI), and/or low-speed WIM	Improved targeting of high-risk carriers through application of screening criteria on a broader population of trucks (i.e., of carriers not registered for mainline screening)
Mobile roadside enforcement units equipped with networked screening data	Improved targeting of high-risk carriers. Identification of and reduction in number of out-of-service (OOS) order violators
Timeliness of the screening data used in the inspection units (fixed or mobile)	Increased compliance with safety regulations. Improved targeting of high-risk carriers. Identification of and reduction in number of OOS order violators
Facilities for screening on bypass routes	Increased safety through identification of violators of safety regulations

**Table 4-2. Key Features and Anticipated Benefits of CVISN Credentials Administration Deployments**

<b>Key Features</b>	<b>Anticipated Benefits</b>
End-to-end electronic application and processing of credentials; includes electronic submittals, direct links to legacy (predecessor computer) systems for automated processing (i.e., edit checks, fee calculation, invoice generation), funds transfer, and production of credentials.	Time and cost savings and increased customer satisfaction for both carriers and states  Fewer delays to carriers for obtaining credentials
Use of PC-based and web-based Carrier Automated Transaction (CAT) software to submit applications for credentials	Time and cost savings and increased satisfaction for both carriers and states  Relative benefits of PC- and Web-based CATs may depend on size of carrier.
Printing of permanent or temporary credentials in carrier offices—especially for trip-related credentials; e.g., oversize/overweight (OS/OW)	Avoids delays in getting vehicle on the road
Interface with IRP and IFTA clearinghouses	Cost savings to states

The anticipated benefits can be grouped into three categories: safety, productivity (cost savings), and customer satisfaction. Efficiency, cited as an important benefit during the workshop, is usually considered to be part of the safety and productivity benefits. Customer

satisfaction is an important area because (1) we need to understand the factors that will ensure a successful deployment, and (2) customer satisfaction is an important means of determining the value of other non-monetary benefits for the benefit-cost analysis.

## **4.2 EVALUATION STUDY AREAS—OBJECTIVES AND METHODS**

Based on the types of benefits expected, the CVISN evaluation project was divided into four study areas: Safety, Costs, Customer Satisfaction, and Benefit/Cost Analysis. The objectives of each study area and summaries of the methods used to accomplish the objectives are presented below. Additional details can be found in Chapters 5 through 8 and the accompanying appendices (Volume II).

### **CVISN Safety Studies**

The primary goal of the CVISN safety study was to identify and document the safety benefits of deploying CVISN technologies. The safety benefits are expected to include a reduction in the number of highway crashes involving trucks, the number of related injuries and fatalities, and the cost of property damage from these crashes. However, the particular CVISN technologies that are included in the model deployment initiative achieve these benefits only through improvements in carrier and driver compliance with safety regulations. Thus, the main focus of this study was on the relationship between CVISN deployment and its impact on enforcement practices. The relationship between enforcement practices and safety impacts (i.e., reduced crashes and fatalities) was established to link safety benefits to the deployment of CVISN services. Results from the literature, as well as new analyses, were used to help determine this relationship.

CVISN technologies are expected to help improve compliance with safety regulations in two ways, both resulting from increased effectiveness of roadside inspection operations. The direct, but smaller, impact is the removal of unsafe drivers and vehicles from the highways. It is anticipated that the screening and safety information exchange technologies will allow inspectors to select commercial vehicles for inspection rapidly, based on the carrier's safety record. Also, on-line access to driver violation records and results of recent truck inspections will help target unsafe drivers and commercial vehicles.

The indirect effect, which is expected to be much larger, is that drivers and carriers will modify their behavior in response to the improved, more targeted inspections. Specifically, it is assumed that carriers will expend resources to ensure that their vehicles stay in compliance. Carriers with good safety records (low risk) will have a small probability of being inspected. High-risk carriers will try to improve their safety rating to avoid increased inspections. Of course, if CVISN does not help inspectors target the high-risk carriers, there will not be any added incentive for a carrier to maintain a good safety rating.

The goals of the CVISN safety study were defined by four study questions:

1. What is the impact of CVISN on the numbers of crashes, injuries, and fatalities involving large commercial motor vehicles?

2. What is the impact of CVISN on rates of driver and carrier compliance with the FMCSR?
3. To what extent does CVISN help roadside safety enforcement officials identify high-risk commercial vehicles and motor carriers?
4. To what extent does CVISN help roadside safety enforcement officials identify OOS violators?

The approach to addressing these questions and estimating safety benefits consisted of several elements. The first step was to develop a crash avoidance model. Because CVISN deployment has not advanced to the stage where the safety benefits can be measured directly (i.e., by comparing the numbers of crashes before and after deployment), it was necessary to develop a probability model that predicts the number of crashes, injuries, and fatalities under several different scenarios. Each scenario was defined by specific assumptions concerning the future deployment of CVISN.

The next step was to identify sources of data. Specifically, data were needed on the number of historical crashes and to estimate probabilities that a crash involving a large truck was caused by vehicle and driver OOS conditions. These data were obtained from the literature. Additional data were needed to determine the impact of CVISN technologies on inspection efficiencies and compliance rates. Therefore, studies were conducted in the CVISN Pilot states of Oregon, Connecticut, and Kentucky.

The two-part Oregon study (1) examined the effects of CVISN on carrier and driver compliance with the FMCSRs and (2) quantified the effectiveness of roadside enforcement staff at targeting vehicles from high-risk carriers with and without using the CVISN Inspection Selection System (ISS). Similarly, the Connecticut roadside study was conducted to estimate the effectiveness of Aspen/ISS to select high-risk vehicles for inspection. The Kentucky screening study was conducted to compare the inspection efficiency of stations with and without electronic transponder facilities that allow participating vehicles to bypass inspection stations. Further details on the approach and methods for these studies are presented in Section 5.2 and all three full study reports are included in Appendix A.

### **CVISN Cost Studies**

The cost analysis considered three major cost-related questions:

1. What are/were the baseline costs associated with CVO processes prior to CVISN technology deployment?
2. What are the one-time start-up costs to the states to deploy CVISN systems, and what are the key drivers or major elements contributing to those costs?
3. What recurring (annual) capital and labor, operating, and maintenance costs do states incur as they use CVISN technologies, and what are the key drivers or major elements contributing to those costs?

In addition, two hypotheses were tested:

- CVISN credentialing systems will result in reduced time, costs, and uncertainties involved with handling (applying for and administering) commercial vehicle credentials for both state agencies and motor carriers
- The deployment of CVISN systems for roadside enforcement operations will result in capital cost increases to state agencies, but are expected to improve (1) inspection efficiency for states and motor carriers and (2) highway safety.

The CVISN cost study consisted of a literature review and on-site, in-person interviews. The primary references on sources of CVISN-related cost data were the National Governors' Association (NGA) Study (Apogee 1997), American Trucking Associations (ATA) Foundation Study (1996), Maryland Benefit/Cost Study (Bapna, et al. 1998), and the Washington State CVISN Pilot Project report (1998). Most of these studies reported costs and cost savings, which were estimated by state and industry officials prior to the deployment of CVISN. Therefore, it was necessary to conduct on-site in-person interviews to obtain actual costs for this study. The objective of the interviews with state agencies was to collect information on

- Costs associated with the current credentialing processes and roadside screening and inspection activities
- Costs associated with deploying and operating various CVISN systems
- Resources (staff and equipment) committed to CVISN deployment.

Interviews were also conducted with representatives of selected motor carriers participating in the pilot testing of CVISN systems. The objectives of these interviews were to

- Gather information on the costs incurred (or savings realized) by the motor carrier industry resulting from CVISN systems deployment
- Learn about the impacts of CVISN systems on the efficiency and productivity of the motor carrier industry, as they affect costs.

All interviews were fact-finding, interactive discussions aimed at gaining an understanding and collecting data on the costs of CVISN systems. The interview guides were developed based on the evaluation strategy, evaluation data requirements plan, experiences from similar studies (e.g., NGA), and information gathered from the literature review.

Cost information was drawn mainly from interviews with state transportation officials from four states: Kentucky, Maryland, Connecticut, and Virginia. Additional information was obtained from field operational tests involving states in the I-95 Corridor Coalition CVO Working Group and a special cost study involving states participating in the IRP Clearinghouse project.

**CVISN Customer Satisfaction Studies**

To measure customer satisfaction with CVISN, several surveys and other measures were planned and carried out. These included a national motor carrier survey, a driver survey, and surveys and focus groups involving state inspectors and law enforcement personnel. Originally, a separate motor carrier survey was planned, to quantify the benefits of electronic credentialing for motor carriers. However, at the time this study was scheduled, there were not enough carriers with experience in electronic credentialing to constitute a valid study population.

Table 4-3 shows the customer groups who were surveyed to determine their experiences in using CVISN technologies and their satisfaction with those technologies. Shippers/receivers and the general public are also recognized as stakeholders in CVO. Benefits to each are discussed indirectly in Chapter 8 on benefit/cost analysis, but direct measures of the satisfaction of these customer groups were beyond the scope of this evaluation.

**Table 4-3. General Topics Covered in Surveys and Other Evaluations of Customer Satisfaction**

Customer Group	Survey Topics Relating to	
	Electronic Credentialing	Roadside Inspections/Enforcement
Motor Carriers	<ul style="list-style-type: none"> <li>• Experience with credentialing</li> <li>• Current credentialing procedures</li> <li>• Awareness and use of electronic credentialing</li> <li>• Opinions about electronic credentialing</li> <li>• Likelihood of using electronic credentialing</li> </ul>	<ul style="list-style-type: none"> <li>• Experience with roadside inspections</li> <li>• Current inspection procedures</li> <li>• Awareness of electronic screening</li> <li>• Opinions about electronic screening</li> </ul>
Drivers	<ul style="list-style-type: none"> <li>• Likelihood of owner-operators to enroll in electronic credentialing</li> </ul>	<ul style="list-style-type: none"> <li>• Opinions about roadside enforcement</li> <li>• Likelihood of owner-operators to enroll in electronic credentialing</li> </ul>
State CVO Administrators	<ul style="list-style-type: none"> <li>• Institutional issues and benefits</li> </ul>	<ul style="list-style-type: none"> <li>• Institutional issues and benefits</li> </ul>
State CVO Inspectors		<ul style="list-style-type: none"> <li>• Inspection systems in use</li> <li>• Satisfaction with equipment</li> <li>• Perceived benefits</li> </ul>

The purpose of the *CVISN Motor Carrier Survey* was to

- Collect baseline information concerning the relevant behaviors, awareness, and attitudes of motor carriers, and
- Identify the incentives and barriers to more widespread deployment of CVISN-type initiatives across the country.

A mail survey of carriers was designed to be representative of the trucking industry throughout the contiguous 48 states. The sample was a stratified random one, selected from the mid-1999 records of firms in the federal government’s MCMIS Census database. Stratification

was used both to compensate for the highly skewed distribution of firms in the industry by size, and to place emphasis on firms operating in the states where CVISN deployment was most highly advanced. Compared to a simple random sample of all firms, the stratified sample contained much higher proportions of larger firms and ones with registered home addresses in five “CVISN focus” states: Connecticut, Kentucky, Maryland, Oregon, and Virginia. A total of 158 complete responses were obtained from approximately 2,000 firms that were mailed questionnaires. Sampling weights were established for each sample stratum to restore correct proportionality of the achieved sample by firm size and by geography.

A *qualitative driver survey* was conducted to explore the opinions of truck drivers about recent, CVISN-related changes in roadside inspection methods, and the opinions of owner-operators about electronic credentialing. The operators’ inputs are intended to help color, interpret, and better understand the information gathered in complementary evaluation activities.

One-on-one interviews were conducted with 61 truck drivers intercepted at large rest/refueling stops located adjacent to major truck routes in Connecticut and Kentucky. These two states are ones that have implemented significant electronic credentialing initiatives, and have been the focus of other, complementary evaluation activities. The interviews took place at four locations, two in each of the states, in late November and early December 2000.

Sample quotas were set to ensure the representation of owner-operators and of drivers employed by firms of varying sizes. Using in-depth, semi-structured personal interviews, all of the respondents were asked about roadside safety and weight inspections. The owner-operators were also asked about electronic credentialing methods.

The primary objective was to identify the *range* of opinions on various aspects of these topics, and to form hypotheses about any apparent areas of consensus or disagreement. Because of the small size of the sample and the method of sample recruitment, the degree to which the people interviewed are representative of any group larger than themselves cannot be determined.

Methods for evaluating of the satisfaction of *state CVO administrators* with CVISN technologies were less formal than the measures used to gauge the satisfaction of motor carriers and commercial vehicle drivers. Evaluation contractor staff participated in many meetings, conferences, and other forums, where the attitudes of state administrators and other CVISN stakeholders were directly solicited and discussed in detail. These include various pilot/prototype state workshops at The Johns Hopkins University, CVISN MDI Program Managers Meetings, and CVISN Deployment Forums and Mainstreaming Conferences. At each of these forums, participants were encouraged to offer opinions on successes, failures, obstacles, lessons learned, and issues to be resolved. Information gathered from these kinds of meetings was taken into account in all phases of evaluating the CVISN MDI.

The attitudes and opinions of *state CVO inspectors* regarding the use of CVISN roadside enforcement technologies were addressed through focus groups and a formal survey conducted in collaboration with the evaluation of the I-95 Corridor Coalition and SAFER Data Mailbox FOTs (Battelle 2000). Over 50 inspectors from six eastern states (Connecticut, Maryland, New Jersey, New York, Pennsylvania, and Rhode Island) participated in the focus groups, and

approximately 370 inspectors from these states completed formal questionnaires. Topics included background information, system usage, satisfaction, and perceived benefits.

### **CVISN Benefit-Cost Analysis**

A comprehensive benefit/cost analysis (BCA) was carried out for the CVISN MDI. Benefit/cost analysis is a public sector evaluation tool that compares all of a project's benefits to society to all of the project's costs to society. The question to be answered in a BCA is: Do these benefits exceed the costs? If the answer is yes, the benefit/cost ratio (BCR) is greater than one, and the project is said to be *economically* "feasible" or economically "justified." *Commercial* feasibility, the analogous private sector criterion, is much narrower in the benefits and costs it compares. Benefits are restricted to commercial *revenue*, and costs are limited only to those paid directly by the project developer.

In the case of CVISN, considerable public benefits can be expected. However, revenue paid by CVISN users is essentially zero, because CVISN is intended to make a regulatory system operate at lower cost and increased effectiveness to both its users and to society. The benefits quantified for inclusion in this BCA do not include every conceivable public benefit of CVISN, but they do include the major categories of *benefits*, such as crashes avoided, transit time savings, operating cost savings to states from electronic credentials administration, and savings to carriers from more efficient inspections and credentialing. The corresponding *costs* included in the BCA cover capital equipment purchases and periodic replacements/upgrades, software development, and increases in operating costs to states and carriers for roadside enforcement, for example. Costs are analyzed over a hypothetical 25-year life cycle beginning in 2000, using appropriate discount rates to achieve constant dollar estimates.

A literature search was conducted to monetize or determine cash values for any costs or benefits unavailable in the data collected from the participating states. For example, the prevailing cost of a crash was determined, as were cost or benefit values for the time vehicles spend in transit or in weigh station queues, and the inventory cost to a motor carrier for every day of delay in obtaining credentials for a new vehicle. A supplemental analysis was done on potential cost savings from reduced pavement damage, assuming that improved roadside enforcement leads to fewer overweight vehicles on the highways. This was a preliminary, qualitative assessment to obtain rough estimates to highlight the importance of this benefit. However, the results have not been included in the BCA in this report. A more rigorous study would be required to verify the assumptions that were made. Further details on the approach and methods for the BCA are presented in Section 8 and in Appendix D.

### **4.3 REFERENCES**

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## **CHAPTER 5. CVISN SAFETY BENEFITS**

In 1998<sup>1</sup>, 5,374 people were killed and approximately 127,000 were injured in crashes involving approximately 412,000 large commercial motor vehicles (CMVs). The FMCSA has set as one of its primary objectives the reduction of CMV-related fatalities and injuries by 50 percent by 2010. Although new research, such as the Large Truck Crash Causation project (FMCSA 2001), will help FMCSA better understand the causes of these crashes, vehicle safety defects and driver violations of the Federal Motor Carrier Safety Regulations (FMCSRs) are known to contribute to a portion of them (VNTSC 1999a).

The most important benefit expected from the deployment of CVISN technologies, especially electronic screening and safety information exchange, is a reduction in CMV-related crashes through improved enforcement of the FMCSRs. The principal hypothesis to be tested is that CVISN technologies will help enforcement staff focus inspection resources on high-risk carriers. This will result in more out-of-service (OOS) orders for the same number of inspections—thereby removing from service additional trucks and drivers that would have caused crashes because of vehicle defects and driver violations of safety regulations. A second hypothesis is that the increased attention on high-risk carriers will encourage motor carriers to improve their compliance with safety regulations. This indirect benefit is the number of crashes that would have been caused by violations in safety regulations, but are avoided due to improved compliance.

As outlined in the CVISN MDI Summary Evaluation Plan (Battelle 1998), the safety benefits analysis addresses the following four questions:

- What is the impact of CVISN on the numbers of crashes, injuries, and fatalities involving large CMVs?
- What is the impact of CVISN on rates of driver and carrier compliance with the FMCSR?
- To what extent does CVISN help roadside safety enforcement officials identify high-risk commercial vehicles and motor carriers?
- To what extent does CVISN help roadside safety enforcement officials identify OOS violators?

The CVISN safety benefits analysis was performed using a probability model that predicts the number of crashes avoided under various scenarios. Each scenario is defined by specific assumptions concerning the future deployment of CVISN. The probability model relates the number of crashes avoided to several input parameters including the probability that a CMV has an out-of-service (OOS) condition, the number of inspections performed, historical rates at which OOS orders were issued, national crash/injury/fatality rates involving large trucks, and

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<sup>1</sup> Although more current crash statistics are available, the safety benefits analysis is performed using a baseline year of 1998 because that was the last year for which complete data were available from all of the relevant sources.

probabilities that certain OOS conditions will contribute to a crash. Estimates of these inputs were obtained from the literature or from data collected in several special studies conducted in states that had previously deployed—or were in the process of deploying—CVISN safety information exchange and electronic screening technologies. States that participated in these studies were Connecticut, Kentucky, and Oregon.

Section 5.1 contains an overview of our findings. Five scenarios are presented to illustrate the safety benefits of CVISN under different deployment options and assumptions concerning the potential outcomes. The technical approach discussion in Section 5.2 describes the probability model and summarizes the design of the special studies that were undertaken to obtain outcome measures used in the model. Section 5.3 shows the calculation of safety benefits for each scenario. Supporting analyses are presented in Section 5.4.

### **Limitation of Findings**

The analysis contained in this chapter uses a probability model to predict the number of truck-related crashes that would be avoided nationwide as CVISN deployment expands. Although the model can be justified by basic principles of probability, its application relies on a variety of input parameters used to estimate impacts and benefits of CVISN. Some of the parameters were estimated using results from the open literature on crashes and highway statistics, and others were estimated with data collected in special studies involving participating CVISN states. Both types of estimates are subject to errors of unknown magnitude.

Some of the literature results were derived from a related FMCSA program (VNTSC 1999a), which was reviewed by an expert panel (Nicholson 1998). The panel expressed concern that the estimates of crash causation probabilities were based on limited data. However, no alternative approach was recommended. Currently, FMCSA is in the process of developing a new data collection program that has the potential to fill this information gap.

Estimates of CVISN impacts and benefits obtained from the special CVISN studies should also be used with caution. There were few if any opportunities to replicate the studies in different states in order to determine the statistical uncertainty of the estimates. In some cases the data limitations were the result of CVISN deployment delays or reduced levels of deployment of specific technologies.

Although additional data are needed to support these results, the safety analysis presented in this chapter helps to illustrate how the deployment of CVISN can affect highway safety. The analysis can be easily modified as new data become available.

## **5.1 OVERVIEW OF RESULTS**

This section contains an overview of the results of our safety benefits analysis. Results were obtained by combining analyses of selected roadside enforcement data with literature results to project the benefits of these technologies under five CVISN roadside enforcement (RE) deployment scenarios that incorporate the anticipated impacts, and a baseline scenario representing current enforcement practices. The deployment scenarios are defined as follows:

*RE-0: Baseline—Pre-CVISN.* Enforcement officers (inspectors) select CMVs for inspection using personal experience and judgment, but without the aid CVISN technologies.

*RE-1: ISS with Manual Pre-screening.* Inspectors are equipped with laptop computers containing Aspen and ISS. CMVs are pre-screened based on weigh-in-motion (WIM) and/or visual screening on a sorter ramp. Of the CMVs directed to the fixed scale, officers use ISS to select vehicles for inspection.

*RE-2: ISS with Electronic Screening.* State deploys electronic screening with safety snapshots at all major inspection sites. Motor carriers classified as “low-risk,” based on SafeStat scores, enroll in the electronic screening program. Trucks from the low-risk carriers (comprising approximately 52 percent of trucks on the road) are equipped with transponders and allowed to bypass inspection sites. Inspectors use ISS in the manner described in RE-1 to select vehicles for inspections from the remaining 48 percent of trucks in the high, medium, or unknown/insufficient data risk categories.

*RE-3: ISS with Electronic Screening and a Reduction in OOS Conditions Due to Improved FMCSR Compliance by Motor Carriers.* Motor carriers respond to targeted enforcement by improving compliance with safety regulations. Specifically, we assume that the total number of vehicle and driver OOS conditions will decrease by 25 percent due to improved compliance. Enforcement is conducted as in RE-2. (25 percent is an assumed value to illustrate potential impacts of improved compliance on crash reductions. The sensitivity of this assumption is assessed by also performing the analysis with an assumed reduction of 10 percent – referred to as scenario RE-3\*. At this time, there is no statistical evidence that targeted enforcement will have such effects on safety violation rates.)

Deployment RE-1 represents a current application of ISS for vehicle selection (e.g., Connecticut’s Greenwich and Union weigh stations). Scenarios RE-2 and RE-3 (or RE-3\*) represent “feasible” situations that could occur as CVISN deployment expands. Benefit/cost analyses for these three scenarios are presented in Chapter 8. However, to illustrate the limits of the direct and indirect benefits of CVISN roadside enforcement technologies, we consider two additional hypothetical scenarios:

*RE-4: 100 Percent Inspection Selection Efficiency.* State deploys electronic screening with safety snapshots at all major inspection sites, and all trucks are equipped with transponders. Safety analysis and screening algorithms have progressed to the point that OOS violations can be identified with near certainty. Therefore, all inspections result in OOS orders. Although not expected to occur, this scenario is used to illustrate the direct benefits of maximizing the efficiency of roadside enforcement operations.

*RE-5: 100 Percent Compliance with Safety Regulations.* In response to targeted enforcement, violations of vehicle and driver safety regulations are eliminated. Although not expected to occur, this scenario represents the maximum possible benefit (direct and indirect) of improved enforcement.

Except as described in scenarios RE-3 and RE-5, the rates of compliance with vehicle and driver safety regulations are based on estimates obtained in the FMCSA's National Fleet Safety Survey, or NFSS (Star 1997). The NFSS collected data from over 10,000 random Level I (driver and vehicle) inspections and estimated that 29 percent of all commercial vehicles and 5 percent of commercial vehicle drivers were operating with OOS conditions. For all of these scenarios, it is assumed that the numbers and types of inspections performed annually are constant and equal to the numbers reported by FMCSA's Motor Carrier Safety Assistance Program (MCSAP) Quarterly Report Information System for Fiscal Year 1998 (FMCSA 1999)—the last year for which complete crash statistics are available. Additional information from the literature, such as annual crash/injury/fatality rates, numbers of inspections performed and OOS orders issued, and crash causation statistics are discussed in Sections 5.2 and 5.3, along with the methods and analyses used to determine the crash reduction benefits of CVISN.

The impacts of CVISN technologies on roadside enforcement operations were evaluated through special studies conducted in participating states. However, because CVISN is still in the early stages of deployment, especially in the area of electronic screening with safety snapshots, opportunities to evaluate these impacts directly were limited. The following results, obtained from CVISN pilot states, provide useful insight into these effects; however, the degree to which these results are statistically representative of future deployments could not be determined:

1. A study of roadside inspection selection strategies at four Connecticut inspection sites (two using ISS and two without ISS) demonstrated that using ISS, in combination with manual prescreening, to select commercial vehicles for inspection increases OOS orders by approximately 2 percent for the same number of inspections—a 2 percent increase in inspection efficiency.
2. Analysis of this same inspection selection strategy under the added assumption that “low-risk” carriers would be permitted to bypass the inspection sites demonstrates that electronic screening, with full participation by all low-risk carriers, could increase inspection efficiency by more than 11 percent.
3. A two-year study of the changes in safety compliance rates in Oregon, conducted during the deployment of roadside screening and safety information exchange technologies, failed to demonstrate that CVISN roadside deployment will increase compliance with safety regulations. However, in designing the study it was anticipated that advanced safety screening technologies would be deployed during the second year; but deployment of these systems was delayed, which made it difficult to observe the expected impact on safety compliance. As discussed in scenario RE-3, the 25 percent reduction (or 10 percent for scenario RE-3\*) in safety violations is assumed for illustration purposes.

These estimated and assumed effects of CVISN deployment, along with results from the literature, were applied to a crash avoidance model (described in Section 5.2) to predict the numbers of truck-related crashes and associated injuries and fatalities that would be avoided under each of the above roadside enforcement scenarios. Table 5-1 summarizes the major results of this analysis. Supporting details are provided in Section 5.3.

**Table 5-1. Estimated Safety Benefits of CVISN Under Selected Deployment Scenarios and Assumptions**

Scenario	Description	Numbers of Safety Events Avoided <sup>1</sup>			Additional <sup>2</sup> Safety Events Avoided (CVISN Benefit)		
		Crashes	Injuries	Fatalities	Crashes	Injuries	Fatalities
	Random Selection	3,765	1,160	49			
RE-0	Baseline (pre-CVISN)	4,423	1,362	57			
RE-1	ISS with manual prescreening	4,507	1,388	59	84	26	2
RE-2	RE-1 plus electronic bypass of low-risk carriers	5,012	1,544	65	589	181	8
RE-3	RE-2 plus 25% reduction in safety violations	14,368	4,425	187	9,945	3,063	130
RE-3*	Same as RE-3 except with a 10% reduction in safety violations	8,755	2,697	114	4,332	1,335	57
RE-4	100% inspection selection efficiency	10,561	3,253	137	6,138	1,891	80
RE-5	100% compliance with safety regulations	42,436	13,070	552	38,013	11,708	494

<sup>1</sup> In 1998, approximately 412,000 large trucks were involved in crashes resulting in 127,000 injuries and 5,374 fatalities. The estimated number of crashes avoided is based the assumption that crashes are avoided when vehicles and drivers with safety violations are placed out-of-service.

<sup>2</sup> Compared to baseline scenario (RE-0)

According to the model, current roadside enforcement strategies (RE-0) are responsible for avoiding 4,423 truck-related crashes, which represents slightly more than 1 percent of the 412,000 truck-related crashes that occur annually, based on 1998 crash statistics (FMCSA 2000b). Assuming that the numbers of injuries and fatalities are proportional to the number of crashes, it is estimated that current roadside enforcement activities are responsible for preventing 1,365 injuries and 57 deaths.

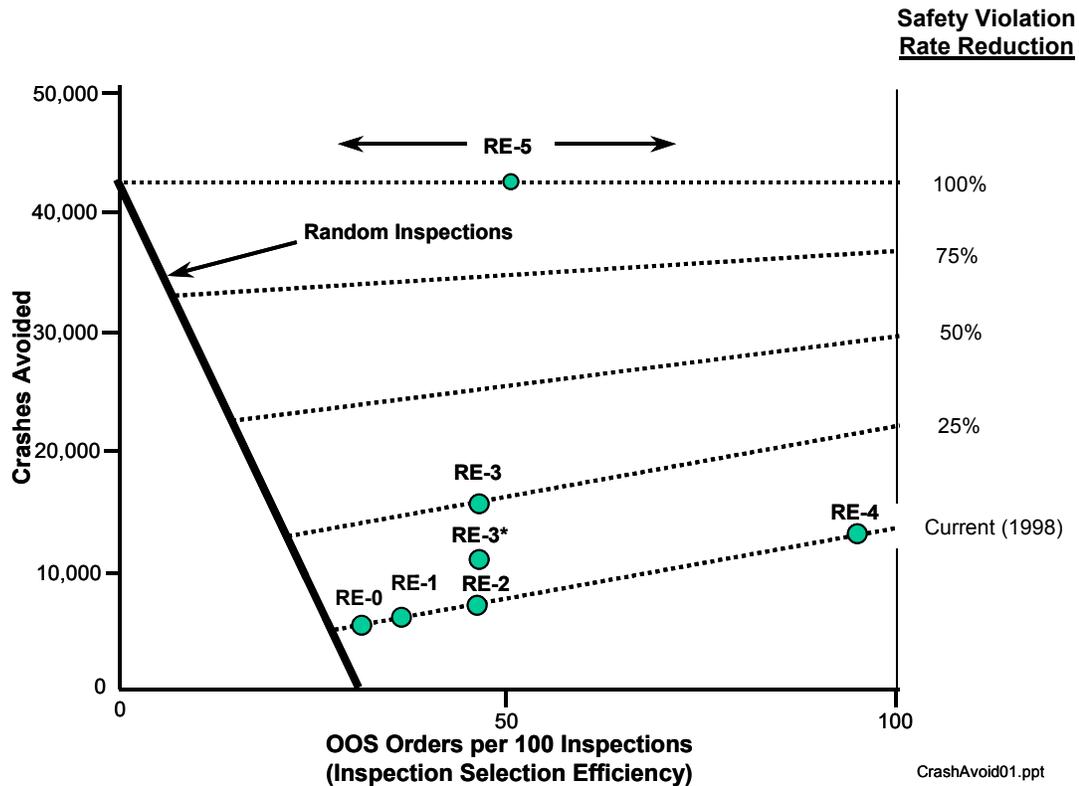
For reference, the numbers of crashes, injuries, and fatalities that would be avoided if vehicles were *randomly* selected for inspection (Random Selection) were also calculated and shown in Table 5-1. The differences between these numbers and the baseline numbers can be used to estimate the benefits of current inspection selection strategies, which include the training, knowledge, and experience that the inspectors bring to the job.

The safety benefits of CVISN are obtained by subtracting the numbers of crashes, injuries, and fatalities avoided under the baseline scenario from the corresponding numbers under scenarios RE-1 to RE-5. For example, if ISS were used to select vehicles for inspection following manual pre-screening on sorter lanes, as currently performed at two sites in Connecticut, an additional 84 crashes, 26 injuries, and two fatalities could be avoided. If electronic screening is added, and all low-risk carriers enroll and are permitted to bypass

inspections, enforcement staff could focus inspections on more high-risk carriers. The increased numbers of OOS orders for the same number of inspections would help avoid 589 additional truck-related crashes as well as 181 injuries and 8 fatalities. Although there is no direct evidence concerning the degree to which safety compliance improves with enhanced enforcement, scenarios RE-3 and RE-3\* demonstrate the substantial safety benefits that would occur if CVISN-enhanced enforcement strategies helped to encourage improved compliance with safety regulations.

Scenarios RE-4 and RE-5 are presented to illustrate the potential benefit of CVISN under limiting conditions at full deployment. Clearly it is not realistic to expect roadside enforcement to achieve 100 percent efficiency in selecting vehicles with OOS conditions. However, it is conceivable that advances in safety analysis, through programs such as the Large Truck Crash Causation Study, combined with enhanced data reporting capabilities offered by CVISN, would help to identify carriers that might pose exceptionally high risks. The additional 6,138 crashes avoided under scenario RE-4 represent the maximum benefit of this enhanced enforcement capability. Of course, the maximum number of crashes that could be avoided with any improvement related to safety compliance is 42,436, of which only 38,013 would be attributable to the indirect benefit of CVISN or any other program that helps to increase compliance with safety regulations. The resulting reduction in injuries (11,708) and fatalities (494) represent 9 percent of the numbers that occurred in 1998. Thus, the analysis of this limiting condition demonstrates the maximum degree to which CVISN can contribute to FMCSA's goals of reducing the number of injuries and fatalities from truck-related crashes by 50 percent by the year 2010.

The model used to calculate the number of crashes avoided is illustrated in Figure 5-1. The direct effect of improved inspection efficiency (OOS orders per 100 inspections) is represented by the contour lines, which determine the number of crashes avoided for a given level of compliance. As inspection efficiency increases, the number of crashes avoided increases up to a limit. Recall that scenario RE-4 produces the maximum number of crashes avoided without increasing safety compliance. Note that the lower (realistic) limit on inspection efficiency corresponds to random selection (percent OOS orders equals the violation rate). The successive lines, from bottom to top, represent the indirect impact of reducing the safety violation rates by 25 percent, 50 percent, 75 percent, and 100 percent. The results (total crashes avoided) for the scenarios described above are marked in Figure 5-1.



**Figure 5-1: Number of Crashes Avoided versus Inspection Selection Efficiency at Selected Levels of Reduction in Vehicle/Driver Safety Regulation Violation Rates (Showing Approximate Locations of Estimates for Selected Scenarios)**

## 5.2 TECHNICAL APPROACH

The CVISN safety benefits estimation methodology is based on a probability model that relates the improvement in safety—as measured by the numbers of crashes, injuries, and fatalities avoided—to the number of OOS orders issued and other CMV safety parameters such as crash rates, violation rates, and crash causation statistics. Data were collected from published sources as well as new, special studies designed to provide input to the model.

The four study questions presented on page 5-1 provide the basis for the safety benefits estimation methodology. While the first of these questions addresses the heart of the safety benefits of CVISN, the particular CVISN technologies that are included in the MDI achieve these safety benefits only through improvements in the enforcement of vehicle and driver compliance with safety regulations. The remaining three questions, which provide the main focus for the safety evaluation, examine the relationship between CVISN deployment and its impact on enforcement practices. Results from the literature and new studies were used to address the latter three questions. Once those questions were answered, a statistical model was

used to relate their answers to the question of the effect of CVISN on crashes, injuries, and fatalities.

The second and third questions indicate that CVISN technologies might be expected to help improve compliance with safety regulations in two ways, both resulting from increased effectiveness of roadside inspection operations. The *direct*, but smaller, impact is the removal of unsafe drivers and vehicles from the highways. The third question addresses the direct effect by examining the impact that electronic screening and safety information exchange technologies will have on the inspectors' ability to select commercial vehicles for inspection in the most efficient manner. The *indirect* effect, which is expected to be much larger, occurs when drivers and carriers modify their behavior in response to the improved, more targeted inspections. The second question addresses this indirect effect. The hypothesis to be tested is that carriers will expend resources to ensure that their vehicles stay in compliance. Carriers with good safety records (low-risk carriers) would expect to have a small probability of being inspected. High-risk carriers will try to improve their safety rating to avoid increased inspections.

The fourth question focuses on a different aspect of safety enforcement, that of identifying violators of OOS orders. Safer Data Mailbox (SDM) is an electronic database of inspection records that has been designed to provide safety enforcement agencies with a national database of inspection information. Queries to this database provide information about any inspection of a vehicle within the past 45-day period. The extent to which it is used by inspectors in the field will indicate the extent to which OOS violators can be identified.

The following sections describe (1) the sources of data obtained from the literature and from special studies that were conducted to quantify the impacts of CVISN on roadside safety enforcement, and (2) the crash avoidance model used to estimate CVISN safety benefits.

## Data Sources

Table 5-2 lists some key safety statistics obtained from the published literature. Most of these data are used in the crash avoidance analysis; others are provided for reference. According to FMCSA, 7.2 million large trucks (>10,000 pounds gross vehicle weight) travel approximately 196 billion miles in the U.S. each year. In 1998, the last year for which complete statistics are available, 412,000 trucks were involved in crashes, resulting in approximately 127,000 injuries and 5,374 deaths. The corresponding rates per vehicle mile traveled are derived from these values. Other relevant statistics provided in Table 5-2 include the number of commercial vehicle inspections performed in 1998 and the actual percentages of OOS orders issued (25.5 percent of vehicles and 8.1 percent of drivers). In 1996 FMCSA sponsored the National Fleet Safety Survey (NFSS), in which 10,000 trucks were selected at random for inspection in order to estimate the percentages of trucks and drivers that operate with OOS conditions (i.e., violation rates). These estimates differ from the actual OOS rates because inspectors choose vehicles for inspection based on vehicle appearance and apply their knowledge and experience. The estimated violation rates reported by the NFSS were 29 percent for vehicles and 5 percent for drivers (Star 1997).

In order to determine the impact of removing OOS violators from the roadway on the number of crashes, it is necessary to estimate certain probabilities associated with crash

causation. Specifically, the probabilities that a crash involving a large truck was caused by vehicle and driver OOS conditions are needed. FMCSA recognizes that information on the causes of large truck crashes is lacking and, therefore, recently initiated the Large Truck Crash Causation Study (2001), which will soon begin collecting the necessary data. In the meantime, this analysis uses the best available information, which FMCSA used to evaluate the safety benefits of roadside inspections (VNTSC 1999a). These data issues are discussed more fully in the next section along with the explanation of the crash avoidance model.

**Table 5-2. Relevant Safety and Safety Enforcement Statistics on Large Trucks**

Statistic Description	Value	Source <sup>1</sup>
Number of large trucks	7.2 million	Safety Action Plan (FMCSA 2000a)
Large truck annual vehicle miles traveled (VMT)	196 billion	Safety Action Plan (FMCSA 2000a)
Number of registered interstate motor carriers	500,000	Safety Action Plan (FMCSA 2000a)
Number of large trucks participating in electronic screening (2000)	150,000	What Have We Learned (FHWA 2000)
Large trucks involved in crashes (1998)	412,000	1998 Crash Profile (FMCSA 2000b)
Injuries from large truck crashes (1998)	127,000	
Fatalities from large truck crashes (1998)	5,374	
Large trucks involved in property damage-only crashes	318,000	1998 Crash Profile (FMCSA 2000b)
Large trucks involved in injury-only crashes	89,000	
Large trucks involved in fatal crashes	4,935	
Large truck crash rate (truck crashes/100 million VMT) = 412,000 truck crashes/196 billion VMT	210.2	Derived
Large CMV injury crash rate (crashes/100 million VMT) =89,000 truck crashes/196 billion VMT	45.4	Derived
Large CMV fatal crash rate (crashes/100 million VMT) =4,935 truck crashes/196 billion VMT	2.5	Derived
Commercial vehicle (non-bus) inspections performed (1998)	1,562,739	MCSAP FY98 Data Report (FMCSA 1999)
Commercial vehicle (non-bus) driver inspections (1998)	2,089,846	
Total CV (non-bus) inspections (driver and vehicle) (1998)	2,113,570	
Percent of vehicles placed OOS (1998)	25.5%	MCSAP FY98 Data Report (FMCSA 1999)
Percent of drivers placed OOS (1998)	8.1%	
Percent of vehicles or drivers placed OOS (1998) [estimated]	30.4%	
Percent of VMT with vehicle OOS conditions (1996)	29%	1996 National Survey (Star 1997)
Percent of VMT with brake-related OOS conditions (1996)	14%	
Percent of VMT with driver OOS conditions (1996)	5%	
Percent of VMT with vehicle or driver OOS conditions (1996)	32%	
Percent of large CMV crashes with vehicle OOS condition as contributing cause	4.6%	Safety Program Performance (VNTSC 1999a); OOS Criteria (Miller et al. 1996)
Percent of large CMV crashes with driver OOS condition as contributing cause	5.7%	Safety Program Performance (VNTSC 1999a)

1 Full reference citations are presented in Section 5.5.

While these data provide much of the necessary information needed to estimate safety benefits, additional data are needed to determine the current impact of CVISN technologies on inspection efficiencies and compliance rates. Thus, three studies were conducted in Oregon, Connecticut, and Kentucky to collect the necessary data for evaluating the impact of CVISN deployment.

In Oregon, a two-part study was conducted. The first part of the study examined the impact of CVISN on carrier and driver compliance with the FMCSR. In the compliance study, conducted in conjunction with Oregon's Green Light project, trucks were randomly selected for inspection using a statistical sampling plan. Approximately 1,200 vehicles were inspected at several locations in Northwest Oregon at four times spread over a period of 2 years. These data were used to estimate the change in violation rates over time as CVISN was deployed in the state and to provide information used in addressing the indirect effect of CVISN deployment currently.

The goal of the second part of the Oregon study was to quantify how effectively roadside enforcement staff were able to target vehicles from high-risk carriers with and without the CVISN technologies. The Oregon Department of Transportation (ODOT) performed 508 inspections between June and September 1999 at various locations in the Interstate 5 corridor in Oregon, some using ISS and others without using ISS. The proportions of high-risk vehicles inspected were compared with and without ISS to determine whether there were any differences. These results were used to examine the direct effects of CVISN deployment currently. Appendix A.1 contains a detailed discussion of the two Oregon studies.

The *Connecticut Roadside Screening Study* was conducted to estimate the effectiveness of the CVISN safety information exchange deployment in Connecticut, which consisted of ASPEN/ISS systems accessed from laptop computers. The inspection operations of two agencies, the Department of Motor Vehicles (DMV) and the Department of Public Safety (DPS), were observed at four different weigh stations in the winter and spring of 1999. Data were collected from more than 10,000 vehicles entering these stations to characterize the distribution of trucks at each location and to evaluate the inspection selection process.

Following the roadside data collection, the motor carrier safety ratings for every truck observed at the Connecticut sites were determined using the SafeStat algorithm (VNTSC 1999b; VNTSC 1998). In addition, over 58,000 historical records from inspections conducted between October 1995 and June 1999 were used to determine the distribution of inspected CMVs among risk categories. As with the Oregon inspection study, the proportion of high-risk CMVs inspected was estimated and compared to the proportion of high-risk CMVs in the population to determine the inspection efficiency conducted with laptops and ASPEN. These data were also used to estimate the effects of using ISS in combination with manual pre-screening on the number of OOS orders issued for a fixed number of inspections performed. Appendix A.2 provides a more detailed discussion of the Connecticut Roadside Screening Study.

The *Kentucky Screening Assessment Study* was conducted to measure changes in screening effectiveness at sites in Kentucky where CVISN's Electronic Screening technology was deployed. Of particular interest in the Kentucky study was to compare the inspection

efficiency between stations with and without electronic transponder facilities that allow participating CMVs to bypass inspection stations. U.S. DOT identification numbers for over 150,000 CMVs that entered or bypassed one of five inspection stations during a 5-week period in September and October 1999 were recorded. Risk categories were determined from these vehicles to represent the distribution of CMVs among risk categories for the population passing each station. Inspection records for 1998 at the same stations were obtained and used to determine the distribution of CMVs among risk categories for inspected vehicles. The proportion of high-risk vehicles inspected at each inspection station was compared to the proportion of high-risk vehicles in the population to estimate the inspection efficiency. Appendix A.3 provides more details about the Kentucky Screening Assessment Study.

To address the fourth research question, regarding inspectors' ability to identify OOS order violators, a study was conducted of the *SAFER Data Mailbox (SDM) system*. This study examined the frequency and timeliness of inspection uploads and queries to SDM to evaluate the potential for using SDM to catch OOS order violators. A separate DOT report provides a more detailed description of the SAFER Data Mailbox study (Battelle 2000).

### **CVISN Crash Avoidance Model**

Ultimately, safety benefits will be realized only to the extent that targeted inspections and improved compliance translate into reductions in numbers of crashes. The premise of targeted inspections is that, for the same number of inspections performed, additional drivers and vehicles operating with OOS conditions will be removed from the roadway. Furthermore, all of the conditions leading to the OOS order will be fixed and "stay fixed" for a period of time after the inspection. Therefore, crashes that would have occurred during this period are prevented because the OOS conditions that would have caused the crashes were eliminated. The safety benefit of CVISN is determined by comparing the number of crashes avoided under the baseline scenario (i.e., with pre-CVISN roadside enforcement strategies and technology) with the number of crashes avoided under each CVISN deployment scenario. It is assumed under each scenario that the corresponding numbers of injuries and fatalities avoided are proportional to the number of crashes avoided.

The basic principle of the CVISN crash avoidance model, as well as certain assumptions about how roadside enforcement affects crash rates, were motivated by research on the Safe-Miles model developed for FMCSA (formerly the Office of Motor Carriers in the Federal Highway Administration) to estimate the benefits of MCSAP, the Motor Carrier Safety Assistance Program (VNTSC 1999a). Although the model used in the CVISN analysis is different from the one used in Safe-Miles, certain model parameters, such as crash causation probabilities and the number of "safe miles" a truck travels following an OOS order, are used in this analysis. It should be noted that the developers of Safe-Miles (VNTSC 1999a), as well as an expert panel convened to review the program (Nicholson 1998), identified certain limitations with the Safe-Miles model. Some of their concerns are relevant to the CVISN crash avoidance model, as discussed below.

In its simplest terms, the number of crashes avoided can be written as

$$\#Crashes\ Avoided = \#OOSO \cdot P(C, D | OOSC) \quad (1)$$

where

- $\#OOSO$  is the number of OOS orders issued, and
- $P(C, D | OOSC)$  is the probability of a crash (C) with a contributing defect or driver safety violation (D), given that a vehicle has the OOS condition (OOSC).

While the number of OOS orders issued is easily obtained, the probability of a crash with a contributing defect that would have resulted in an OOS condition is more complicated. We start by representing the second term in (1) as a product of conditional probabilities, so that the model for the number of crashes avoided can be rewritten as

$$\#Crashes\ Avoided = \#OOSO \cdot P(C | OOSC) \cdot P(D | C, OOSC) \quad (2)$$

where

- $P(C | OOSC)$  is the probability of a crash given that a vehicle has an OOS condition, and
- $P(D | C, OOSC)$  is the probability of a contributing defect given that a vehicle is involved in a crash and has an OOS condition.

Using Bayes Theorem, the middle term in Equation (2) can be rewritten as

$$P(C | OOSC) = \frac{P(OOSC | C) \cdot P(C)}{P(OOSC)} \quad (3)$$

where

- $P(OOSC | C)$  is the probability that a vehicle has an OOS condition given it is in a crash,
- $P(C)$  is the probability of a crash, and
- $P(OOSC)$  is the probability that a vehicle has an OOS condition.

Similarly, the last term can be rewritten as

$$P(D | C, OOSC) = \frac{P(D | C) \cdot P(OOSC | D, C)}{P(OOSC | C)} \quad (4)$$

where

- $P(D|C)$  is the probability of a contributing defect given that there was a crash, and
- $P(OOSC|D,C)$  is the probability that a vehicle has an OOS condition given it has a crash with a contributing defect.

The last term,  $P(OOSC|D,C)$ , is equal to 1 because we are assuming that the vehicle defect or driver violation (D) is an OOS condition.

In this analysis, we are only concerned with crashes that are avoided because they would have been caused by a defect or driver violation that resulted in an OOS order. Also, it is generally assumed that the probability of a crash is proportional to the number of vehicle miles traveled (VMT). Therefore, the probability of a crash (among vehicles that would have been operating with defects or driver violations) is estimated by the national crash rate for large trucks (denoted by  $\lambda$ ) multiplied by the number of safe miles (SM) traveled as a result of “fixing” an OOS condition. This is the approach used in the Safe-Miles program. The values of SM used in the Safe-Miles program are 15,000 miles for vehicle OOS orders and 10,000 miles for driver OOS orders.

It should be noted that the expert panel reviewing the Safe-Miles program was uncomfortable with these assumptions; but no alternative approach was identified. The CVISN evaluation team looked at an alternative approach to representing crash probabilities following an inspection. It was determined that the “safe miles” model was conceptually consistent with a more rigorous approach that does not assume a fixed number of miles without OOS conditions. However, both approaches require data that currently do not exist. Therefore, it is recognized that this portion of crash avoidance model should be updated as new information becomes available from the Large Truck Crash Causation Project.

Combining Equations (2), (3), and (4) yields the following model for crashes avoided:

$$\#Crashes\ Avoided = \frac{\#OOSO \cdot SM \cdot \lambda \cdot P(D|C)}{P(OOSC)}. \quad (5)$$

Equation (5) is used in Section 5.3 to estimate the safety benefits associated with various CVISN deployment scenarios. Under each scenario,  $\lambda$ , the national crash rate for trucks, is 412,000 truck crashes divided by 196 billion vehicle miles traveled (VMT), or 2.1 crashes per million miles traveled. Applying the same crash causation probability estimates used in the Safe-Miles program, we have  $P(D|C)$  is equal to 0.046 for vehicle OOS conditions and 0.057 for driver OOS conditions. The expert panel had concerns about the accuracy of these estimates, so it is noted that these estimates should also be updated as new information becomes available from the Large Truck Crash Causation Project.

Additional data needed for this model include #OOSO, the number of OOS orders issued nationally, and  $P(OOSC)$ , the probability that a vehicle will have an OOS condition. These values depend on the particular roadside deployment scenario or enforcement strategy under consideration.

### 5.3 ESTIMATION OF CVISN SAFETY BENEFITS

In this section we present the calculations of the numbers of truck crashes, injuries, and fatalities avoided under each of the roadside enforcement scenarios described in Section 5.1. These calculations are based on Equation (5) and utilize specific assumptions defined by the scenarios. Results from special studies are presented as needed to justify some of the parameter estimates used in these models.

We begin by calculating the number of crashes that would be avoided were trucks to be selected for inspection randomly. This is not one of the roadside enforcement strategies being considered, nor is it a realistic strategy to employ. However, the calculation is useful for determining the contribution of the inspectors' knowledge and experience during the vehicle selection process.

Under random inspections, the proportions of inspected vehicles and drivers that are given OOS orders are equal to corresponding FMCSR violation rates. Thus, by applying the results from the NFSS, 29 percent of the 1,562,739 vehicle inspections (453,194) would result in vehicle OOS orders (Star 1997). From Equation (5), the number of crashes that are avoided due to vehicle OOS orders when random inspections are performed is equal to

$$\frac{453,194 \cdot 15,000 \cdot (2.1) \cdot (0.046)}{0.29} = 2,264.$$

Similarly, 5 percent of the 2,089,846 driver inspections (104,492) would have resulted in driver OOS order leading to

$$\frac{104,492 \cdot 10,000 \cdot (2.1) \cdot (0.057)}{0.05} = 2,502$$

crashes avoided. Note that these two numbers cannot be added to get the total number of crashes avoided because there is some overlap in vehicle and driver OOS orders. To get an estimate of the total number of crashes avoided, Table 5-2 shows that 29 percent of inspections results in a vehicle OOS order, 5 percent of inspections result in a driver OOS order, and 32 percent of *all* inspections results in an OOS order. Thus, 2 percent of inspections result in both a driver and vehicle OOS order. Equivalently, in 40 percent of the inspections where there is a driver OOS order, there is also a vehicle OOS order. Because the impact of vehicle OOS orders is greater than the impact of driver OOS orders, the number of crashes avoided combined over vehicle and driver OOS orders can be determined by adding (a) the number of crashes avoided due to vehicle OOS orders and (b) 60 percent of the crashes avoided due to driver OOS orders. Thus, the total number of crashes avoided with random inspections would be  $2,264 + (0.6 \cdot 2,502) = 3,765$ .

Using the injury and fatality data in Table 5-2, there are on average  $5,374/412,000 = 0.013$  fatalities per crash and  $127,000/412,000 = 0.308$  injuries per crash. Therefore, if 3,765 crashes were avoided, it would be expected that  $3,765 \cdot 0.308 = 1,160$  injuries would be avoided and  $3,765 \cdot 0.013 = 49$  fatalities would be avoided. This relationship between the numbers of crashes, injuries, and fatalities is assumed to hold for all of the scenarios below.

**Scenario RE-0: Baseline – Pre-CVISN**

The calculation of crashes avoided in the baseline scenario is very similar to the calculation with random selection of vehicles, except instead of applying the results from the NFSS, we use the actual numbers of OOS orders for vehicles and drivers. In 1998, the reference year, 25.5 percent of the vehicles inspected were placed OOS, and 8.1 percent of the drivers received OOS orders.

Following the approach used with random selection, 25.5 percent of the 1,562,739 inspections (398,498) resulted in vehicle OOS orders. From Equation (5), the predicted number of crashes avoided due to vehicle OOS orders is equal to

$$\frac{398,498 \cdot 15,000 \cdot (2.1) \cdot (0.046)}{0.29} = 1,991.$$

Similarly, 8.1 percent of the 2,089,846 driver inspections (169,278) would have resulted in driver OOS order leading to

$$\frac{169,278 \cdot 10,000 \cdot (2.1) \cdot (0.057)}{0.05} = 4,053$$

crashes avoided.

Applying the 60 percent adjustment factor used under random selection, the estimated number of crashes avoided is  $1,991 + 0.6 \cdot 4,053 = 4,423$ . The corresponding numbers of injuries and fatalities avoided are 1,362 and 57, respectively.

Note that the 1998 vehicle OOS rate of 25.5 percent is lower than the 29 percent violation rate estimated in the NFSS, and the 1998 driver OOS rate of 8.1 percent is higher than the 5 percent rate from the NFSS. This could be due to many factors, including individual or state-specific inspection selection priorities or differences in truck traffic during scheduled versus randomly selected times. No specific explanation is available. Nevertheless, it is interesting to note that the estimated number of crashes avoided under normal (pre-CVISN) inspection practices is 17 percent higher (4,423 versus 3,765) than the number that would be avoided under random selection of vehicles.

**Scenario RE-1: ISS with Manual Pre-Screening**

The primary direct impact of CVISN safety information exchange technologies is expected to be an increase in the efficiency of safety enforcement activities. In particular, it was expected that ISS would be used by safety enforcement staff to select vehicles and drivers for inspection based on a safety rating of the motor carrier and supplementary information on the carrier’s history involving inspections and safety incidents. However, because of the time and logistics involved in stopping a vehicle, entering identification numbers into the computer, and reviewing the data, ISS has not been used extensively as a tool for inspection selection. So, until

ISS is integrated into electronic screening algorithms, or states develop other innovative ways to apply ISS as a selection tool (e.g., license plate readers or slow-down lanes with manual entering of identification numbers), the primary benefit of ISS will not be realized. Currently, most inspectors use Aspen/ISS *after* vehicle selection to help focus the inspection effort or adjust the level of inspection. Aspen is also used to record and transmit inspection results.

Fortunately, an opportunity to evaluate the use of ISS as a selection tool was made possible by the unique situation in one state. Connecticut, one of the first states to widely deploy laptop computers with Aspen and ISS, conducts a large number of inspections at four fixed weigh stations. Each station is equipped with a fixed scale, and all trucks are required to enter the station when it is open. Commercial vehicle inspectors are assigned at each station. However, at two of the stations, Danbury and Middletown, inspectors select vehicles for inspection using only judgment and experience. Inspections are then conducted with the aid of Aspen and ISS. At the other two sites, Union and Greenwich, all vehicles are pre-screened using weigh-in-motion results and quick visual inspections. Some trucks are allowed to bypass the fixed scale and return to the highway. The remaining trucks are sent to the fixed scale, and their identification numbers are entered into a roadside computer, which contains Aspen and ISS. The ISS information is then used to select vehicles for inspection.

During the spring and summer of 1999, a Screening Assessment Study was conducted at the four Connecticut weigh stations to evaluate the impact of ISS on the inspection selection process. Complete details on the study design, analysis plan, and findings are presented in Appendix 2. Also, a summary of the analysis supporting the major findings related to this crash avoidance analysis is provided in Section 5.4.

The primary finding relevant to scenario RE-1 is that when ISS is used in combination with manual pre-screening to select commercial vehicles for inspection (as currently performed at Union and Greenwich sites in Connecticut), the number of OOS orders issued for a fixed number of inspections will increase by 1.9 percent compared to sites that do not use ISS and manual pre-screening for inspection selection. Although this is a small increase in inspection selection efficiency, it is important to recognize that ISS is used to select vehicles for inspection after most of the vehicles have been eliminated during manual pre-screening. See Section 5.4 for additional discussion of these findings.

The calculation of the numbers of crashes, injuries, and fatalities avoided under this scenario is fairly straightforward. With a 1.9 percent increase in OOS orders, the number of crashes avoided under this roadside enforcement scenario is  $1.019 \times 4,423 = 4,507$ . This represents an increase of 84 crashes avoided compared to the baseline scenario. The corresponding number of injuries avoided is 1,388 (a difference of 93), and the number of deaths avoided 59 (a difference of 2). Although these benefits are fairly modest, they do not represent the full potential of ISS when it becomes integrated with electronic screening or other innovative roadside enforcement strategies. The following scenario helps to demonstrate some of this potential.

## Scenario RE-2: ISS with Electronic Screening

As CVISN deployment expands and begins to integrate the use of ISS with electronic screening, roadside enforcement officials should be able to improve the efficiency with which they select high-risk CMVs for inspection. Currently, only a few states use ISS or similar tools in combination with electronic screening. However, even in these states, carrier enrollment in electronic screening is not sufficient to demonstrate any impacts on the inspection selection process. Therefore, to illustrate what could happen, the impact of using ISS with electronic screening was simulated using results from the Connecticut Screening Assessment Study. An analysis was performed under the scenario that (a) all states deploy electronic screening at all major inspection sites and (b) all of the motor carriers with SafeStat ratings in the low-risk category (representing approximately 52 percent of all trucks) choose to enroll in the electronic screening program.

Under this scenario, enforcement officials could choose to let the low-risk vehicles bypass the inspection site and focus all of their efforts on inspecting medium- and high-risk carriers and carriers with insufficient safety data. It is assumed that ISS will be used with manual pre-screening, as in scenario RE-1, on the 48 percent of trucks that are not allowed to bypass the inspection site. Section 5.4 presents an analysis demonstrating that, under this scenario, the number of OOS orders will increase by 11.2 percent compared to the average number that would be achieved under scenario RE-1.

From here, the calculation of the numbers of crashes, injuries, and fatalities avoided under scenario RE-2 is straightforward. With an 11.2 percent increase in OOS orders (compared to RE-1), the number of crashes that can be avoided under RE-2 is  $1.112 * 4,507 = 5,012$ . This represents an increase of 589 crashes avoided compared to the baseline scenario. The corresponding number of injuries avoided is 1,544 (a difference of 181), and the number of deaths avoided 85 (a difference of 9).

## Scenario RE-3 : ISS with Electronic Screening and a 25 Percent Reduction in OOS Conditions

The preceding scenarios looked at the direct effects of CVISN deployment as it affects inspection selection efficiency. An additional, indirect effect of CVISN deployment will be to deter carriers from operating vehicles in unsafe conditions in violation of the FMCSRs. The increased compliance with the FMCSRs will result in fewer unsafe trucks on the road. This will also reduce the numbers of truck-related crashes, injuries, and fatalities.

Although the Oregon Compliance Rate Study (See Appendix A.1) was conducted too early to determine if there will be a decline in FMCSR violation rates as CVISN deployment expands, the potential impact of this effect was investigated in scenarios RE-3 by *assuming* that targeted enforcement will result in 25 percent fewer FMCSR violation rates.

The calculation of the number of crashes avoided under scenario RE-3 is divided into two parts. The first part involves determining the number of crashes avoided because there are 25 percent fewer trucks and drivers with safety violations on the road (the indirect effect). The

second part involves determining the impact on inspection selection efficiency because there are fewer OOS violators to select for inspection.

It is assumed that a 25 percent reduction in FMCSR violation rates occurs uniformly across all types of driver and vehicle violations, including those that are likely to cause crashes. Again, no crash causation data exist to support or refute this assumption at this time. If the reduction occurs in this manner, the number of crashes avoided would be equal to 25 percent of the number of crashes caused by vehicle defects and driver violations before the improvement in safety compliance. Using the crash causation probabilities employed in the Safe-Miles model, it is estimated that driver violations contribute to 4.6 percent of truck-related crashes, and vehicle defects contribute to 5.7 percent of these crashes. Therefore, assuming minimal cases in which both driver and vehicle OOS conditions contributed to the same crash, the number of crashes caused by OOS conditions is

$$412,000 * (0.046 + 0.057) = 42,436.$$

From the discussion above, scenario RE-3 would result in a 25 percent reduction in these crashes, or 10,609 crashes avoided due to the *indirect* effect of enhanced roadside enforcement.

For the *direct* effect we consider how a 25 percent reduction in FMCSR violation rates affects the number of crashes avoided due to roadside enforcement. From Equation (5) we see that a change in the violation rates affects the calculation in three ways. First, the denominator,  $P(OOSC)$ , which represents the violation rate, will be reduced by 25 percent. Second, the number of OOS orders that will be obtained with the same level of effort will decline, because the proportion of CMVs with OOS orders will be smaller. It is assumed in this illustration that compliance improves uniformly across all risk categories of CMVs and inspection selection strategies at the roadside remain the same. Therefore, a 25 percent decline in violation rate will result in a 25 percent decline in the number of OOS orders issued. Third, if the violation rate decreases by 25 percent, it is expected that the percent of crashes caused by defects or driver violations, represented by  $P(D|C)$ , will also decrease because there will be fewer CMVs in violation, including those involved in crashes. We assume this probability will decrease by the same percentage; however, the data needed to support this argument are not yet available. FMCSA's Large Truck Crash Causation Study may provide the necessary data. The net effect of reducing FMCSR violation rates by 25 percent is that for the same number of inspections performed there will be a 25 percent decrease in the number of OOS orders issued. Based on results for scenario RE-2, there will be  $(1-0.25)*5,012 = 3,759$  crashes avoided through roadside enforcement with ISS and electronic screening.

Combining direct and indirect effects yields  $3,759 + 10,609 = 14,368$  crashes avoided, which is an increase of 9,945 compared to the baseline scenario. The corresponding number of injuries avoided is 4,425 (a difference of 3,063), and the number of fatalities avoided is 187 (a difference of 130).

### Scenario RE-3\*: ISS with Electronic Screening and a 10 Percent Reduction in OOS Conditions

Using the same approach as for scenario RE-3, a 10 percent reduction in OOS conditions will result in 4,244 fewer crashes due to indirect effect and 4,511 fewer crashes from the direct effect. Combining these yields  $4,511 + 4,244 = 8,755$  crashes avoided, which is an increase of 4,332 compared to the baseline scenario. The corresponding number of injuries avoided is 2,697 (a difference of 1,335), and the number of fatalities avoided is 114 (a difference of 57).

### Scenario RE-4: 100 Percent Inspection Selection Efficiency

The calculations of the number of crashes avoided under scenarios RE-1 and RE-2 assumed that the increases in inspection selection efficiency would be proportional to baseline scenario for both the vehicle and driver inspections. If we assume that CVISN technology will advance to the point that every inspection will result in an OOS order, it would be necessary to make unfounded assumptions concerning the distribution of OOS orders attributable to vehicles versus drivers. Therefore, we make the simplifying assumption that all OOS orders will be for vehicle violations; but calculate the number of crashes avoided using the total number of inspections (Levels 1 through 5) performed in 1998. This yields a conservative estimate of

$$\frac{2,113,570 \cdot 15,000 \cdot (2.1) \cdot (0.046)}{0.29} = 10,561$$

crashes avoided, which is 6,138 more than the baseline scenario. The corresponding numbers of injuries avoided is 3,253 (a difference of 1,891), and the number of deaths avoided 137 (a difference of 80).

The preceding calculations (as well as those in the preceding three scenarios) assume that the number of inspections performed annually is constant and equal to the number performed in 1998. The direct safety benefits of CVISN could be further improved by increasing the number of inspections that are performed annually.

### Scenario 5: 100 Percent Compliance with Safety Regulations

If CVISN deters *all* carriers from driving with OOS conditions, all crashes caused by OOS conditions would be eliminated. Thus, the number of crashes avoided is estimated by the number of trucks involved in crashes (412,000) times the probability that the crash is caused by a vehicle or driver OOS condition. As discussed under scenario RE-3, the estimated number of crashes avoided is

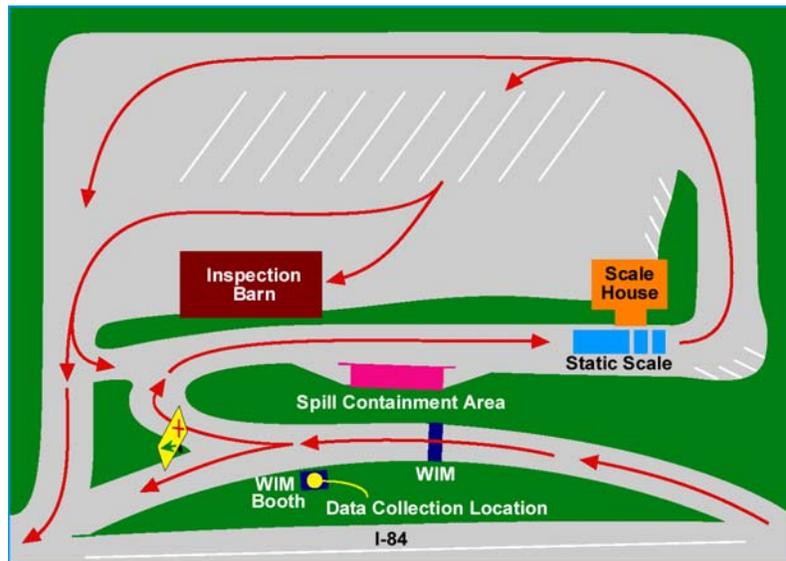
$$412,000 \cdot (0.46 + 0.57) = 42,436.$$

Because both vehicle and driver violations can be contributing causes to the same crash, this estimate represents an upper limit on the number of preventable crashes. This estimate represents an increase in 38,013 crashes avoided compared to the baseline scenario. The corresponding numbers of injuries avoided is 13,070 (a difference of 11,708), and the number of deaths avoided 552 (a difference of 494).

#### 5.4 KEY FINDINGS FROM THE CONNECTICUT SCREENING ASSESSMENT STUDY

The prediction of CVISN safety benefits under roadside enforcement scenarios RE-1 to RE-3 relied on specific estimates of the improvement in inspection selection efficiency that are or could be directly attributable to CVISN deployment. The primary source of data for developing these estimates was the Connecticut Screening Assessment Study. This section presents the analyses that support these key findings.

As discussed in Section 5.2, the Connecticut Screening Assessment Study was conducted at four commercial vehicle weigh stations in Connecticut to evaluate the effectiveness of ISS for improving the inspection selection efficiency of roadside operations. Inspection selection efficiency is measured by the number of OOS orders issued per 100 vehicles inspected. Increased efficiency means that more unsafe vehicles or drivers will be removed from the highway for the same number of inspections performed. During 13 days of data collection, approximately 10,000 vehicle identification numbers were recorded for all trucks entering the four weigh stations. At two of the stations (Danbury and Middletown), vehicles are selected for inspection without the aid of ISS. At the other sites (Union and Greenwich), vehicles are pre-screened using weigh-in-motion (WIM) and visual inspection. Vehicles sent to the fixed scale for weighing are then screened for inspection using ISS ratings. Figure 5-2 shows the configuration of the Union facility.



**Figure 5-2. Schematic of Connecticut's Union Facility with WIM Sorting**

The vehicle identification numbers were used to characterize the distribution of trucks in terms of safety risk at each inspection site. This was achieved during the analysis phase by calculating the SafeStat score for each truck. SafeStat is an automated motor carrier safety status measurement system developed for FMCSA that combines current and historical safety data to measure the relative fitness of motor carriers (VNTSC 1999b; VNTSC 1998). In addition to the inspection results obtained during the data collection phase, results of over 58,000 inspections performed over a four-year period at these sites were analyzed.

The analyses performed with these data are summarized in Table 5-3. The SafeStat scores for the 10,000 trucks that entered the sites were used to estimate the distribution of trucks that would be inspected if vehicles were selected at random. This serves as a baseline which allows us to make valid comparisons of inspection selection strategies at each site. For example, at the Danbury site, which does not use ISS for vehicle selection, the distribution of trucks includes 8.6 percent high-risk vehicles (according to SafeStat scores) and 47.2 percent low-risk vehicles. The actual inspection results show that inspectors are selecting more high-risk (12.0 percent versus 8.6 percent) and fewer low-risk (36.1 percent versus 47.2 percent) vehicles for inspection than they would if vehicles were selected at random. Multiplying these percentages by the statewide OOS rate gives the expected number of OOS orders per 100 vehicles inspected within each risk category. The statewide OOS rate for low-risk carriers is 38 percent compared to rates of 42 percent to 63 percent for the other risk categories (Medium, Insufficient Data, and Unknown). The totals represent the expected number of OOS orders for a given inspection selection strategy. The inspectors at Danbury average 48.4 OOS orders per 100 inspections using their own judgment and experience to select vehicles for inspection. Random selection would produce only 46.76 OOS orders per 100 inspections. Combining the Danbury and Middletown results, we see that inspector judgment and experience produce 3.5 percent more OOS orders than random selection. Even though Connecticut's OOS rates are much higher than the national average, the percent difference in these rates is consistent with similar findings from the National Fleet Safety Survey (1997).

The same calculations were performed with the data from the Greenwich and Union, which use ISS and manual pre-screening with WIM, in addition to judgment and experience, to make inspection selection decisions. This inspection selection process produces 5.4 percent more OOS orders than random selection. Using an odds ratio to adjust for differences in populations, we estimate that using ISS with manual pre-screening produces a net effect of 1.9 percent more OOS orders than would be achieved with inspector judgment and experience. This estimate was used in the model for crashes avoided under scenario RE-1.

To simulate the impact of electronic screening under full deployment, we assumed that all low-risk carriers would enroll and be permitted to bypass all inspection sites. Since no low-risk carriers will be inspected, we assumed that inspectors would proportionally allocate the inspections among the other risk categories. The predicted number of OOS orders with electronic screening was then calculated in the same manner. The relevant finding is that by using electronic screening to eliminate the low-risk carriers (and thereby target high-risk carriers) can increase OOS orders by 11.2 percent. This estimate was used in the model for crashes avoided under scenario RE-2.

**Table 5-3. Estimating the Improvements in OOS Rates Resulting from the Use of ISS and Electronic Screening in Roadside Enforcement.**

Station	Risk Category	CMV Inspection Selection Percentages			State OOS Rate (%)	No. OOS Orders per 100 Inspections <sup>4</sup>		
		Random Selection <sup>1</sup>	Actual Inspection Selections <sup>2</sup>	With Electronic Screening <sup>3</sup>		With Random Selection	Predicted from Actual Inspections	With Electronic Screening
Danbury (non-ISS)	High	8.6	12.0	18.8	63	5.42	7.56	11.83
	Medium	30.5	33.1	51.8	59	18.00	19.53	30.56
	Low	47.2	36.1	0.0	38	17.94	13.72	0.00
	Insufficient Data	10.7	13.7	21.4	42	4.49	5.75	9.00
	Unknown	3.0	5.1	8.0	53	1.59	2.70	4.23
	<b>Total Expected OOS Orders per 100 Inspections</b>						<b>47.43</b>	<b>49.26</b>
Middletown (non-ISS)	High	5.1	6.8	11.3	63	3.21	4.28	7.14
	Medium	26.1	27.4	45.7	59	15.40	16.17	26.94
	Low	49.8	40.0	0.0	38	18.92	15.20	0.00
	Insufficient Data	13.8	16.2	27.0	42	5.80	6.80	11.34
	Unknown	5.2	9.6	16.0	53	2.76	5.09	8.48
	<b>Total Expected OOS Orders per 100 Inspections</b>						<b>46.09</b>	<b>47.54</b>
Average for Non-ISS Sites						<b>46.76</b>	<b>48.40</b>	<b>54.77</b>
Percent increase in OOS orders compared to random inspections							<b>3.5%</b>	<b>17.1%</b>
Greenwich (with ISS)	High	5.1	7.8	10.8	63	3.21	4.91	6.81
	Medium	29.2	26.9	37.3	59	17.23	15.87	21.98
	Low	45.4	27.8	0.0	38	17.25	10.56	0.00
	Insufficient Data	16.2	25.9	29.7	42	6.80	10.88	15.07
	Unknown	4.1	11.6	7.5	53	2.17	6.15	8.52
	<b>Total Expected OOS Orders per 100 Inspections</b>						<b>46.67</b>	<b>48.38</b>
Union (with ISS)	High	4.6	11.1	18.3	63	2.90	6.99	11.50
	Medium	25.8	32.2	53.0	59	15.22	19.00	31.25
	Low	55.7	39.2	0.0	38	21.17	14.90	0.00
	Insufficient Data	11.9	13.8	22.7	42	5.00	5.80	9.53
	Unknown	2.0	3.7	6.1	53	1.06	1.96	3.23
	<b>Total Expected OOS Orders per 100 Inspections</b>						<b>45.34</b>	<b>48.64</b>
<b>Average for ISS Sites</b>						<b>46.01</b>	<b>48.51</b>	<b>53.94</b>
Percent increase in OOS orders compared to random inspections							<b>5.4%</b>	<b>17.1%</b>
Percent increase in OOS orders due to use of ISS – versus non-ISS							<b>1.9%</b>	
Percent increase in OOS orders with electronic screening of low-risk carriers – compared to ISS users without electronic screening								<b>11.2%</b>

1. Random selection percentages were determined from SafeStat scores of more than 10,000 vehicles that were observed at specified inspection stations during the Screening Assessment study (Spring 1999).
2. Actual selection percentages are based on more than more than 58,000 inspections performed at the specified inspection stations between October 1995 and June 1999.
3. Distribution was derived from actual selection percentages (note 2) and the assumption that electronic screening will eliminate low-risk carriers from the selection process (e.g., for Danbury high-risk category 18.8 percent = 12.0 percent/(1-0.361).
4. Product of CMV selection percentage and state OOS rate.

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## **CHAPTER 6. CVISN COST ANALYSIS**

The purpose of the cost analysis component of the CVISN MDI evaluation is to assess the effects CVISN is likely to have on CVO costs to states and motor carriers. Specifically, this analysis covers deployment and annual operating costs (i.e., nonrecurring and recurring costs, respectively) associated with credentials administration and two aspects of roadside enforcement operations: electronic screening and safety information exchange. In addition to supporting the CVISN Benefit/Cost Analysis (Chapter 8), the cost data presented in this chapter constitute part of the information needed by states and motor carriers to make CVISN implementation decisions. Therefore, the intended audience for this cost analysis chapter consists of

- State administrators responsible for CVO activities, especially those embarking on CVISN deployment
- Motor carrier managers, especially those considering electronic credentialing.

We begin in Section 6.1 with a brief overview of the major findings. The study goals and cost measures are described in Section 6.2 and the approaches to data collection and analysis are summarized in Section 6.3. Section 6.4 contains a summary of the deployment and annual operating costs to states for various components of CVISN Level 1 deployment. The detailed cost breakdowns are provided in Section 6.5. Projected costs and cost savings to states under various CVISN deployment scenarios are presented in Section 6.6. Motor carrier costs related to electronic credentialing are discussed in Section 6.7. Finally, Section 6.8 summarizes and discusses the relevance of cost information that was published in previous studies. Supporting appendices in Volume II provide additional background on state deployment status (Appendix B.1), interview guides for states and motor carriers (Appendix B.2), and cost elements/calculations used in this chapter (Appendix B.3).

### **Limitations of Findings**

To obtain information for this chapter, Battelle staff conducted in-person interviews with officials from commercial vehicle regulatory and enforcement agencies in four states that have actually deployed CVISN technologies. Contacts were also made with a limited number of motor carriers who participated in pilot studies of CVISN credential systems. The methodology for analyzing and presenting the cost information acknowledges that each participating state has unique characteristics and policies. No attempt was made to determine if these costs are applicable to other states. Officials evaluating CVISN technologies may benefit from contacting their counterparts in states that have begun deployment, to determine the extent to which each state's needs and expectations are comparable to those of their own state.

The results presented in this chapter have important limitations: only a few states have enough experience with CVISN to provide adequate data for this analysis. Thus, the study focused on those states with the most advanced deployment of the system or that were expected to make significant progress in deploying CVISN for credentialing and/or roadside enforcement operations. Because this is the first study of CVISN systems as actually deployed, it is expected

that the preliminary findings presented here will be expanded and refined in later DOT publications as deployment proceeds.

Two prototype states (Maryland and Virginia) and three pilot states (Kentucky, Connecticut, and Oregon) were initially targeted for data collection efforts. Kentucky, Maryland, and Connecticut were the three main states whose cost data are presented in this analysis. Unfortunately, no cost data were available from Oregon and only limited data came from Virginia. Some additional cost data came from separate studies of the I-95 Corridor Coalition states (Connecticut, Maryland, Massachusetts, New York, Pennsylvania, and Rhode Island) and of seven states participating in a study of the International Registration Plan (IRP) Clearinghouse (Arizona, Arkansas, California, Kansas, Kentucky, Maryland, and Virginia).

Some states targeted for data collection provided detailed data from their commercial vehicle operations, highway infrastructure, and CVISN systems. These data, as analyzed here, should provide sufficient cost information for future decision-makers in other states to determine the applicability of costs from this evaluation to their situations. Wherever possible, costs are expressed as recognizable units (e.g., one patrol car, one weigh station, statewide computer system) associated with key investments or activities. Costs are also presented at various layers or levels of deployment (e.g., CVISN Level 1). States attempting to adapt or extrapolate the costs and cost elements reported here should first determine if there are significant differences in operating procedures compared with the states participating in this study.

## 6.1 OVERVIEW OF FINDINGS

### Costs to States

*Credentialing.* The analysis of actual deployment and operation costs in two states, Kentucky and Maryland, demonstrated that electronic credentialing could offer states substantial cost savings, depending on the level of motor carrier participation. Up-front investments averaging \$700,000 were required for one state to deploy an end-to-end IRP credentialing system. However, annual operating costs to the states, which ranged from \$63 to \$138 for each carrier account before CVISN, can be reduced by almost 35 percent for each participating carrier. Assuming states can achieve a 50 percent participation rate by motor carriers, the annual cost savings to each state after deployment is expected to be between \$40,000 and \$140,000. Table 6-3 (below) and Section 6.4 summarize the unit costs to the states, Section 6.5 details the unit cost derivations, and Section 6.6 presents the statewide cost projections.

Both states were in the process of deploying electronic credentialing systems for IFTA. It was estimated that, for the additional investment of \$65,000, states could realize additional annual cost savings of approximately \$150,000, assuming 50 percent of the accounts file IFTA credentials electronically. The deployment cost for IFTA electronic credentialing is lower than the cost for a comparable IRP system in part because IFTA processing uses many of the same systems developed for IRP.

Additional cost savings are expected when trip-related credentials (HAZMAT, OS/OW, etc.) are filed electronically. However, neither state had begun deployment of these systems.

*Electronic Screening.* For electronic screening at the roadside, the one-time capital cost to deploy basic screening equipment (AVI and WIM) at a single weigh station was reported by Kentucky to be \$150,000. This does not include the cost of land, buildings, or fixed scales. Upgrading this site further to electronic snapshot capability was reported to result in nearly \$375,000 in one-time deployment costs. The cost to equip additional sites with the same electronic screening capability would be lower, because part of the start-up cost at the first site is for software development that would not need to be repeated. Incremental costs for full electronic screening capabilities at one site were reported to be approximately \$300,000, a savings of \$225,000 per site compared to the cost of the first screening site. Annual capital replacement and operating costs would increase by approximately \$75,000 per site to support full CVISN electronic screening.

To illustrate the cost impacts, assume that a state wished to equip and staff five existing roadside weigh stations for CVISN electronic screening. Based on pre-CVISN annual capital and operating costs, plus salary and benefits for three full-time staff per weigh station, a state would already be incurring nearly \$700,000 in annual costs for these five sites before CVISN technology was introduced. The deployment costs for full electronic screening capabilities at five sites is approximately \$1,725,000. The total annual capital replacement and operating costs at these five sites (not counting one-time start-up costs) would increase by nearly \$400,000. Table 6-3 (below) and Section 6.4 summarize the unit costs to the states, Section 6.5 details the unit cost derivations, and Section 6.6 presents the statewide cost projections.

*Safety Information Exchange.* For Safety Information Exchange at the roadside, a statewide upgrade to Aspen capability was reported by Connecticut to cost the state \$31,000 for infrastructure upgrades, plus \$4,800 for equipment and training for each enforcement unit (one patrol car and one officer or inspector). Upgrading to wireless telecommunication and SAFER mailbox capability adds an additional cost of \$1,000 per unit. Statewide deployment of CVIEW or equivalent was reported by Kentucky to cost \$325,000. Accompanying increases in annual capital and annual operating costs (again assuming no change in the state's labor costs for enforcement patrol officers/inspectors following CVISN deployment) were reported to be approximately \$88,000 per state and approximately \$1,400 per mobile unit.

Assuming a state has 50 mobile enforcement units, the one-time start-up costs for full CVISN deployment of safety information exchange statewide (including wireless telecommunication, SAFER Data Mailbox, and CVIEW) would be \$650,000. Looking at post-CVISN annual operating and annual capital costs, a statewide deployment including 50 mobile units would result in increased costs to the state of \$160,000, which is only 6 percent of the estimated \$2.7 million that such a state spends in labor and annual operating costs for 50 officers or inspectors and their vehicles pre-CVISN. Table 6-3 (below) and Section 6.4 summarize the unit costs to the states, Section 6.5 details the unit cost derivations, and Section 6.6 presents the statewide cost projections.

## **Summary of Costs to Motor Carriers**

Motor carriers participating in pilot tests of electronic credentialing reported saving between 60 and 75 percent of their costs for credentialing, with minimal start-up costs. For the motor carrier, only a desktop personal computer is required; many carriers already use computers with internet access in their business. Straightforward user interfaces are assumed capable of keeping training time and costs to a minimum. The reported time savings to the motor carriers is also substantial, at greater than 60 percent. One of the best benefits of electronic credentialing is the capability for carriers to print their own credentials without waiting for the mail or traveling to the state agency offices. This enables carriers to put new vehicles into operation more quickly. Savings are expected to be greater for new credentials than for renewals, because of the additional data entry that accompanies new applications processed via paper-based systems. Electronic credentialing, which offers database access to carrier information, processing templates, and automated error checking capabilities, promises to yield great savings to motor carriers. Section 6.7 presents the detailed results of the motor carrier cost evaluation.

Determining motor carrier costs and cost savings related to roadside enforcement activities was outside the scope of this evaluation project due to funding limitations – especially when considering the technical challenges in getting accurate operations cost data from motor carriers. However, some additional information on motor carrier costs, based on literature-derived projections, is presented in the benefit/cost analysis in Chapter 8.

## **6.2 STUDY GOALS AND MEASURES FOR CVISN COST ANALYSIS**

The cost analysis considered three major cost-related questions:

1. What are/were the baseline costs associated with CVO processes prior to CVISN technology deployment?
2. What are the one-time start-up costs to the states to deploy CVISN systems, and what are the key drivers or major elements contributing to those costs?
3. What annual capital and labor, operating, and maintenance costs do states incur as they use CVISN technologies, and what are the key drivers or major elements contributing to those costs?

In addition, two hypotheses were tested:

- CVISN credentialing systems will result in reduced time, costs, and uncertainties involved with handling (applying for and administering) commercial vehicle credentials for both state agencies and motor carriers
- The deployment of CVISN systems for roadside enforcement operations will result in capital cost increases to state agencies, but is expected to improve (1) inspection efficiency for states and motor carriers and (2) highway safety.

The first hypothesis and the cost impacts associated with the second are discussed in this chapter. The inspection efficiency and safety impacts are discussed in Chapter 5 (CVISN Safety Benefits). Formal benefit/cost analyses under various deployment scenarios involving CVISN credentialing and roadside systems are presented in Chapter 8.

## Baseline Costs

Baseline costs include annual capital costs and annual operating costs. With a few exceptions as noted, the term “baseline” refers to operating procedures that do not use CVISN or similar ITS/CVO technologies, even if the state used these technologies prior to the start of the CVISN MDI. Baseline systems use conventional (mostly paper-based) administrative or roadside technology. Baseline systems are sometimes referred to as “legacy” systems, especially in the case of computer technologies.

*Credentialing.* The baseline cost elements for credentialing include

- Labor and fringe benefits for staff who process new, supplemental, and renewal credential and permit applications
- Operation and maintenance of pre-CVISN, paper-based credentials administration equipment and facilities
- Communication, mailing, and reporting.

*Roadside Enforcement.* The operating costs of “baseline” activities are presented in order to provide a perspective on the added costs of CVISN. For example, the costs of baseline activity associated with electronic screening included staffing and operating costs for fixed weigh stations. The cost of baseline activities related to safety information exchange includes salaries of enforcement officers and vehicle costs.

The actual deployment date for a device or system was not the sole factor that determined whether a cost was classified as baseline or post-CVISN. For example, Connecticut was well advanced in using electronic safety data exchange technologies prior to becoming a pilot state in the CVISN MDI. But the systems they deployed were essentially CVISN. Therefore, Connecticut’s costs for electronic devices were treated as post-CVISN costs.

In states where the operation of an existing CVISN-like technology is completely modified to conform to CVISN standards, the pre-existing situation was considered a baseline case. “Post-CVISN” refers to the situation after the modification. For example, Kentucky had an electronic mainline screening capability as part of the Advantage I-75 program prior to becoming a CVISN pilot state. Under CVISN systems deployment in Kentucky, the screening system and its operation have been completely modified to be CVISN compatible. Costs for such modifications are classified as post-CVISN.

Attempts were made to isolate costs devoted to CVISN functions or their corresponding baseline activities before CVISN deployment. However, baseline costs do not include certain capital equipment and facilities costs. For example, the capital costs of computer resources for

baseline credentialing activities are excluded because they are often shared with other state agencies and are difficult to isolate. Also excluded are the costs of land and buildings for fixed weigh stations. The requirements for these types of facilities vary significantly from state to state.

### **CVISN Deployment Costs**

Deployment (one-time start-up or nonrecurring) costs associated with CVISN include

- Up-front purchases of equipment, goods, and services, such as hardware acquisition and software development costs
- Systems integration, consultant fees, planning, and design
- Outreach efforts
- Training for staff to use the new technologies.

Some costs to the states are expected to remain the same following CVISN deployment (e.g., roadside staff labor rates or the costs to install and operate a fixed weigh scale). These figures, assumed to be the same for both pre- and post-CVISN in this analysis, should help put the incremental costs for CVISN deployment in the context of overall state CVO costs.

### **Post-CVISN Costs**

Recurring costs to the states following deployment of CVISN technologies included annual capital costs and annual operating costs.

*Annual Capital Costs.* The start-up (deployment) costs for purchasing capital equipment were used to calculate annual capital costs. To simplify the presentation of costs in this chapter, the annual capital costs were determined by dividing the original purchase price of the equipment by the estimate of the expected replacement life of that equipment (in years). For example, a desktop personal computer having a service life of 5 years and costing \$2,000 to purchase new was assumed to carry with it an annual capital cost of \$400. This \$400 is believed to represent a fair value for periodic replacement of that equipment. The formal benefit/cost analysis presented in Chapter 8 uses appropriate discount factors to determine the true costs at given points in time.

Vehicles were assumed to have a life of 3 years; personal or laptop computers and printers were assumed to have a life of 5 years. All other capital equipment (e.g., scales, computer network database servers, modems, AVI readers) was assumed to have a life of 10 years.

Inferring annual capital costs from one-time start-up costs may seem to be double-counting. However, this approach was considered reasonable in that, once a state makes an up-front capital investment in equipment, the state will also want to plan for the cost of replacing the original equipment when it reaches the end of its useful life.

*Annual Operating Costs.* Recurring (annual) operations costs incurred after CVISN technology deployment generally include operations and maintenance (O&M) costs such as

- Labor and fringe benefits for credentialing, roadside, and administrative staff
- Operation and maintenance of the CVISN systems
- Communication
- Equipment and software replacement or upgrades.

In some cases, as noted below, labor is excluded from the O&M cost values. This usually means that CVISN deployment is not expected to affect labor costs significantly.

In general, cost data are presented for activities that correspond with CVISN Level 1 deployment. When firm cost data were unavailable, informed estimates of the costs were used. For example, only about 1 percent of credentialing volume was being handled with CVISN systems at the time of the evaluation, so post-CVISN credentialing labor costs were estimated. Any such estimates, their bases, and their limitations are identified in this report.

Detailed descriptions of the baseline and CVISN systems in place in each state at the time of data collection are presented in Appendix B.1.

### **6.3 COST DATA COLLECTION AND ANALYSIS APPROACH**

The CVISN cost study presented in this chapter consisted of the following activities: data collection, preparation of representative scenarios, and data analysis. Two data collection approaches were used: a literature review and a series of on-site, in-person interviews. Reference materials were obtained from the states, vendors, and publications prior to the site visits. Materials included case study evaluations, system studies, and empirical databases. In-person interviews were the primary source of cost data.

#### **Literature Review Summary**

The following sources were consulted in the literature review:

- National Governors' Association (NGA) Study (Apogee 1997)
- American Trucking Associations (ATA) Foundation Study (1996)
- Maryland Benefit/Cost Study (Bapna et al. 1998)
- Washington State CVISN Pilot Project report (1998).

The NGA study, based on states' advance estimates of project deployment costs, covered the same three functions as the CVISN cost study: credentialing, electronic screening, and SIE. The study estimated low and high ranges of start-up and annual costs, based on the systems identified for deployment in the individual states and their deployment schedules.

The ATA Foundation study assessed the impacts of ITS technology on regulatory compliance costs for motor carriers. ITS/CVO user services for which costs and benefits were evaluated include (1) administrative processes, (2) electronic clearance, (3) automated roadside safety inspections, and (4) on-board safety monitoring.

A benefit/cost study conducted in Maryland assessed the benefits of CVISN deployment. The study tested the hypothesis that the net benefits of CVISN deployment are positive and substantial, but vary among system components and between the state and motor carrier industry. Both qualitative and quantitative analyses of benefits and costs were conducted. The costs consist of CVISN investment, maintenance and operating costs to the state, and costs to motor carriers (e.g., transponders, computers, and software).

The Washington State Patrol departments of Licensing and Transportation conducted a feasibility study to determine the effects of continuing implementation of the CVISN pilot project. Effects on state administrative and enforcement functions were assessed, as were effects on motor carriers, commerce, and the traveling public. Incremental and 10-year costs for the pilot project were estimated. The study also evaluated benefits to the various stakeholders.

Comparisons of CVISN costs reported in this evaluation with the cost impacts predicted in the literature are presented in Section 6.8.

### **In-Person Interviews**

The objective of the interviews with state agencies was to collect information on

- Costs associated with the current credentialing processes and roadside screening and inspection activities
- Costs associated with deploying and operating various CVISN systems
- Resources (staff and equipment) committed to CVISN deployment.

Interviews were also conducted with representatives of selected motor carriers participating in the pilot testing of CVISN systems. The objectives of these interviews were to

- Gather information on the costs incurred (or savings realized) by the motor carrier industry resulting from CVISN systems deployment
- Learn about the impacts of CVISN systems on the efficiency and productivity of the motor carrier industry, as they affect costs.

All interviews were fact-finding, interactive discussions aimed at gaining an understanding and collecting data on the costs of CVISN systems. The interview guides were developed based on the evaluation strategy, evaluation data requirements plan, experiences from similar studies (e.g., NGA), and information gathered from the literature review. The interview guides are included in Appendix B.2.

Battelle staff summarized the data gathered from the interviews and then confirmed the summaries with the officials who provided the information, prior to data analysis.

Cost information in this chapter was drawn mainly from interviews with state transportation officials from four states: Kentucky, Maryland, Connecticut, and Virginia. Table 6-1 shows which states provided input on baseline costs (pre-CVISN), CVISN deployment or start-up costs, and post-CVISN annual costs. Information collected from some states was insufficient to be included in the cost analysis. Besides these four states, supporting information was drawn from several other states, including those in the I-95 Corridor Coalition and those participating in an evaluation of the IRP credentialing clearinghouse (IRP CH), as shown in Table 6-1.

**Table 6-1. States Participating in Cost Analysis of Various CVISN Technologies**

State	Role	Credentialing, Administration		Roadside Operations	
		Baseline	Post-CVISN	Baseline	Post-CVISN
Kentucky	CVISN Pilot, IRP CH	●	●	●	●
Maryland	CVISN Prototype, IRP CH	●	●		○
Connecticut	CVISN Pilot	●			●
Virginia	CVISN Prototype, IRP CH	○	○		●
Massachusetts	I-95 Coalition				○
New York	I-95 Coalition				○
Pennsylvania	I-95 Coalition				○
Rhode Island	I-95 Coalition				○
Arizona	IRP CH	○	○		
Arkansas	IRP CH	○	○		
California	CVISN Pilot, IRP CH	○	○		
Kansas	IRP CH	○	○		

Key: ● = primary data sources ○ = secondary data sources

Table 6-2 shows the approximate scope of CVO in each of the primary states participating in the cost analysis. These indicators were used in developing the representative state scenarios presented later in this report.

**Table 6-2. General Indicators of CVO Activity in Participating States**

CVO Indicators	Number per State			
	KY	MD	CT	VA
IRP Credentialed Motor Carriers	4,400	6,500	2,000	--
IFTA Credentialed Motor Carriers	4,000	5,500	2,800	--
Commercial Vehicle Credentials Issued per Year (IRP)	6,600	15,100	8,125	>6000
Commercial Vehicle Credentials Issued per Year (IFTA)	4,500	50,472	7,500	>14,600
Fixed-Site Weigh Stations	18	16	4	13
Roadside Inspectors	68	--	33	5

Note: Numbers of carriers and credentials are as reported for one year only. Representativeness to other years is unknown.

### **State Deployments**

The following descriptions summarize the baseline and post-CVISN deployments that are the focus of this report. More detailed information by state is presented in Appendix B.1.

*Kentucky.* Before deploying the CVISN model, Kentucky credentialing was paper-based. As part of CVISN model deployment, Kentucky deployed electronic credentialing using carrier automated transaction (CAT) software (InterCAT) developed by IDT (Intelligent Decisions Technology). The new system allows electronic application submittal and processing, funds transfer, and issuance of credentials for IRP and the International Fuel Tax Agreement (IFTA).

Pre- and post-CVISN cost data for roadside operations were also collected in Kentucky. Roadside operations include mainline screening and SIE. Prior to CVISN model deployment in Kentucky, mainline automated clearance systems (MACS) were in operation as part of the Advantage I-75 project. Under CVISN, the primary emphasis has been to develop the software to transition Advantage I-75 MACS to full CVISN compliance.

*Maryland.* For electronic credentialing, Maryland deployed the PC-based CAT software developed by IDT. Maryland wanted the capability of communicating directly with the VISTA system, offered by Lockheed Martin, a third-party service provider. Maryland also developed an in-house system for electronic permitting to process applications for OS/OW permits. This automated system allows carriers to print their permits at their terminal sites or to a designated fax line. It was noted that the Maryland IRP system was not completely “end-to-end” at deployment, as Kentucky’s system was. For example, in Maryland, state personnel re-keyed the carrier credential application information submitted electronically by the carriers, for processing by VISTA. Also, Maryland reported spending less than \$90,000 for one-time contracted software development, whereas Kentucky reported more than \$400,000 in software development costs. The reason for this difference in IRP deployment cost elements is unknown.

*Connecticut.* CVISN model deployment in Connecticut includes only roadside functions, not credentialing. CVISN technology deployment for roadside operations in Connecticut was relatively advanced prior to the CVISN MDI. Safety inspectors were equipped with laptop computers and used wireless CDPD modem technology for accessing carrier safety data. Cost analysis of roadside operations in Connecticut focuses on post-CVISN deployment for SIE.

*Virginia.* Cost data from Virginia were limited to the NOMAD mobile weight enforcement system and Virginia's participation in the separate IRP Clearinghouse study. Data on credentialing and other roadside costs from Virginia were unavailable.

### **Motor Carrier Representatives**

At the time of data collection, only a handful of motor carriers were participating in electronic credentialing programs. Three of the motor carriers participating in the CVISN deployment for electronic credentialing were interviewed as part of the cost analysis data collection effort. Results are presented briefly in this report. A separate survey of motor carriers is also in progress as part of the CVISN program; results from that survey are presented in Chapter 7.

### **Challenges in Data Collection and Analysis**

Cost data were generally difficult to collect. Initially, there were misconceptions concerning the use of the data. Some respondents erroneously perceived the cost analysis to be a means of auditing or tracking Federal funds allocated to CVISN model deployment. Others believed the study was intended to assess the efficiency in the state accounting systems with regard to the CVISN funds. These concerns were eventually overcome in the states involved in this effort.

Several other factors hindered the collection of cost data. First, computers, infrastructure, and facilities are maintained by agencies that may be different from those engaged in the CVO functions. Second, operation and maintenance costs are often lumped together with other cost items, making it difficult to isolate those directly related to credentialing and other CVO functions.

In many states, communication and mailing costs are not treated as discrete cost items that are attributed to individual processes. These are usually considered as part of general and administrative (overhead) costs for the entire agency. Mailing cost estimates for credentialing processes were based on the annual average number of credentials mailed and the average cost of mailing a single package. Telephone and other communication costs for both credentialing and roadside operations were likewise difficult to estimate.

“Roadside operations” in the CVISN context is understood to consist of two aspects: electronic screening and SIE. The systems are different, yet they rely on some of the same principles, personnel, and kinds of technology, so in some discussions they are treated together, and in others they are separated. One example is the development of a state's Commercial Vehicle Information Exchange Window (CVIEW) system, which can be adapted to support both electronic screening and Safety Information Exchange.

Kentucky's post-CVISN roadside deployment focused on electronic screening, whereas Connecticut's focused on SIE. As noted in greater detail in the sections below, the overlap of roadside technologies caused some cost elements to be counted in one area when in fact the element benefited both electronic screening and SIE activities.

Despite these limitations, this evaluation presents a first look at CVISN deployment and operating costs in the context of existing CVO costs. Based on data from the handful of states that are furthest along in their implementation of CVISN technologies, this evaluation should give state officials and policymakers important early insights into what they may expect as CVISN progresses in their states.

### **Development of Scenarios**

To present a realistic picture, valid cost and operations data have been combined and averaged across the states that supplied the data. These costs are summarized in Table 6-3 below. Supporting explanatory data show details of the CVO costs that are currently being incurred and what new costs states may incur during and following CVISN deployment. In every case, Table 6-3 shows the units, scope, or quantities reflected in the cost values.

Costs are expressed as units whenever possible (e.g., annual labor costs per carrier account, or one-time start-up dollars per fixed weigh scale site upgraded with basic electronic screening equipment). In other cases, scenarios are used to provide a sense of the scope of the operation being reported.

Every state entered the CVISN MDI with a different "baseline," which sometimes included certain "CVISN" components (e.g., laptop computers in Connecticut, Advantage I-75 roadside electronic screening systems in Kentucky). Nevertheless, this cost analysis defines "baseline" as CVO processes that are not assisted by CVISN technologies, and then estimates the cost impact of adding CVISN technologies.

## **6.4 SUMMARY OF CVISN DEPLOYMENT AND ANNUAL OPERATING COSTS FOR STATES**

Table 6-3 presents a summary of baseline, one-time deployment, and post-CVISN annual costs. Most of these costs were determined from actual data provided by the states. However, in some cases, certain assumptions were made or models were used to estimate costs that could not be observed. All costs are expressed in U.S. dollars as reported at the time of the CVISN cost analysis (generally incurred by the states between 1995 and 1999). In this chapter, no attempt was made to apply a discount rate (or escalation factor) to convert these general cost values to constant dollars at some fixed time for this analysis.

The table breaks out costs for specific features within each CVO area. The three main operations areas are (1) credentialing, (2) electronic screening, and (3) Safety Information Exchange.

## **Table Presentation Format**

Each row of Table 6-3 represents one CVO function. For electronic screening and SIE, the rows progress downward from a non-CVISN case to cases with increasing CVISN capabilities. For example, the electronic screening costs start with a fixed weigh scale, add a WIM and automatic vehicle identification (AVI) equipment, and then add electronic snapshot capability.

Columns progress left-to-right from baseline costs to deployment costs to operating costs of the new CVISN technology. Where data are available, the columns give cost values for baseline annual capital costs, baseline annual operating costs, one-time start-up (deployment) costs, post-CVISN annual capital costs, and post-CVISN annual operating costs.

These cost values may be expressed per some defined unit (e.g., per carrier account, per credential issued, per officer); per site (e.g., one weigh station); or statewide (e.g., start-up costs for an end-to-end IRP electronic credentialing system). The sources for each set of cost values are also presented in the far right-hand column.

As noted elsewhere, electronic screening and SIE are considered to be CVISN technologies, so the table generally shows no pre-CVISN or baseline costs to report. Thus, most of these rows are shaded in the baseline columns of Table 6-3.

For all values presented in Table 6-3, explanatory discussions follow. These explanations provide detail on the contributing cost elements, their sources and constituents, the factors and calculation methods, and the assumptions used to infer costs where actual data were unavailable. Further cost details are presented in Appendix B.3.

## **How to Use Table 6-3**

As an example, study the first row under credentialing. Baseline annual capital costs could not be determined, so that cell is shaded. Kentucky reported baseline annual operating costs of \$62.54 to administer each of its 4,400 IRP (non-VISTA) carrier accounts. This operating cost included labor costs. To deploy electronic credentialing for IRP credentials, Kentucky invested \$935,906 in one-time start-up costs.

The next column shows an estimate of annual capital costs, determined from Kentucky's start-up cost data. The annual capital cost to the state post-CVISN is estimated to be \$1.48 per carrier account. In the post-CVISN annual operating column is the Kentucky estimate of \$39.54 per account.

If a state has already deployed some CVISN functions, state officials could use the table to illustrate potential costs that may be incurred for the logical next steps in deployment. For example, under Safety Information Exchange, a state could start with stand-alone Aspen systems in roadside laptop computers (the second row in this section) and advance downward through the table to see estimates for upgrading to wireless modem and SAFER mailbox capability, or full CVIEW capability at the roadside. (A stand-alone Aspen system assumes that data are downloaded periodically via disk or hard-wire connection.)

## **Expanded Cost Scenarios**

Many of the values in Table 6-3 are presented as unit costs. To help state officials, in Section 6.6 these units are extrapolated to provide estimated statewide costs.

**Table 6-3. Summary of Commercial Vehicle Operations Costs (\$) to State Agencies for Baseline (without CVISN Technologies), CVISN Deployment, and Post-CVISN Stages**

Commercial Vehicle Operations Area - Operating Features	Baseline		CVISN Deployment (Nonrecurring, One-Time Start-Up) Costs	Post-CVISN Recurring (assuming 100% deployment)		Data Sources (States)
	Annual Capital Costs	Annual Operating Costs <sup>a</sup>		Annual Capital Costs	Annual Operating Costs <sup>a</sup>	
<b>Credentialing (Administrative Processes)</b>						
- End-to-end IRP (4,400 carrier accounts)	<i>Note b</i>	62.54 per account	935,906 statewide	1.48 per account	39.54 per account	KY
- IRP with VISTA (6,500 carrier accounts)		138.20 per account	464,802 statewide	2.03 per account	91.95 per account	MD
- End-to-end IFTA (4,750 carrier accounts)		166.11 per account	63,596 statewide	0.14 per account	100.00 per account (assumed) <sup>c</sup>	KY, MD
- IRP clearinghouse	<i>Note d</i>	79,656 per year statewide	0	0	14,220 per year statewide plus membership fee	Note e
<b>Electronic Screening</b>						
- One static scale at fixed site, plus labor for 3 persons	10,850 per site	128,580 per site	108,500 per site <sup>f</sup>	10,850 per site	128,580 per site	KY, CT
- Basic screening equipment (AVI & WIM, 1 site)	<i>Note g</i>		150,000 per site	15,000 per site	6,500 per site (excluding labor)	KY
- Site upgrade to elec. snapshot capability; equipment & training for 3 persons			372,252 per site	14,300 per site	42,416 per site (excluding labor)	KY
- Mobile unit (1 unit & 2 persons)			405,000 per unit	40,500 per unit	97,500 per unit	VA
<b>Safety Information Exchange</b>						
- Enforcement officer and vehicle (1 unit)	10,325 per unit	45,320 per unit	33,250 per unit <sup>f</sup>	10,325 per unit	45,320 per unit	KY, CT
- Upgrade to Aspen capability (statewide); equipment and training (1 unit)	<i>Note g</i>		31,000 per state 4,822 per unit	2,200 per state 810 per unit	6,000 per state 74 per unit (excluding labor)	CT
- Wireless and SAFER mailbox (1 unit)			1,000 per unit	100 per unit	469 per unit (excluding labor)	CT
- CVIEW or equivalent (statewide)			325,000 per state	0	80,000 per state (assumed) <sup>h</sup>	KY

(See explanatory notes on pages 6-12 to 6-14, and 6-16, and in Section 6.5.)

**Notes to Table 6-3**

N/A = Data not available.

- a. All operating costs are assumed to include annual operating, maintenance, and communication costs, plus labor costs, unless otherwise indicated.
- b. Start-up and annual capital costs pre-CVISN were considered sunk costs for credentialing facilities and systems already in place and were not reported by the states.
- c. Detailed information on the changes in operating costs per carrier account for IFTA credentials administration post-CVISN was not available. An estimate was made based on the changes expected in processing IRP credentials.
- d. Participation in the IRP Clearinghouse does not involve any substantial capital costs for the states. The Clearinghouse charges an annual membership fee, which varies based on the number of credentialed vehicles operating in a participating state.
- e. Arizona, Arkansas, California, Kansas, Kentucky, Maryland, and Virginia.
- f. These costs (electronic screening and SIE start-up costs for pre-CVISN equipment) are presented for information only, to put CVISN additions in a more complete cost context. The values of \$108,500 and \$33,250 are not CVISN deployment costs, but are actually considered “sunk costs” to the state, and are not being used in any of the subsequent cost analysis.
- g. CVISN roadside operations (i.e., electronic screening and Safety Information Exchange) are assumed not to have existed pre-CVISN. The baseline costs presented in these rows are for non-CVISN equipment and operations, which are presumed to continue in operation following CVISN deployment. These costs are presented to provide a fuller context for the incremental costs of CVISN deployment and operations that are likely to be incurred.
- h. Detailed information on the operating costs per state for the CVIEW system post-CVISN was not available. An estimate was made based on the assumed cost for two central office staff (such as systems analysts or database managers) dedicated to maintaining and managing a statewide CVIEW system.

## **6.5 COST DETAILS**

### **Credentialing (Administrative Processes) Costs**

For all credentialing functions, CVISN technologies are intended to enable states and motor carriers to move away from paper-based systems and toward computer-based systems to streamline credentials administration. For example, motor carriers may be able to use modems and dedicated software or internet browsers to apply for, pay for, and receive credentials without mailing a paper application or traveling to a state credentialing office. As noted below, states anticipate continuing to mail permanent credentials to the carriers for the foreseeable future, even after CVISN deployment.

As indicated in Table 6-3, several states provided credentialing cost data. However, the credentialing section is based primarily on data obtained from Kentucky because that was the state that offered the most comprehensive cost data on pre- and post-CVISN systems deployment. The cost and time savings data in this analysis thus tend to reflect the particular features of the Kentucky credentialing systems.

This analysis concentrates on IRP and IFTA credentials. Data on costs for processing other kinds of credentials (e.g., oversize, overweight, or weight-distance permits) were not readily available. At the time of data collection, CVISN systems had not been deployed for these “other credentials”. State officials may be able to infer CVISN cost impacts based on the similarities and differences between the processes for administering these other credentials and IRP or IFTA credentials.

#### **End-to-End IRP (Non-Vista) (4,400 Carrier Accounts)**

The costs of this operation area are defined as those the state pays for administering, processing, and issuing motor carrier credentials within the International Registration Plan (IRP). The IRP agreement between jurisdictions in the U.S. and Canada allows commercial vehicles to register in a single home jurisdiction, travel in and through all IRP jurisdictions without additional accreditation, and pay apportioned fees based on the proportion of mileage traveled in each jurisdiction.

While the general steps involved in IRP credentialing are fairly uniform across states, some requirements may be state-specific. In addition, the planned CVISN systems were not fully deployed at the time of evaluation, and only a handful of the carriers were participating in pilot testing of the electronic credentialing systems. Therefore, the observed changes are based on partial deployment and represent short-term effects of CVISN systems.

IRP credentialing costs presented in this chapter do not include revenues collected by the states through license or tax fees paid by the motor carriers. Kentucky has its own in-house credentialing system, as opposed to other states (e.g., Maryland) that engage the services of a third-party provider to support the credentials administration function. The designation “non-VISTA” or “VISTA” indicates whether the state uses the third-party Vehicle Information System for Tax Apportionment (VISTA) for its credentialing activities.

*Baseline Costs.* Prior to CVISN deployment, Kentucky spent about \$62.54 per account on average in annual operating funds for processing and issuing IRP credentials. Kentucky has about 4,400 IRP carrier accounts, and administers new, supplemental, and renewal applications. The \$62.54 amount includes costs for three basic elements: labor costs (including salary and fringe benefits), mailing or communication costs, and operations and maintenance (O&M) costs. Labor is the main cost element in processing credentials, representing approximately 70 percent of the total baseline operating costs.

*CVISN Deployment Costs.* One-time start-up costs to implement CVISN technology for IRP electronic credentialing were reported by Kentucky only. Start-up costs required to implement a computer-to-computer (PC-based CAT) IRP credentialing system similar to Kentucky's system would be around \$936,000. Start-up costs include equipment purchases and software development, in-house and contracted labor for software development and legacy (existing computer) system modifications, training for staff and state-sponsored training for motor carriers, and showcases to publicize the electronic credentialing program. The cost also includes administrative support and management costs as well as outreach program costs. The cost does not include new construction or communication infrastructure or the labor cost of new staff hired specifically to operate the new systems.

Software development, legacy system modification, and start-up labor were the major cost elements, accounting for nearly 90 percent of the total start-up costs. Software development was the major driver of electronic credentialing deployment costs, representing about 46 percent of the total start-up cost. Modifying the legacy system cost a significant amount, representing about 25 percent of the total start-up cost. Equipment (hardware) costs were relatively minimal compared to other cost components. Training costs for state agency staff to use the new systems were negligible.

Even though the widespread adoption of electronic credentialing by motor carriers will take time, the start-up costs incurred by Kentucky are expected to be capable of covering 100 percent of that state's credentialing activity.

*Post-CVISN Costs.* Based on the equipment required to deploy CVISN for IRP electronic credentialing (i.e., one server at \$65,000) and its estimated service life (10 years), the post-CVISN annual capital cost per carrier account was estimated to be \$1.48.

Regarding post-CVISN annual operating costs, the more credentials a state administers using CVISN technologies, the more it saves. The post-CVISN credentialing values shown in Table 6-3 presume full deployment and full motor carrier adoption of CVISN systems. The savings in annual operating cost is mostly attributable to lower labor costs.

A state such as Kentucky deploying a PC-to-PC electronic credentialing system and processing only 10 percent of its IRP credentials with that system (while continuing to process 90 percent of its credentials using baseline methods) would incur only slightly less than the baseline costs per carrier account statewide, when the post-CVISN annual capital costs are considered. If we assume a straight-line relationship between carrier participation and cost savings, then the same state processing all IRP credentials electronically (as shown in Table 6-3) would find its average annual operating cost to be about \$39 per carrier account. This represents

approximately \$20 in cost savings per carrier account compared to the baseline annual operating cost of \$62.54.

To calculate the post-CVISN operating costs, annual labor costs were separated from O&M, communication, and database backup costs. Looking only at labor costs, the total baseline labor cost to the state per credential processed was determined. Then, the relative costs to the state for processing new/supplemental and renewal applications were determined, taking into account (a) the different numbers of each type of credential processed per year in the state and (b) the fact that each new application generally takes several more minutes to process than each renewal application.

The baseline labor cost per credential processed was then adjusted to derive post-CVISN labor costs. With CVISN in place, discrete steps in credentials administration, such as processing applications, generating invoices, and issuing temporary credentials, are expected to take less time compared to the paper-based system. This is expected to free state staff for other assignments. Table 6-4 shows the time-weight factors and the expected time and cost savings. In the time-weight factor column, each step in the process was assigned a weight value (between 1 and 5) to represent the relative amount of time that step customarily requires. These weighting factors were then combined with the estimated time savings from CVISN deployment and used to reduce the labor cost accordingly.

For example, the step “Process the application” was given a weight factor of 5, meaning that it takes relatively more time than the other steps. This step was estimated to take 75 percent less time post-CVISN. By contrast, issuing permanent credentials was given a weight factor of 1, meaning it takes relatively less time, but this step was estimated to see no reduction in time post-CVISN. The weight factors were combined with the estimated reductions, and these were then used in conjunction with the baseline labor costs to derive a post-CVISN labor cost per carrier account.

Table 6-4 shows one example of part of the post-CVISN labor cost adjustment. The baseline labor portion of the total cost to the state is \$35.49 per carrier account. After CVISN electronic credentialing is put in place, the labor cost for new and supplemental IRP (non-VISTA) credentials is expected to change to \$16.28 per carrier account. Similar calculations were used to derive the post-CVISN labor costs for renewal IRP applications in Kentucky and for both new and renewal IRP credentials in Maryland, a VISTA state.

**Table 6-4. Example IRP (Non-VISTA) Labor Adjustment, New and Supplemental, Per Credential Application Processed in Kentucky**

Baseline Labor, \$	Labor (\$ ) 12	Process Step	Time-Weight Factor	\$/Step Baseline	Post-Time ) Pre-Time	\$/Step (Post-CVISN)
35.49	2.96	Process Application	5	14.80	0.25	3.70
		Generate Invoice	1	2.96	0.25	0.74
		Receive Payment	3	8.88	1	8.88
		Issue Temp Credential	2	5.92	0	0.00
		Issue Perm Credential	1	2.96	1	2.96
		<b>TOTAL</b>	<b>12</b>			<b>16.28</b>

For comparison with baseline values per carrier account, the post-CVISN labor costs per credential application processed were converted to a statewide per-account basis as follows: the post-CVISN labor costs for new and supplemental credentials were multiplied by the numbers of each type of credential processed, and then the resulting totals were combined to give a statewide total post-CVISN annual labor cost. This post-CVISN total labor cost was divided by the number of carrier accounts in the state, and then added to the known per-account O&M, communication, and database costs to yield the post-CVISN annual operating cost of \$39.54 shown in Table 6-3.

This analysis assumed that post-CVISN mailing/communications and operations and maintenance (O&M) costs (exclusive of labor) for electronic credentialing would remain the same. This is because the states expect to continue to mail permanent credentials to the carriers for the foreseeable future, even after CVISN deployment. Thus, communication/ mailing and O&M costs should remain the same. Labor costs, however, dropped, based on an informed estimate of the amount of time state employees would save when processing credential applications electronically.

In addition to the communication and O&M cost elements, which were assumed to remain the same after CVISN deployment, Kentucky also reported a new annual expense of \$10,000 for database backup. This was classified as a post-CVISN annual operating cost element and is included in the total of \$39.54 per account.

**IRP with VISTA or Other Provider (6,500 Carrier Accounts)**

Pre- and Post-CVISN costs for IRP credential processing in states using a third-party service provider were based on costs reported by Maryland. VISTA, offered by Lockheed Martin, is the third-party system being used for electronic credentials administration in Maryland and other states. Maryland is also starting to use a PC-PC electronic credentialing system.

*Baseline Costs.* Baseline annual operating costs per motor carrier account in Maryland were reported to be \$138.20. These costs included elements similar to those reported in Kentucky for non-VISTA IRP credentialing.

*CVISN Deployment Costs.* One-time start-up costs for IRP (VISTA) deployment in Maryland were provided for the period 1996 through 1999, and amounted to \$464,802. Of these costs, in-house development labor amounted to more than 30 percent, while equipment purchases amounted to just under 30 percent. Administrative costs and contract costs were the other major start-up cost elements. As noted earlier, Maryland's IRP credentialing system was not completely deployed and functional at the time these costs were reported. Also, software development costs were lower than those reported for Kentucky's IRP deployment, for reasons that are unknown.

*Post-CVISN Costs.* Post-CVISN annual capital costs were estimated based on the equipment portion of the start-up costs (unspecified equipment costing \$131,626) and its estimated service life (10 years). This annual capital cost of \$13,163 was apportioned across 6,500 carrier accounts, resulting in a post-CVISN per-account annual capital cost of \$2.03.

Labor cost analysis methods for the Maryland IRP VISTA case were similar to those used for Kentucky, but allowed for the slight difference in effort between the VISTA and non-VISTA credential processes. The cost of processing each IRP carrier account in Maryland is expected to drop to \$133.59 when 10 percent of carrier accounts are processed electronically. When all carrier accounts are processed electronically, the cost per carrier account would be about \$91.95, representing approximately \$46 in cost savings per carrier account, compared to the baseline annual operating cost of \$138.20.

#### **End-to-End IFTA (4,750 Carrier Accounts)**

The costs for this operation area are those the state pays for administering, processing, and issuing motor carrier credentials within the International Fuel Tax Agreement (IFTA). In IFTA, states and other taxing authorities collaborate to simplify the collection and distribution of CVO-related tax revenues. No firm post-CVISN labor or operating costs were available, but the effect of CVISN technologies in saving money for the state for IFTA credentialing is expected to be similar to the effect on IRP credentials administration costs.

Costs for IFTA credential processing were taken from the average of costs reported from Kentucky and Maryland.

*Baseline Costs.* The baseline average annual operating cost to these states per carrier account was \$166.11. These costs included elements similar to those reported in the IRP credentialing cases.

*CVISN Deployment Costs.* One-time start-up costs for IFTA electronic credentialing were averaged across the values reported by Kentucky (\$98,650) and Maryland (\$28,541), resulting in an average cost of \$63,596. These capital costs for IFTA electronic credentialing assume that a state already has a CVISN credentialing system in place for IRP credentials. Kentucky, for example, uses elements of its IRP processing system (already in place) for IFTA processing. Software development was the major start-up cost element in Kentucky (81 percent), while equipment and in-house labor were major elements in Maryland (96 percent).

*Post-CVISN Costs.* Kentucky did not report any start-up hardware or equipment costs for developing the IFTA system. Maryland reported approximately \$15,000 in start-up equipment costs. When averaged, the annual capital cost for IFTA credentials post-CVISN was \$0.14 per carrier account.

Because no post-CVISN labor hour or cost information was available for IFTA credentials processing, post-CVISN annual operating costs of \$100 per carrier account were assumed for IFTA credentials. This represents a decrease of about \$66 compared to the reported baseline cost of \$166.11 per carrier account, and is in line with the declines in per account costs seen in the IRP credentialing cases.

### **IRP Clearinghouse**

The IRP Clearinghouse provides a mechanism within the IRP for tabulating the net amounts due to or owed by a jurisdiction to all other participating jurisdictions. This Clearinghouse transfers these funds electronically. Costs for the IRP Clearinghouse are based on results from a separate investigation within the CVISN MDI evaluation project (Springer 1999). The results are expressed as an average per state per year to operate the entire IRP credentialing program, before and after joining the clearinghouse. In all, 22 jurisdictions were participating in the IRP Clearinghouse as of early 2001 (AAMVA). The study averaged data collected from seven states: Arizona, Arkansas, California, Kansas, Kentucky, Maryland, and Virginia.

Baseline costs represent the cost of monthly activities, such as distributing registration funds to other jurisdictions and collecting funds from other jurisdictions before joining the Clearinghouse. After joining the IRP Clearinghouse, the between-state transactions are centralized, reducing or eliminating many monthly costs.

According to the American Association of Motor Vehicle Administrators (Arlington, Virginia), states participating in the IRP Clearinghouse pay an annual fee to participate, based on the number of commercial power units in the state. States with fewer than 1,000 power units pay the minimum fee of \$1,000 annually, while states with more than 100,000 power units pay a maximum fee of \$20,000. The fee scale is graduated.

### **Electronic Screening Costs**

#### **Static Scale and Supporting Staff (One Site; Three Full-Time Staff Members)**

A fixed weigh station is defined in this analysis as a facility housing one static scale and staffed by three full-time state enforcement staff. The purpose of most weigh stations is to weigh commercial vehicles away from the mainline of traffic; to help ensure that commercial vehicles are in compliance with the relevant size, weight, and credentialing regulations; and to inspect and remove unsafe or otherwise out-of-compliance vehicles and drivers from the traffic stream.

*Baseline Costs.* Baseline annual capital costs for one fixed-site weigh station, understood to consist of a single static scale, were determined to be \$10,850, based on average purchase costs for such scales reported by Kentucky and Connecticut. The fixed weigh station was assumed to have a service life of 10 years.

Baseline annual labor costs for each full-time roadside enforcement staff member (\$41,000) were determined by averaging reported labor costs (including fringe benefits) across two states (Kentucky and Connecticut). The costs are assumed to apply to staff performing both roadside functions associated with CVISN, electronic screening and Safety Information Exchange. For example, the Connecticut Department of Motor Vehicles (DMV) and Department of Public Safety (DPS) staff work at fixed scale sites and also participate in mobile team operations.

Assuming three full-time equivalent (FTE) staff at the average labor rates and adding the annual operating costs reported by Kentucky for one baseline or pre-CVISN fixed weigh station (\$5,580), the total annual baseline operating costs were assumed to be \$128,580.

*Deployment Costs.* One-time start-up costs for purchasing one static scale (considered to be a baseline or pre-CVISN facility for this analysis) were estimated to be \$108,500, an average of the purchase costs for this equipment reported by Kentucky and Connecticut. This value does not include the cost of real estate, permanent structures, or site improvements beside the scale.

*Post-CVISN Costs.* The operation of static scale sites and staffing levels for commercial vehicle enforcement functions are expected to continue basically unchanged post-CVISN. Thus, their associated costs are expected to remain basically the same during and after CVISN deployment. For these reasons, identical values for annual capital and annual operating costs are presented in the baseline and post-CVISN columns of Table 6-3. As discussed in greater detail in Chapter 8 (Benefit/Cost Analysis), to isolate the costs and benefits of CVISN deployment at the roadside, we assumed that the numbers of trucks inspected or weighed per day would remain constant. CVISN technologies are eventually expected to result in more efficient inspections, meaning that (a) the inspectors' time will be devoted more to higher-risk vehicles and (b) more out-of-service (OOS) orders will be issued per given number of vehicles inspected. This way, the greatest safety benefits can be realized. If a state is able to increase the number of inspections, this will yield additional safety benefits.

#### **Basic Screening Equipment (AVI and WIM; One Site)**

To establish electronic screening, states can install automated vehicle identification (AVI) devices and weigh-in-motion (WIM) scales at some location upstream from a fixed-site weigh station. The AVI and WIM enable enforcement personnel to identify vehicles or carriers at highway or ramp speeds, with the goal being to allow certain approved vehicles to bypass the weigh station, or avoid stopping. Carriers and state officials can thus enhance safety by focusing inspection resources on high-risk carriers and vehicles. WIM capability is not a requirement of CVISN Level 1 deployment.

*Baseline Costs.* This operations area and the other areas under electronic screening are considered to be exclusively post-CVISN functions, so no baseline annual capital or baseline annual operating costs are reported in Table 6-3.

*CVISN Deployment Costs.* One-time start-up costs for equipment to upgrade an existing fixed-site facility for AVI and mainline WIM capability were based on costs from Kentucky,

incurred as part of the Advantage I-75 program that preceded the CVISN MDI. The mainline WIM scale was the major cost (\$125,000) of this upgrade total (\$150,000).

*Post-CVISN Costs.* Annual capital costs were estimated based on the initial capital cost (i.e., one WIM plus AVI readers, electronic signs, and loop detectors at \$150,000) and a service life of 10 years. Annual operating costs (excluding labor) were determined based on a \$6,500 annual maintenance cost per WIM as reported by Kentucky.

**Site Upgrade to Electronic Snapshot Capability; Equipment and Training for Three Persons (One site)**

“Electronic snapshots” are “packets of safety data which can be made available at roadside inspection stations via SAFER and/or CVIEW. Snapshots contain safety information on carriers and vehicles” (ITS/CVO Glossary, 2000). Once a state’s electronic screening system has a method of automatically identifying a vehicle in traffic, the state can then check the vehicle identification with a centralized database of information on carriers and vehicles credentialed to operate in the state. A snapshot report on the vehicle is available at the roadside very quickly. This allows vehicle screening systems or personnel to make weight and inspection decisions and then communicate those decisions to the vehicle operators in real time.

*CVISN Deployment Costs.* Kentucky reported one-time start-up costs of \$372,252 for upgrading one existing (Advantage I-75) site to full CVISN status. Communication equipment and consulting costs amounted to more than 75 percent of Kentucky’s start-up costs. Kentucky’s deployment involved aspects of both electronic screening and Safety Information Exchange, so the separation of cost elements for purposes of this analysis is somewhat artificial, as discussed below. Kentucky purchased roadside operations computers (ROCs) for the fixed-site weigh station and paid for training for staff members. Equipment and training (but not labor) costs for an arbitrary staffing level of three full-time equivalents (FTEs) were chosen for this analysis; other states can scale up or down according to their staffing requirements.

The costs for electronic screening deployment assume that the CVIEW software, which applies to all CVISN roadside operations (electronic screening and Safety Information Exchange), has already been developed. (Costs for the CVIEW software development are presented and discussed separately, under Safety Information Exchange.)

The study further assumes that some of the one-time start-up costs included in this analysis for electronic screening would also be of benefit to a state’s deployment of Safety Information Exchange. For example, consulting costs reported by Kentucky covered software development for both roadside functions and included the costs to establish interfaces with the CVIEW system.

*Post-CVISN Costs.* Annual post-CVISN capital costs of \$14,300 per site for the electronic screening upgrade to snapshot capability were calculated from the costs for hardware or equipment (i.e., communication equipment and personal computers at \$133,000) with expected service lives of 10 and 5 years respectively.

Post-CVISN annual operating costs for electronic screening at one fixed site in Kentucky (excluding labor) were reported to be \$42,416 with hardware/software upgrade costs, database costs, and mainline screening equipment maintenance being the major contributors.

**Mobile Unit (One unit; Two full-time persons)**

Virginia has deployed a CVISN-compatible system for mobile weight enforcement, consisting of an operations van and an electronics trailer. This system, deployed by the state Department of Transportation and known as NOMAD, can be used for weight enforcement and statistical data collection. The NOMAD van includes a WIM sorter system, a roadside operations computer (ROC), static scale interface, and other support equipment normally used in a fixed-site weigh station. The electronics trailer houses a WIM scale, AVI, variable message sign, and telemetry equipment to measure and communicate information about commercial vehicles.

As deployed in Virginia, the system serves as a means for identifying suspect vehicles for further inspection by enforcement units. The NOMAD system requires two full-time employees and can be used at any location. However, Virginia has found that the most productive use of the system is at “pre-engineered” sites where transducers and other infrastructure are already in place and the mobile system can be set up quickly.

The NOMAD system is designed to screen for weight, credentials, and safety, but is currently being used only for weight. Screening for credentials and safety will depend on timely data availability. NOMAD can connect to CVIEW via a telephone line or can access CVIEW data downloaded to the ROC daily.

*CVISN Deployment Costs.* The van described above was purchased for approximately \$70,000; a trailer similar to the one used in Virginia would cost between \$200,000 and \$335,000, depending on equipment and optional features. The cost shown in Table 6-3 assumes the greater figure.

*Post-CVISN Costs.* Post-CVISN annual capital costs were estimated based on the equipment (i.e., computer-equipped support van and electronics trailer) start-up costs. The equipment’s estimated service life is 10 years. The life of 10 years was used for the van, even though it is technically a vehicle, because its reported cost of \$70,000 suggests that the base vehicle portion of the cost may be less significant than the screening and communication equipment it houses.

Although Virginia did not report staffing costs, annual operating costs in this analysis include estimated labor for two full-time roadside employees. Virginia did report actual O&M costs for consumables such as piezo cables and portable temporary inductive loops, which are included in post-CVISN annual operating costs.

**Safety Information Exchange Costs**

Safety Information Exchange (SIE) is the electronic exchange of safety data and supporting credential information regarding carriers, vehicles, and drivers involved in CVO. The

exchange of such information would ideally enable roadside decisions to be supported by historical safety performance information available to enforcement personnel in real time.

#### **Enforcement Officer and Vehicle (One Unit)**

Because SIE tends to rely on officers working from vehicles rather than at fixed-site weigh stations, baseline costs for this functional area are defined as one roadside enforcement officer and one conventional patrol vehicle equipped with a portable weigh scale. The baseline case does not include any computer equipment.

*Baseline Costs.* Table 6-3 shows the annual capital costs (\$10,325) and annual operating costs (\$45,320) for one enforcement officer and his/her vehicle, including a portable scale, but excluding accessories added to the vehicle as part of CVISN deployment. The annual operating cost includes labor. Annual capital costs were estimated based on the purchase price of the capital equipment (i.e., one car and one portable scale) and on a service life of 3 and 10 years, respectively.

The total annual operating costs were determined by averaging the annual labor costs (including salary and fringe benefits) for roadside officers as reported by Kentucky and Connecticut, then adding the maintenance cost for one vehicle as reported by Connecticut. The same labor cost values were used in calculating operating costs for the roadside electronic screening functions.

*Deployment Costs.* A typical vehicle plus portable scale were assumed to cost \$33,250 (not including a computer).

*Post-CVISN Costs.* The operation of one enforcement vehicle/portable scale unit and the cost to support one officer for commercial vehicle enforcement functions are expected to continue basically unchanged post-CVISN. For these reasons, identical values for annual capital and annual operating costs are presented in the baseline and post-CVISN columns of Table 6-3. As noted above in the discussion of post-CVISN costs for electronic screening, the number of trucks inspected would remain constant following CVISN deployment. Inspection efficiency should increase as resources are focused on higher-risk carriers, vehicles, and drivers.

#### **Upgrade to Aspen Capability (Statewide); Equipment and Training (One Person)**

Aspen is a pen-based roadside inspection system that allows commercial vehicle inspection data to be electronically transferred periodically between the roadside and SafetyNet, using hard-wire connections or exchange of physical computer storage media between computers. These transfers take place via either Avalanche or the CVIEW/SAFER Data Mailbox System. A related system, the Inspection Selection System (ISS), is used to aid inspectors in deciding how to inspect a vehicle that has been stopped. It is envisioned that eventually ISS will be used to help inspectors make inspect/bypass decisions in real time at the roadside. The costs for this upgrade are based on statewide and unit cost information from Connecticut.

*Baseline Costs.* This operation area and the other areas under Safety Information Exchange are considered to be exclusively post-CVISN functions, so no baseline annual capital or baseline annual operating costs are reported in Table 6-3.

*CVISN Deployment Costs.* This analysis assumes that equipment for one roadside staff member is to be upgraded to Aspen capability, with appropriate training for the officer. Costs are for a state to upgrade the officer's equipment with a stand-alone laptop computer and a printer, plus Aspen/ISS. Costs also include one-time costs for training the staff member.

Connecticut reported \$31,000 in statewide start-up costs for the central system to support this upgrade. A one-time per-person cost of \$4,822 for upgrading the personal equipment and training of one staff member was determined by dividing Connecticut's total personal equipment/training costs by 63 (i.e., the number of laptop PCs and mobile printers purchased for roadside use statewide, consisting of 48 sets for DMV staff and 15 sets for State Police staff). A "stand-alone computer" indicates that data are transferred to and from the laptop and a central station computer or database via hard wire connection (e.g., computer port or modem) or via a periodic download (refresh) from a compact disk or other physically connected storage medium. Wireless telecommunication costs are presented below and discussed separately.

*Post-CVISN Costs.* Annual capital costs for the statewide and single-officer upgrade to Aspen (\$2,200 per state, and \$810 per unit) were calculated based on the reported purchase costs of equipment and their expected service life.

Annual operating costs for CVISN systems were reported by Connecticut to include statewide server maintenance costs of \$6,000, plus a cost of \$74 for version control or upgrading each of the laptop computers. These costs exclude roadside labor costs.

#### **Wireless and SAFER Mailbox (One Unit)**

This upgrade is assumed to include wireless telecommunication equipment, plus full SAFER Data Mailbox capabilities. The upgrade permits a roadside officer in a vehicle to use a laptop computer to send and receive inspection reports and other carrier information from a roadside location. SAFER (Safety and Fitness Electronic Record) is an on-line nationwide data network that, when fully deployed, is intended to return a standard carrier safety fitness record to the requestor in a few seconds.

*CVISN Deployment Costs.* Each cellular digital packet data (CDPD) wireless modem purchased by Connecticut cost \$1,000.

*Post-CVISN Costs.* The annual capital cost for each modem (with an expected life of 10 years) was calculated to be \$100. Connecticut reported post-CVISN annual operating costs for wireless capability (excluding labor) of \$469 per modem. This cost was based on a monthly communication cost of \$39.05 per CDPD unit.

Kentucky anticipated incurring \$50,000 in consultant costs for upgrading to wireless technology. Because the cost had not yet been incurred, it was not included in this analysis. Connecticut reported no comparable consultant expenses.

### **CVIEW or Equivalent (Statewide)**

CVIEW (Commercial Vehicle Information Exchange Window) is a state-based software system that provides carrier, vehicle, and driver safety and credential information to fixed and mobile roadside inspection stations. The CVIEW system functions as an interface or software umbrella through which users can readily gain access to a variety of data sources.

The CVIEW upgrade is understood to encompass general roadside functions common to electronic screening and Safety Information Exchange. The system provides enforcement officers at the roadside with integrated safety and credentials data. Cost for developing electronic screening and SIE applications for CVIEW are expected to complement each other. Because CVIEW is technically more closely allied with SIE than with electronic screening, statewide CVIEW start-up costs are presented in the SIE portion of Table 6-3.

*CVISN Deployment Costs.* Kentucky reported development costs of \$325,000 for statewide development of a CVIEW capability. These start-up (deployment) costs for CVIEW should permit the CVIEW software, once developed, to be installed at multiple sites across a state.

*Post-CVISN Costs.* No annual capital costs were reported for CVIEW, presumably because the system is not heavily dependent on new capital hardware or equipment. States can use CVIEW on existing computer platforms. Annual post-CVISN operating costs for CVIEW were estimated at \$80,000, to consist of costs for two full-time staff members to maintain, troubleshoot, and consult on software development throughout the system's life.

## **6.6 PROJECTED COSTS AND COST SAVINGS UNDER VARIOUS DEPLOYMENT SCENARIOS**

The total costs of deploying CVISN and maintaining CVISN-enhanced credentialing and roadside CVO operations, as well as the potential cost savings from electronic credentialing, can be estimated for one hypothetical state using the unit costs in Table 6-3. This process is illustrated below using scenarios derived from the operating parameters reported by the states participating in the CVISN cost analysis.

### **Credentialing**

Costs for credentialing were extended from a per-carrier-account basis to a statewide annual cost basis, making assumptions about stages of CVISN deployment and the level of participation in electronic credentialing by motor carriers.

### **End-to-End IRP (non-VISTA)**

Based on the data shown in Table 6-3, a non-VISTA state having 4,400 IRP carrier accounts would incur \$275,176 per year in operating costs before CVISN deployment of electronic credentialing (\$62.54 per account H4,400 accounts). Such a state might make a one-time investment of \$935,906 to deploy a statewide CVISN system for electronic credentialing. Following CVISN deployment, depending on the level of adoption by motor carriers, the state should expect to incur lower per-account costs.

Table 6-5 shows that total annual costs to the state are expected to increase slightly at 10 percent CVISN adoption, because the additional annual capital expense (\$1.48 per account) is not offset by sufficient labor savings when only 10 percent of credentials are processed electronically. But at 100 percent CVISN adoption, total annual costs should decline sufficiently to provide states with a cost savings of nearly \$95,000 per year.

This level of savings was determined by taking the difference between pre-CVISN operating costs (\$62.54 per account) and the post-CVISN annual costs (\$1.48 + \$39.54 per account); then multiplying by the number of IRP accounts (4,400) and the percent deployment (percent of accounts processed electronically). For example, the annual savings at 100 percent deployment would be  $(\$62.54 - \$41.02) * 4,400 * 100\% = \$94,688$ .

**Table 6-5. Total Annual Costs to State at Various Post-CVISN Adoption Levels (IRP, non-VISTA)**

CVISN Deployment (%)	Statewide Annual Cost, \$	Statewide Annual Savings (Cost) versus Baseline, \$
0 (Baseline)	275,176	0
10	280,544	(5,368)
50	236,104	39,072
100	180,488	94,688

If a state incurred CVISN deployment costs similar to Kentucky’s for electronic administration of its IRP credentials (\$935,906), and similar annual operating cost savings, and if 100 percent of its motor carriers quickly adopted the system, allowing the state to realize the full labor cost savings, then such a state might recover its start-up costs in approximately 10 years.

**End-to-End IRP (VISTA)**

A VISTA state having 6,500 IRP carrier accounts would incur \$898,300 in annual operating costs before CVISN deployment (per-account cost of \$138.20). One-time start-up costs would be \$464,802. Following CVISN deployment, the state would incur new annual capital costs of \$2.03 per account, but lower annual operating costs. The total annual cost savings to the state would range from about \$16,000 per year at 10 percent CVISN deployment to more than \$280,000 per year at 100 percent CVISN deployment. If 100 percent of motor carriers adopted CVISN, then the state could recover its start-up costs for electronic IRP credentialing within 2 years. Table 6-6 shows the projected annual costs at various levels of CVISN adoption for IRP (VISTA) credentialing.

**Table 6-6. Total Annual Costs to States at Various Post-CVISN Adoption Levels (IRP, VISTA)**

CVISN Deployment, %	Statewide Annual Cost, \$	Statewide Annual Savings versus Baseline, \$
0 (Baseline)	898,300	0
10	881,530	16,770
50	761,280	137,020
100	610,870	287,430

**End-to-End IFTA**

A state processing credentials from 4,750 in-state IFTA carrier accounts would incur \$789,023 in pre-CVISN annual operating costs (\$166.11 per account). The same state would spend \$63,596 in start-up costs to establish electronic credentialing for IFTA. Based on data from Kentucky and Maryland, the post-CVISN annual capital costs per account would be only \$0.14. Based on the assumed similarity of IRP and IFTA processing labor changes that will be brought about by CVISN deployment, the study assumes that post-CVISN annual operating costs per account will fall to \$100 at 100 percent deployment.

Using these assumptions, the state would incur \$475,665 in total annual IFTA credentialing costs post-CVISN, a savings of more than \$300,000 per year in total annual costs, once 100 percent of motor carriers had adopted CVISN credentialing. Assuming that an IRP electronic credentialing system is already in place to support the IFTA processing capability, such a state would recoup its one-time start-up costs to deploy the IFTA function of CVISN in less than 3 months.

**Electronic Screening**

The cost values for electronic screening operations pre- and post-CVISN were presented on a per site basis in Table 6-3. Staffing level per site and annual capital cost for one static scale were assumed to remain the same from the baseline to the post-CVISN deployment phase. The projected costs below assume that a state might want to deploy CVISN electronic screening capabilities at four additional weigh station sites, for a total of five sites.

**Expanded CVISN Deployment (Start-Up) Costs**

A state with more than one conventional static weigh scale station might be interested in upgrading several of its stations to CVISN electronic screening capabilities (i.e., AVI, WIM, plus snapshot capability). Some of the one-time deployment costs are for software development; so such costs might not be incurred again as the program is expanded to additional stations. Table 6-7 shows details of the total start-up cost for electronic screening at the first site and at each additional site.

**Table 6-7. Elements of Total Deployment Costs for Electronic Screening**

Cost Element	Cost (\$) for the First Site	Cost (\$) for Each Additional Site
AVI Reader	15,000	15,000
Scale, WIM, Mainline	125,000	125,000
Electronic Signs/Loop Detectors	10,000	10,000
Administrative/other	27,000	
Communication equipment	123,000	123,000
Consultant (software development)	166,712	
Interfaces	25,000	
Personal Computer (3 desktop)	10,000	10,000
Retrofit fixed weigh scale	20,000	20,000
Training, PC (3 persons)	240	240
Training, Info Technology (3 persons)	300	300
<b>TOTAL</b>	<b>522,252</b>	<b>303,540</b>

If a state wanted to convert five existing weigh stations to electronic screening capability, the cost would total \$1.7 million (approximately \$500,000 for first station + \$1,200,000 for four additional stations).

**Expanded Post-CVISN Annual Costs**

If a state wanted to deploy a CVISN electronic screening capability at an additional weigh scale station, it would presumably need to incur the baseline annual capital and annual operating costs shown in Table 6-3, i.e., \$10,850 per site in annual capital and \$128,580 per site in annual operating costs (including labor for three roadside staff members). In addition, the state would incur \$29,300 in post-CVISN annual capital costs and \$48,916 in post-CVISN annual operating costs (resulting in a total annual cost of \$78,216) for AVI, WIM, and electronic snapshot capability at each site.

Table 6-8 shows the effect of a five-site expansion of CVISN electronic screening capability, in the context of the existing annual capital, labor, and operating costs of those five sites. This table shows that the state would already be incurring nearly \$700,000 in annual capital and annual operating costs (including labor) for the five sites, and that the CVISN upgrades included in Table 6-3, i.e., AVI, WIM, and electronic snapshot capability, would result in an additional \$391,080 in annual costs to the state. Again, this assumes that the three FTE staff members per weigh station will be able to use the CVISN technology without additional labor being required.

**Table 6-8. Cost-CVISN Annual Costs for Five Electronic Screening Sites**

Cost Element	Expanded Cost, \$
Static Scale & 15 FTEs (3/site)	697,150
CVISN Upgrades (AVI, WIM, snapshot)	391,080
<b>Total for Five Sites</b>	<b>1,088,230</b>

**Safety Information Exchange**

Deployment of Safety Information Exchange is based on the number of enforcement “units” used by the state. An enforcement unit consists of an officer or inspector and a vehicle. Statewide costs include costs for software and other central infrastructure elements to support a set of enforcement officers operating in the field. To operate SIE technology using land-line communication technology for the Aspen system, these start-up costs are \$31,000 statewide, plus \$4,822 per unit. Wireless communication capabilities cost \$1,000 per unit and CVIEW capabilities cost \$325,000 for the entire state.

Table 6-9 shows that for a state with 50 inspectors, the one-time start-up (deployment) cost for SIE, including upgrade to Aspen capability, wireless communication, and CVIEW, would be nearly \$650,000. Table 6-9 assumes that the state does the following:

- Upgrades its statewide system to Aspen capability
- Equips its 50 officers with laptop computers, wireless modems, and mobile printers
- Trains those same 50 officers
- Develops a state-specific version of the CVIEW software to support all roadside operations.

**Table 6-9. SIE Start-Up Costs (Extended to 50 Units)**

Cost Element	Cost per Unit, \$	Number of Units	Extended Cost, \$
Start-Up Cost (Aspen), Statewide	31,000	1	31,000
Start-Up Cost (Aspen), per unit	4,822	50	241,100
Start-Up Cost (wireless), per unit	1,000	50	50,000
Start-Up Cost (CVIEW), Statewide	325,000	1	325,000
<b>TOTAL</b>			<b>647,100</b>

Table 6-10 shows that, once CVISN is deployed, the state could expect to incur \$160,850 in combined annual capital and annual operating costs, excluding roadside labor.

**Table 6-10. SIE Total Annual Costs for Upgrade to Aspen & CVIEW (Extended to 50 Units)**

Cost Element	Annual Cost, \$	Number of Units	Extended Annual Cost, \$
Annual Capital (Aspen), Statewide	2,200	1	2,200
Annual Capital, per Unit	810 + 100	50	45,500
Annual Operating (Aspen), Statewide	6,000	1	6,000
Annual Operating, per Unit	74 + 469	50	27,150
Annual Operating (CVIEW), Statewide	80,000	1	80,000
<b>TOTAL</b>			<b>160,850</b>

Table 6-11 illustrates how the one-time start-up cost and the annual operating costs for moving to CVISN technology, including Aspen, wireless communication, and CVIEW compare to the baseline costs to operate 50 enforcement officers (with vehicles) in roadside inspection service

**Table 6-11. SIE Deployment Statewide, Plus 50 Enforcement Officers**

Cost Element	Cost, \$	% of Baseline Annual Operating Costs
Total Annual Cost, Baseline	2,782,250/yr	100%
Start-Up Cost for Aspen, wireless, and CVIEW	647,100 one time	23%
Total Post-CVISN Annual	160,850/yr	5.8%

**Cost Projections to Other Scenarios**

The above analysis was presented to illustrate how the unit costs, which were derived from actual costs in selected states, might be applied to calculate start-up and annual costs in states with different operating parameters (numbers of credentialing accounts, weigh stations, and enforcement units). However, at the time this study was concluded, only a few states had experience at deploying these systems. Therefore, it was not possible to determine how these cost elements and the associated cost values might vary from state to state. CVISN involves the integration of existing (i.e., legacy) software systems, which might not look the same in different states. As additional states gain experience at deploying and operating these systems, new cost data will become available for this type of sensitivity analysis. In the meantime, states attempting to use these data to project future costs and cost savings should consider the degree to which their legacy systems and operating procedures are comparable to those of the states participating in this study.

## **6.7 CVISN COSTS TO MOTOR CARRIERS**

Three motor carriers participating in the CVISN deployment for electronic credentialing were interviewed as part of the cost analysis data collection effort. Two carriers participating in the Kentucky deployment and one carrier in the Maryland deployment were interviewed. The interview objectives included

- Gathering information on the costs incurred by the motor carrier industry in obtaining IRP credentials before and after CVISN systems deployment
- Understanding the impact of CVISN systems on the efficiency and productivity of motor carrier operations.

The carriers were also asked to identify significant changes or benefits resulting from deploying CVISN systems. Table 6-12 summarizes the characteristics of the three carriers interviewed and the expected savings to be realized from CVISN deployment.

Data concerning motor carrier cost to deploy electronic credentialing systems include:

- Start-up costs for motor carriers for either the PC-based or web-based CAT option are minimal because the only equipment required is a computer with the necessary communication peripherals. As part of the pilot testing, the CAT software was provided by the states at no cost to the motor carriers. The amount of training required to use the CAT software is considered minimal for computer-literate motor carrier staff.
- Labor and other costs associated with obtaining IRP credentials in terms of the number and level of staff responsible for obtaining credentials is not affected by the credentialing option(s) used by the state, mainly because the one person assigned the credentialing duties does other things as an employee, but is still needed to devote some hours to credentialing activities.
- The only relevant communication charges for the motor carriers are the internet or e-mail charges associated with interfacing with state credentialing systems. This additional cost is only for carriers who did not have internet or e-mail service prior to using electronic credentialing.
- No separate or additional O&M charges are expected because operating and maintenance costs of equipment and software are covered by service warranties that come with the equipment purchase.

**Table 6-12. Motor Carrier Credentialing Costs and Savings**

	Carrier 1		Carrier 2		Carrier 3	
State	KY		KY		MD	
Type of Operation	Private		For-hire		Leasing	
# of Trucks	75		115		1000	
Time Sensitivity of Freight	very		very		very	
Staff for Credentialing	1		1		1	
Other Staff	1		1		N/A	
Salary of Credentialing Staff	\$25/hr		\$17/hr		\$8.5/hr	
Salary of Other Staff	\$15/hr		\$9/hr		N/A	
New Credentials per Year	12		30		120	
	Cost (\$)	Time (hrs)	Cost (\$)	Time (hrs)	Cost (\$)	Time (hrs)
<b>Pre-CVISN</b>						
New Credential	\$2334	11	312	6.5	\$5525	49.3
Credential Renewals	\$346	17	360	24	\$344	88.5
Total						
<b>Post-CVISN</b>						
New Credential	\$480	2.2	130	1.4	\$765	24.5
Credential Renewals	\$167	7.2	201	11.2	N/A	N/A
Total						
<b>Percent Savings<sup>a</sup></b>						
New Credential	79%	67%	82%	78%	86%	50%
Credential Renewals	52%	80%	44%	53%	N/A	N/A
<b>Average Savings</b>	<b>75%</b>	<b>59%</b>	<b>60%</b>	<b>58%</b>	<b>86%</b>	<b>50%</b>

<sup>a</sup> Changes expressed as percent of the pre-CVISN case

Based on data summarized in Table 6-12 above, motor carriers can expect the following impacts from CVISN systems on IRP credentialing:

- Start-up cost is minimal; only a PC is required. Motor carriers who use PCs prior to CVISN system deployment have no start-up costs.
- Electronic credentialing should save from 60 to 75 percent of former costs. These savings are primarily labor cost savings.
- The estimated savings in time is equally significant: greater than 60 percent. For example, the time needed to complete, submit, process, and mail payment and to print temporary credentials has been reduced considerably from 9 hours on average to less than 2 hours. Turn-around time between application submittal and receipt or printing of temporary credentials is reduced by 1 or 2 days. Resubmittals of applications drop because the software is self error-checking. This reduction improves the efficiency of the credentialing process.
- The ability of carriers to print temporary credentials is a great benefit because it allows motor carriers to put vehicles on the road faster. Electronic credentialing

saves time—time in waiting for permanent credentials in the mail (lost revenue) and travel time to the state agency offices to pick up credentials (lost productivity).

- The cost savings are higher for new credentials than for renewals. New credentials involve a lengthier application. Electronic credentialing can cut that lengthy time and achieve a high percentage of labor cost savings. Renewing credentials takes less time per application. However, the speed of electronic credentialing cannot eliminate a minimum handling time per application renewal. Therefore, with a shorter process and a minimum time necessary, cost savings are less.

## **6.8 COST INFORMATION REPORTED IN PUBLISHED LITERATURE**

### **National Governors' Association (NGA) Study**

The National Governors' Association (NGA) Study (Apogee 1997) consisted of a case study of eight states: California, Colorado, Minnesota, Kentucky, Florida, Delaware, New Jersey, and Connecticut. State agency costs and cost savings were projected over a 10-year period. Conclusions suggest that electronic credentialing will be financially self-supporting within the state budget context. Roadside operations using electronic clearance (screening) and safety systems, by contrast, are expected to be a net cost to the states, but such systems may provide operational and public policy benefits to the states that counter the financial costs. The authors also note that motor carrier participation in CVISN technologies is critical to the success of the process.

The purpose of the cost analysis was to provide states with a better understanding of the specific cost components, the drivers of these costs, and a methodology for developing cost estimates given the unique characteristics and policies of each state. For each functional area, start-up and annual costs were analyzed. Start-up costs are essentially equipment and installation costs. Annual costs refer to operations and maintenance costs.

Given the overlap in safety inspections and electronic screening (roadside clearance) activities, these two were combined for the cost analyses in order to account for the shared operating costs and inclusive applications. The cost data have certain limitations because these were estimates in the states' project plans and were evolving at the time of data collection. Consequently, low- and high-cost scenarios were identified for each system, and the analyses were based on assumptions regarding the deployment schedules in the states. Cost estimates were based mainly on estimates from the states regarding operation and maintenance costs; equipment costs are based on vendor estimates.

The NGA study predicted that carrier participation in ITS/CVO would lag behind state deployment of CVISN systems. The study assumed an exponential relationship between system deployment and motor carrier participation. This relationship assumes that carriers will be reluctant to participate in ITS/CVO until they are confident that the new systems are becoming the normal business practice. Thus, participation will be expected to be low in the early years of deployment and high close to the end of the economic life of the systems. The exponential relationship implies that only a few carriers will participate in the early years, but as the value

becomes fully appreciated, more and more carriers will join. Consequently, the benefits of CVISN systems will be relatively small in the initial years and quite large toward the end of the economic life of the systems.

The study estimated low and high start-up and annual costs of credentialing systems based on the systems identified for deployment in the individual states and assuming certain deployment schedules. Significant cost factors that differentiate costs among states are the level of deployment and the selection of deployment options. In the cost analysis, annual operating costs for credentialing systems were calculated to comprise additional staff, communication costs, lease costs, and system costs. It was noted that while lease costs are not a major factor in the overall costs, communication costs are important. The credentialing cost estimates assumed that carriers would use PC-based CAT to communicate with the state regulatory agencies. The primary cost factor driving differences between low and high estimates for roadside systems is the cost of developing and operating central database management systems.

Table 6-13 summarizes the cost estimates for the three CVISN functional areas. Across the eight case study states (Apogee 1997, Exhibit V-5, page 52), estimated start-up costs for electronic credentialing averaged from \$397,000 to \$517,000, while estimated annual operating costs ranged from an average of \$112,000 to \$187,000.

**Table 6-13. Summary of Cost Estimates (NGA Study)**

Functional Area	Description	Start-up costs (\$000)		Annual costs (\$000)	
		Low	High	Low	High
<b>Electronic Credentialing</b>	All credentials (IRP, IFTA, OS/OW and Hazmat)	134 - 753	178 - 959	50 - 243	86 - 364
<b>Electronic Clearance</b>	<u>Clearance only</u>				
	Weigh station screening	217	643	11	107
	Mainline screening	295	825	12	72
	Credential screening	40	95	2	4
	Remote screening	65	259	3	2
	<u>Clearance and safety</u>				
	Weigh station screening	257	787	13	142
	Mainline screening	295	922	13	72
<b>Automated Safety</b>	<u>Clearance only</u>				
	Weigh station safety management	240	465	3	81
	Remote credential/safety checks	233	460	5	22
	Roving weight/credential/safety	190	539	120	201
	<u>Clearance and safety</u>				
	Weigh station safety management	240	465	5	138
	Remote credential/safety checks	253	480	74	132
	Roving weight/credential/safety	480	789	165	310

Source: National Governor's Association, *Budgetary implications of ITS/CVO for state agencies*, Apogee Research, Inc. November 1997, Exhibits V-5 and V-6.

These start-up cost estimates are fairly comparable with those reported in the CVISN cost analysis by Kentucky and Maryland, which ranged from approximately \$464,000 to \$935,000.

Because CVISN costs in this chapter are presented on a per-carrier-account basis, comparisons with the statewide annual operating costs reported in the NGA study are not possible.

### **ATA Foundation Study**

The American Trucking Associations (ATA) Foundation conducted a study to assess the impacts of ITS technology on regulatory compliance costs for motor carriers (1996). ITS/CVO user services for which costs and benefits were evaluated included (1) administrative processes, (2) electronic clearance, (3) automated roadside safety inspections, and (4) on-board safety monitoring. The benefits were calculated by examining the labor costs of regulatory compliance for motor carriers using technology systems and those who do not. This study examined the costs and benefits from the motor carrier perspective.

Benefits were narrowly defined as reductions in labor costs of demonstrating regulatory compliance with no inclusion of impacts on operational efficiency or safety. Costs were calculated for single power units and include only labor costs. Costs of regulatory compliance varied depending on the range of operations, types of loads carried, industry segment, internal efficiencies derived from automation of functions, and specialization of personnel. Carrier size was a major factor that determined compliance costs as measured in terms of labor costs. Costs of compliance activities estimated based on driver time (e.g., stops for compliance checks or filling out logs and trip reports) were assumed to apply only to carriers who pay drivers based on time worked. Driver settlements that were not time-based (e.g., those paid by miles driven or percentage of revenue) were assumed not to incur these costs.

The findings from this study are summarized in Table 6-14. The study showed that reductions in motor carriers' administrative compliance labor costs were expected to be in the range of 9 to 18 percent. These labor costs related to licensing, permitting, registration, fuel tax reporting, and installation of operating credentials on vehicles. The potential benefit of electronic clearance to motor carriers was a cost reduction of 50 to 100 percent for driver time resulting from fewer stops for roadside compliance checks. However, this benefit was applicable only to carriers who paid their drivers based on time worked.

According to the study, the primary purpose of automated roadside safety inspections is to increase efficiency of enforcement personnel in conducting roadside inspections in terms of higher volume of vehicles inspected. The benefit of automation to carriers was about a 25 percent reduction in time required for the driver to complete logs and trip reports. Also, on-board safety monitoring of drivers and vehicles was assessed based on labor cost savings. The benefit of using such devices was found to be small compared to the cost of on-board computers or trip recorders.

The labor cost savings to motor carriers for electronic credentialing as reported by the ATA Foundation (9 to 18 percent) were significantly smaller than the cost savings expected by the three Kentucky motor carriers interviewed for the CVISN analysis presented in this chapter. The three motor carriers that were interviewed anticipated administrative labor savings on the order of 75 percent following the deployment and adoption of electronic credentialing.

**Table 6-14. Summary of Costs and Benefits (ATA Study)**

Functional Area	Description	Size of carrier		
		Small 1-10 units	Medium 11-99 units	Large >99 units
<b>Administrative Processes</b>	Average annual labor costs for administrative compliance functions per vehicle	\$918.00	\$306.00	\$145.00
	Cost of PC based EDI software	\$83	\$55.00	\$22.00
	Average percent savings due to technology (EDI)	9%	18%	15%
<b>Electronic Clearance</b>	Average hours per year per vehicle undergoing roadside checks	4.9	5.7	2.9
	Average annual cost of driver time at roadside compliance checks per vehicle @ \$14.49 per hour	\$0.00 <sup>1</sup> \$71.00 <sup>2</sup>	\$0.00 <sup>1</sup> \$81.00 <sup>2</sup>	\$0.00 <sup>1</sup> \$42.00 <sup>2</sup>
	Cost of Type I, read-only transponder (\$33 per transponder), capitalized over three years	\$11.00	\$11.00	\$11.00
	Assumed percent savings in driver time at roadside compliance checks per vehicle due to Electronic Clearance	50-100%	50-100%	50-100%
<b>Automated Roadside Safety Inspections</b>	Average annual cost of driver time at roadside safety inspections per vehicle @ \$14.49 per hour	\$0.00 <sup>1</sup> \$30.00 <sup>2</sup>	\$0.00 <sup>1</sup> \$28.00 <sup>2</sup>	\$0.00 <sup>1</sup> \$11.00 <sup>2</sup>
	Average annual cost of driver time completing logbooks per vehicle @ \$14.49 per hour	\$0.00 <sup>1</sup> \$2443.00 <sup>2</sup>	\$0.00 <sup>1</sup> \$2577.00 <sup>2</sup>	\$0.00 <sup>1</sup> \$2567.00 <sup>2</sup>
	Cost of technology (hand-held computer)	\$465	\$465	\$465
	Average percent savings in driver time due to technology (electronic logbooks)	25%	25%	25%
<b>On-Board Safety Monitoring</b>	Average annual labor costs for observing driver and vehicle performance on the road per vehicle	\$572	\$183	\$60.00
	Likely cost of technology per vehicle	\$232 to \$633	\$232 to \$633	\$232 to \$633
	Average percent savings due to technology (on-board sensing device)	20%	20%	20%

<sup>1</sup> Estimated for carriers whose driver settlements are not time based

<sup>2</sup> Estimated for carriers who pay driver based on hours worked

Source: *Assessment of ITS/CVO Users Services: ITS/CVO Qualitative Benefit/Cost Analysis – Executive Summary. ATA Foundation for FHWA. June 1996*

### Maryland Benefit/Cost Study

A benefit/cost study in Maryland (Bapna et al., 1998) presented an evaluation of projected CVISN capital and operating costs (combined) for nine state agencies across 10 years. The primary purpose of the study was to assess the benefits of CVISN deployment. The study

was based on the hypothesis that the net benefits of CVISN deployment are positive and large but vary among system components and between the state and motor carrier industry. The methodology adopted consisted of both qualitative and quantitative analyses of benefits and costs. The costs consisted of CVISN investment maintenance and operating costs to the state and the costs to motor carriers (e.g., transponders, computers, and software). The benefits included savings in agency time, savings in agency costs, carriers' operating time, and cost and safety benefits (in terms of enhanced roadside inspections for out-of-service placement and identifying overweight vehicles).

The total CVISN project was assumed to have an economic life of 10 years. The analysis assumed a sigmoid or s-curve relationship between deployment and motor carrier participation. That is, the rate of participation in CVISN technology would increase slowly at first, followed by a dramatic increase in the middle years as CVISN catches on. Participation increases would then level off in the later years. Using a discount rate of 7 percent and 1998 dollars, the benefit/cost ratio was found to be in the range 3.28 to 4.68. The net benefits and costs that accrued to carriers and state agencies due to CVISN deployment were in direct proportion to the level of participation of carriers and their implementation of the proposed technology-based solutions.

The benefit/cost analysis did not include potential benefits to agencies due to reduction of operating costs of weigh facilities. Electronic credentials, in addition to increasing the productivity of agency personnel, were also predicted to result in a reduction of agency overhead costs. The study also noted that additional revenues for IRP and IFTA taxes would be collected due to increased monitoring of carrier activities.

Results showed that predicted total costs for CVISN credentials administration would average \$1,244,851 per year, and that total costs for CVISN safety enforcement would average \$1,733,195 per year, for a total average annual cost to the state of approximately \$3,000,000.

Because costs in the Maryland study are statewide, comparisons with the per-carrier-account costs in this analysis are not possible.

### **Washington State Feasibility Study**

The Washington State feasibility study (1998) projected incremental costs for continuing the CVISN pilot project at \$2.7 million for the 1997-99 biennium with ongoing support costs for the pilot project infrastructure at \$6 million over 10 years, or an average of \$600,000 per year. These costs did not include the expansion of CVISN beyond one point of entry station (Ridgefield).

## **6.9 OTHER STATE COST INFORMATION**

For comparison purposes, Table 6-15 shows the costs that Washington State DOT incurred (as reported in mid-2001) to develop, deploy, and operate electronic credentialing and roadside enforcement. Virginia's Department of Motor Vehicles reported that it costs the state approximately \$1 million per site to install mainline WIM, AVI technology, and electronic clearance (screening) software.

**Table 6-15. Washington State DOT CVISN Costs**

Cost Type	Description	Cost, \$
Development	Electronic credentialing; MVS Express (VISTA RS & RT)	560,000
	In-house development of CVIEW, ROC, etc.	340,000
Deployment	CVISN IT equipment per weighing site; includes network equipment, servers, workstations, displays, printers, and software	70,000
	IT equipment for headquarters; includes large server and backup server	60,000
	AVI per site	200,000
	WIM per site	900,000
Ongoing (annual)	O&M, IT lifecycle, ongoing development	900,000

These costs are generally higher than those presented above, as reported by Kentucky, Connecticut, and Maryland. It was outside the scope of the present task to analyze in detail the costs reported by other states.

**6.10 REFERENCES**

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Apogee Research, Inc., “Budgetary Implications of ITS/CVO for State Agencies,” Report EDL 10125 to the U.S. Department of Transportation, FHWA [directed by National Governor’s Association], November 1997, available at <http://www.itsdocs.fhwa.dot.gov/jpodocs>.

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## CHAPTER 7. CVISN CUSTOMER SATISFACTION

Improved customer satisfaction is key to the success of CVISN. For CVISN to lead to more widespread deployment of the demonstrated technologies and operating procedures, its customers must value the incremental benefits they experience more highly than the incremental costs they bear.

Customers or users of CVISN technologies include independent and company drivers; motor carrier operators; state transportation and CVO administrators; law enforcement, highway, and public safety personnel; and the businesses and industries that engage the services of motor carriers.

To measure customer satisfaction with CVISN, several surveys and other measures were planned and carried out. These included a national motor carrier survey, a driver survey, and surveys and focus groups involving state inspectors and law enforcement personnel. Originally, a separate motor carrier survey was planned, to quantify the benefits of electronic credentialing for motor carriers. However, at the time this study was scheduled, there were not enough carriers with experience in electronic credentialing to constitute a valid study population.

Table 7-1 shows the customer groups who were surveyed to determine their experiences in using CVISN technologies and their satisfaction with those technologies. Shippers/receivers and the general public are also recognized as stakeholders in CVO. Benefits to each are discussed indirectly in Chapter 8 on benefit/cost analysis, but direct measures of the satisfaction of these customer groups were beyond the scope of this evaluation.

**Table 7-1. General Topics Covered in Surveys and Other Evaluations of Customer Satisfaction**

Customer Group	Survey Topics Relating to	
	Electronic Credentialing	Roadside Inspections/Enforcement
Motor Carriers	<ul style="list-style-type: none"> <li>• Experience with credentialing</li> <li>• Current credentialing procedures</li> <li>• Awareness and use of electronic credentialing</li> <li>• Opinions about electronic credentialing</li> <li>• Likelihood of using electronic credentialing</li> </ul>	<ul style="list-style-type: none"> <li>• Experience with roadside inspections</li> <li>• Current inspection procedures</li> <li>• Awareness of electronic screening</li> <li>• Opinions about electronic screening</li> </ul>
Drivers	<ul style="list-style-type: none"> <li>• Likelihood of owner-operators to enroll in electronic credentialing</li> </ul>	<ul style="list-style-type: none"> <li>• Opinions about roadside enforcement</li> <li>• Likelihood of owner-operators to enroll in electronic credentialing</li> </ul>
State CVO Administrators	<ul style="list-style-type: none"> <li>• Institutional issues and benefits</li> </ul>	<ul style="list-style-type: none"> <li>• Institutional issues and benefits</li> </ul>
State CVO Inspectors		<ul style="list-style-type: none"> <li>• Inspection systems in use</li> <li>• Satisfaction with equipment</li> <li>• Perceived benefits</li> </ul>

Section 7.1 presents a summary of the objectives and methods used. Section 7.2 summarizes the findings and details the results of the various customer satisfaction measures.

Appendices C.1 through C.6 contain data tables and supporting documentation related to customer satisfaction.

## 7.1 CUSTOMER SATISFACTION TECHNICAL APPROACH

### Motor Carrier Survey Approach

In planning to appraise customer satisfaction associated with CVISN initiatives, the original plans<sup>1</sup> included a *baseline national motor carrier survey* (BNMCS), intended

- to collect baseline information<sup>2</sup> concerning the relevant behaviors, awareness, and attitudes<sup>3</sup> of motor carriers;
- to identify the incentives and barriers to more widespread deployment of CVISN-type initiatives across the country; *and*
- to aid potentially in designing subsequent surveys of motor carriers on other topics (such as credentials administration).

We examined several existing databases that were relevant either to the *substance* of the enquiry or to the *methods* that might be used to survey motor carriers, and concluded that no existing study met the objectives of the proposed baseline survey.

However, the progress of CVISN deployment has been slowed by a variety of factors, which has limited the ability to monitor, within the evaluation timeframe, the experience of a critical mass of motor carriers affected *directly* by the new initiatives. As a result, the objectives and value of this survey have changed somewhat to reflect this slow deployment progress. This survey provides a picture, as of mid-2000, of the awareness, attitudes, and experience of motor carriers concerning CVISN-type initiatives generally. To some extent, the survey responses will be colored by on the ongoing CVISN model deployment: it may be expected to have affected awareness positively (albeit not necessarily to a significant degree), and some respondent firms may well have directly experienced innovations that have been funded in part through the CVISN program.

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<sup>1</sup> Battelle (1999), *Test Plan: Baseline National Motor Carrier Survey for Commercial Vehicle Information Systems & Networks Model Deployment Initiative*.

<sup>2</sup> “Baseline” was used here in two related contexts. First, for carriers whose operations are such that they may be affected, directly or indirectly, by CVISN deployment, the baseline data were intended to provide a *pre-implementation* (“before”) picture. Secondly, for other surveyed firms whose operations were unlikely to be so affected, the survey was intended to provide a picture of the national industry as a whole, showing in what ways participating or affected firms may be representative or unrepresentative of the industry-wide picture.

<sup>3</sup> “Relevant” here means awareness, behaviors, and attitudes with respect to (for example) credentialing, regulatory administrative procedures, safety, enforcement, labor relations, the use of advanced computing and telecommunications technologies, CVISN participation, and any other aspects of CV operations that might potentially be affected significantly by initiatives of the types being deployed in CVISN.

We designed a mail survey of carriers to be representative of the trucking industry throughout the contiguous 48 states. The sample was a stratified random one, selected from the mid-1999 records of firms in the federal government's MCMIS Census database. Stratification was used both to compensate for the highly skewed distribution of firms in the industry by size, and to place emphasis on firms operating in the states where CVISN deployment was most highly advanced. Compared to a simple random sample of all firms, the stratified sample contained much higher proportions of larger firms and ones with registered home addresses in five "CVISN focus" states: Connecticut, Kentucky, Maryland, Oregon, and Virginia.

Experience with the methodologically most closely analogous survey of carriers – one conducted in 1996 by the ATA Foundation<sup>4</sup> – suggested that (1) the response rate was likely to vary inversely with the size of the firm, and (2) in larger firms, obtaining authoritative answers about both credentialing and roadside inspection matters might well involve consulting different employees. To achieve a target sample size of 150 substantially complete responses would require an issued sample of approximately 1,500 firms.

In practice, only 116 responses were received from this issued sample. In particular, the response rate from larger firms was disappointing by comparison with that achieved by the ATA Foundation survey.<sup>5</sup> A second sample of 500 firms with 100 or more power units was issued, and achieved a further 31 responses before books were closed at the end of 2000. A further 11 responses from the pilot survey were also added to the database file, resulting in a final total of 158 achieved responses.

A weight was computed for each sample stratum to restore correct proportionality of the achieved sample by firm size and by geography.<sup>6</sup> The choice of the weighted total number of observations is arbitrary. In the cross-tabulations provided in Appendix C.3, we chose to use a weighted base of 10,000 firms.<sup>7</sup> *All of the data and commentary provided in this report are based on the **weighted** data, except (rarely) where information is identified specifically as "unweighted."*

This sample design, while based on a quite small achieved sample size, allows some (limited) disaggregation by firm size and by exposure to CVISN concepts, thought to be important influencing variables for the behaviors and opinions under analysis.

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<sup>4</sup> The ATA Foundation (1996), *Assessment of Intelligent Transportation Systems / Commercial Vehicle Operations (ITS/CVO) User Services Qualitative Benefit / Cost Analysis*, Report no. FHWA-MC-96-028, prepared for the U.S. DOT Federal Highway Administration.

<sup>5</sup> The ATA survey response rate probably benefited from the fact that the sampling frame was based in part on membership in certain trade associations, which probably indicates a higher level of engagement in industry affairs than is reflected in a random sample of all firms.

<sup>6</sup> That is, large firms and those with home office addresses in the five focus states were assigned relatively small weights, while the small firms (because of their considerably smaller sampling fractions) were assigned much larger weights.

<sup>7</sup> Using smaller numbers (including the common practice of setting the total weighted sample size to be identical to the unweighted sample size) would have resulted in estimates of the numbers of small firms involved, when weighted to represent the national industry, in small fractions of a single unit. The choice of 10,000 firms as the weighted base scales the numbers to a level where the weighted large firm data are at least distinguishable as integers.

## Driver Survey Approach

Among the various “customers” of interest are commercial vehicle drivers and owner-operators. The purpose of the data collection activity summarized here was to explore the opinions of truck drivers about recent, CVISN-related changes in roadside inspection methods, and the opinions of owner-operators about electronic credentialing. The operators’ inputs are intended to help color, interpret, and better understand the information gathered in complementary evaluation activities.

A *qualitative* survey was conducted with 61 truck drivers intercepted at large rest/refueling stops located adjacent to major truck routes in Connecticut and Kentucky. These two states are ones that have implemented significant electronic credentialing initiatives, and have been the focus of other, complementary evaluation activities. The interviewing took place at four locations, two in each of the states, in late November and early December 2000.

Sample quotas were set to ensure the representation of owner-operators and of drivers employed by firms of varying sizes. Using in-depth, semi-structured personal interviews, all of the respondents were asked about roadside safety and weight inspections. The owner-operators were also asked about electronic credentialing methods.

Like all qualitative research, the primary objective was to identify the *range* of opinions on various aspects of these topics, and to form hypotheses about any apparent areas of consensus or disagreement. Because of the small size of the sample and the method of sample recruitment, the degree to which the people interviewed are representative of any group larger than themselves cannot be determined.

Gathering statistically defensible information about commercial vehicle drivers is a challenging objective, because of myriad practical difficulties in building a sampling frame, and contacting and interviewing people who, by virtue of their occupations, are on the move for large portions of their time. It is not surprising that many of the surveys of drivers have used highly questionable sampling methods.<sup>8</sup> A notable exception is the recently-published 1997 survey of commercial vehicle drivers at Midwestern rest/refueling stops, undertaken by the University of Michigan Trucking Industry Program.<sup>9</sup> This study made serious attempts to design a randomized sample within a specified geographical scope for intercept points, and invested significant resources and time into development work to refine the survey procedures and instrument.

The resources available for this survey did not permit comparable efforts, nor a sample size sufficiently large to afford precise quantitative estimates, even were it feasible to design a random sample of drivers. The approach adopted here was to use appropriate procedures and data from the UMTIP survey to help design a *qualitative* investigation of driver and owner-operator opinions about CVISN-type innovations, primarily (1) the use of electronic

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<sup>8</sup> Some examples have been summarized in CRA’s test plan for the CVISN evaluation *Baseline National Motor Carrier Survey*.

<sup>9</sup> Dale L Belman, Kristen A Monaco, & Taggert J Brooks (2000), *Let It Be Palletized: A Portrait of Truck Drivers’ Work and Lives*, University of Michigan Trucking Industry Program.

vehicle identification and information in roadside inspections and (2) electronic credentialing practices.

A further complicating factor in obtaining driver inputs about CVISN initiatives is that the general level of deployment to date has been such that drivers with *direct, personal* experience of them are likely to have very low incidence at possible intercept points. In consequence, the interview focus was more concerned with reactions to the general CVISN concepts than to the specific extant deployments of those concepts.

The survey approach was to undertake a number of semi-structured *qualitative* interviews with drivers at rest and refueling stops selected to provide a relatively high incidence of drivers likely to be familiar with new roadside screening methods. The respondent selection process sought to randomize the selection of qualified respondents intercepted at those stops at the survey times. However, because of the sample design and size, the survey does not generate *quantitative* estimates that are reliably projectable to any larger group than the people interviewed.

### **State Administrator Forums**

Methods for evaluating of the satisfaction of state CVO administrators with CVISN technologies were less formal than the measures used to gauge the satisfaction of motor carriers and commercial vehicle drivers. Evaluation contractor staff participated in many meetings, conferences, and other forums, where the attitudes of state administrators and other CVISN stakeholders were directly solicited and discussed in detail. Examples of recent conferences and meetings include:

- Various design and planning workshops organized by The Johns Hopkins University Applied Physics Laboratory on behalf of FMCSA.
- CVISN MDI Prototype and Pilot States Program Managers Meetings. These meetings are held every three months or as needed.
- Institute for Transportation Engineers (ITE) 2000 International Conference, April 2000, Irvine, California.
- Great Lakes and Southeast States CVISN Mainstreaming Conference, May 11-12, 2000, West Palm Beach, Florida.
- Eastern States ITS-CVO Deployment Forum, November 14-16, 2000, Crystal City, Virginia.

At each of these forums, participants were encouraged to offer opinions on successes, failures, obstacles, lessons learned, and issues to be resolved. Information gathered from these kinds of meetings was taken into account in all phases of evaluating the CVISN MDI.

## Roadside Enforcement Staff Surveys

Attitudes and opinions of state motor carrier inspectors regarding the use of CVISN roadside enforcement technologies were addressed through focus groups and a formal survey conducted in collaboration with the evaluation of the I-95 Corridor Coalition and SAFER Data Mailbox FOTs (2000). Over 50 inspectors from six eastern states (Connecticut, Maryland, New Jersey, New York, Pennsylvania, and Rhode Island) participated in the focus groups, and approximately 370 inspectors from these states completed formal questionnaires. Topics included background information, system usage, satisfaction, and perceived benefits.

## 7.2 FINDINGS

### Motor Carrier Survey Overview of Findings

On the basis of our investigation of the motor carrier survey data set, we formed the following conclusions:

- The general awareness throughout the national trucking industry of CVISN-type initiatives is very low: about 4 percent for electronic credentialing methods, about a third of all firms for electronic screening, and between a quarter and a third of firms for SAFER-type innovations. Less than a half of one percent of firms currently have any experience using electronic credentialing, and about 6 percent are using electronic screening.
- The effort and time presently involved in credentialing compliance and in roadside inspections is quite considerable. Across all firms, the reported total in-house staff time involved in credentialing had a mean of about 73 full-time equivalent days per firm per year, with a median value of about 20 FTE days. Examining these data on a “per powered unit<sup>10</sup> operated” basis and breaking them down by firm size produces estimates that would intuitively appear to be inflated. For example, for the firms operating 10 or fewer powered units, the mean claimed credentialing time expended *per unit* was 34 (“29”)<sup>11</sup> FTE days per year, with a median value of 8 FTE days.
- Relatively few firms collect or analyze data about their roadside inspections. However, the survey respondents’ estimates of the mean amount of time involved per inspection (19 minutes for size/weight checks and 45 minutes for safety checks) are quite similar to earlier estimates from the ATA Foundation survey.
- For the firms that use in-house staff to handle some or all of their credentials work, the most common methods of submitting paperwork are by mail, walk-in, and fax.

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<sup>10</sup> A “powered unit” is either a single-unit vehicle or a separate power unit (“tractor”).

<sup>11</sup> The numbers in parentheses show the 95 percent confidence interval. It is relatively large for this statistic because of the highly diverse weights used for small firms.

About one in ten of these firms claimed to have used the Internet to file information over the preceding twelve months, but this statistic is highly variable by type of firm.

- The respondents' average levels of satisfaction with their current credentialing methods range from "weakly dissatisfied" to "weakly satisfied." OS/OW and HAZMAT permitting generally received the lowest satisfaction ratings, but these were also the types of credentials required by the smallest proportions of all firms.
- The concept of electronic credentialing, of which most responding firms were not aware before the survey, elicited a significantly positive endorsement of the statement "*With electronic credentialing, I'd expect the turnaround time to be much quicker.*" On the other hand, responses to other attitudinal statements revealed concerns about possible expansion of state regulation and charges, and the cost-effectiveness of the method for the respondent's own firm. Relatively favorable responses tended to be given by those firms currently devoting high levels of in-house staff time to credentialing, or expressing most dissatisfaction with current credentialing methods. These same firms expressed a relatively high likelihood of adopting electronic methods if given the opportunity to do so, along with firms with a relatively high fleet mileage and intermediate sized firms (in terms of numbers of vehicles and drivers).
- The levels of satisfaction expressed with current roadside check procedures were generally lower than for credentialing, despite the fact that (on a per firm basis) the amount of reported time involved per year was considerably less. However, there seems to be significant agreement that the *types* of roadside checks made are appropriate. The highest levels of dissatisfaction were with the criteria for deciding which vehicles to inspect, the time spent in the inspection itself, and (most markedly) the time spent *waiting* for inspection. Several respondents commented also on safety concerns about truck queues for inspection backing up onto the highway.
- Responses to attitudinal statements about electronic screening methods evidenced some similar negative concerns to those we found about electronic credentialing: concerns about cost-effectiveness for the company and expansion of state regulation, for example. Possibly because of closeness to the debate about deployment of vehicle monitoring technologies, the phrase "big brotherism" was volunteered by a number of respondents. Nonetheless, there were significant levels of endorsement for the statements "*Even without equipping our vehicles, we would probably benefit if the inspection officials had better information*" and "*These types of changes will make the roadside inspection system significantly more fair.*"
- Despite the relatively small sample size for this survey, it is apparent that examining the attitudinal responses about both electronic credentialing and electronic screening in greater detail, using multivariate clustering methods, could provide important insights into the types of firms most amenable to early adoption of these technologies.

## Motor Carrier Survey Results

### The Respondents' Experience of Credentialing

Four out of every five trucking firms had obtained at least one permit within the preceding twelve months. Roughly half the firms had filed for the most common paperwork: the IRP/IFTA initial application, annual renewals, or IFTA quarterly tax. Table 7-2 shows the incidence of credentialing experience (by permit type) for all firms, and for three subgroups expected to require permits and credentials to a greater than average extent: the “for-hire truckload carriers,” the firms with over 3 million fleet miles, and those requiring more than five different permit types.

**Table 7-2. Experience with Credentialing**

Type of permit	Firms obtaining in the last twelve months			
	All firms	For-hire truckload carrier	High vehicle mileage	Obtained over five permit types
IRP/IFTA annual renewals	57%	83%	99%	100%
IRP/IFTA initial application	47%	77%	14%	95%
IFTA quarterly tax	47%	90%	99%	100%
Single state registration system (SSRS)	41%	71%	98%	97%
Intrastate registrations, for intrastate-only vehicles	40%	39%	4%	86%
Weight/Distance tax reports	29%	57%	98%	92%
IRP/IFTA supplemental application (fleet changes)	22%	46%	97%	63%
IRP/IFTA “single trip” application	10%	32%	8%	17%
Oversize/Overweight (OS/OW) permits	4%	48%	3%	13%
Hazardous materials (HAZMAT) permits	1%	3%	2%	4%
No permits obtained in last twelve months	21%	1%	1%	0%

Source: Table A [Sources designated in tables and footnotes in Chapter 7 correspond to data tables in Appendix C.3].

Roughly 28 percent of all firms use an outside firm to help obtain at least one form of credential. By far the greatest use of outside firms, as a proportion of all applications, is to help obtain IRP/IFTA annual renewals. Outside firms are used most heavily by medium-sized fleets (those with 11 to 50 powered units, or 11 to 70 drivers), and those with high annual fleet mileages (over 3 million miles per year).<sup>12</sup>

About 59 percent of all firms use in-house resources in obtaining some or all of their credentials, and two-thirds of those provided some estimates of the staff time involved over the preceding twelve months. We used the data from Questions 4 and 5 to compute estimates of the numbers of full-time equivalent (FTE) days expended by in-house managerial and clerical staff, and in total.<sup>13</sup>

<sup>12</sup> Table A (see Appendix C.3).

<sup>13</sup> Tables F, G, and H.

The mean total staff time expended, across all of the firms that gave us estimates, was approximately 73 person days involved in credentialing. But because of the highly skewed distribution of firms by size, this mean is heavily influenced by the relatively small number of giant firms (the largest estimate for total staff time was 2.9 person years). The *median* level of effort was approximately 20 FTE days. Not surprisingly, the amount of *clerical* time spent increases with the size of the fleet, the annual fleet mileage, and the geographical scope of operations. However, the mean level of “*management*” time expended is lower for the medium-sized firms (11 to 50 powered units, 11 to 70 drivers) than for the smaller or larger firms, perhaps reflecting the greater use of outside firms by the medium-sized group.

Examining these staff time estimates on a per powered unit operated<sup>14</sup> basis, Table 7-3 summarizes how this statistic varies by the size of the fleet. Because the data weights are large and highly variable for firms with small fleets, the mean value for them has a large confidence interval. The median value for the small firms – 8 person-days per powered unit – intuitively seems high, which may indicate a tendency (by at least the small firms) to overstate the level of internal effort.

**Table 7-3. Total In-house Staff Time Expended per Year per Powered Unit (FTE Days)**

	Mean value ( $\pm$ 95% confidence limits)	Median value
All firms	26.0 $\pm$ 9.2	8.0
10 or fewer powered units	34.3 $\pm$ 29.0	8.0
11 to 50 powered units	1.6 $\pm$ 0.4	2.0
Over 50 powered units	1.0 $\pm$ 1.2	0.2

Source: CRA calculations based on this statistic for each firm

Table 7-4 shows the various methods of filing applications that respondent firms had used over the previous twelve months. Overall, about one in ten of the firms doing their own credentialing work had used the Internet to file information (via E-mail or the World Wide Web) in that timeframe. But the patterns here were quite variable, as the table illustrates. Internet submission was relatively high for firms operating predominantly within their own states, for small firms, and for those firms who (in answers to a subsequent question) showed most dissatisfaction with their current credentialing processes. As many as 35 percent of the “within state only” firms claimed to have used Internet submission within the last twelve months.

<sup>14</sup> For the purposes of this report, a “powered unit” is either a single-unit vehicle or a separate power unit (“tractor”).

**Table 7-4. Methods Used to File Credentials Paperwork**

Method of application	Firms using in the last twelve months			
	All such firms	Within state hauls only	Obtained over five permit types	Dissatisfied currently
Mail-in applications (submitted paperwork by mail)	65%	91%	97%	97%
Walk-in applications (in-person visits to a credentialing office)	40%	52%	47%	35%
Faxed applications	27%	40%	18%	46%
Provided all necessary information by telephone	15%	2%	11%	25%
Submitted paperwork by Internet or E-mail, or filled out forms on a WWW website	10%	35%	0%	19%
None of these	1%			1%
Not reported	22%	5%	0%	0%

Source: Table E

Experience with mail and walk-in submissions tended to be high for all groups. Heavy use of faxed applications was associated with medium-sized firms, those with high fleet mileage, for-hire truckload carriers, and firms devoting considerable staff time to credentialing matters.

#### Satisfaction with Current Credentialing Procedures

Table 7-5 shows the mean satisfaction scores expressed for each of the ten types of credentials listed on the questionnaire, using a scale of -5 (“completely dissatisfied”) through +5 (“completely satisfied”). The question wording asked specifically “How satisfied are you currently with the *process* your firm has to use (or has decided to use) for each of the following types of credentials or permits?”

For the full sample of firms, the mean scores cover a relatively small section of the range, from -1.9 (which might be described as “weakly dissatisfied”) to +1.4 (“weakly satisfied”). The means were positive and more than two standard errors from the neutral (zero) mark for the top four types of permits listed in the exhibit. They were negative and more than two standard errors from zero for the last three permit types listed.

**Table 7-5. Satisfaction with Credentialing**

Statement	Mean satisfaction score			
	All firms	Heavy staff burden	Uses outside firm	Likely to use EC
+5 means “completely satisfied”; -5 means “completely dissatisfied”; zero is “neutral”				
Single state registration system (SSRS)	+1.4	-1.3	+0.2	+4.3
IRP/IFTA supplemental application (fleet changes)	+1.1	-1.8	-0.6	+4.1
IFTA quarterly tax	+1.0	-0.3	+1.3	+0.7
IRP/IFTA initial application	+0.9	-0.8	+0.2	+4.3
Intrastate registrations, for intrastate-only vehicles	+0.4	-4.7	-0.4	+3.8
IRP/IFTA annual renewals	+0.2	-3.1	+0.2	+2.4
Weight/Distance tax reports	-0.1	-2.2	+1.3	+0.4
IRP/IFTA “single trip” application	-0.8	+1.4	-0.8	+4.3
Oversize/Overweight (OS/OW) permits	-0.8	-4.7	+1.3	0.2
Hazardous materials (HAZMAT) permits	-1.9	-3.8	-3.1	0.8

Source: Table I

The table also illustrates how the expressed satisfaction scores varied for some of the relevant sample segments that were least like the overall pattern of responses. Firms devoting over 50 annual FTE days to credentialing activities were generally markedly less satisfied with the process for all permit types except for “single trip” applications. The firms that, in answer to a later question identified themselves as either already using electronic credentialing or likely to do so if given the option within the next twelve months<sup>15</sup> (just 27 unweighted respondents, representing 0.9 percent of all firms industry-wide), were generally more satisfied with their current processes than were firms as a whole.

#### Awareness and Use of Electronic Credentialing

Very few of the firms in our sample had any current experience of electronic credentialing: they constituted 0.4 percent of the total industry, or 0.5 percent of those firms answering all of the questions about awareness and use.<sup>16</sup> Another 4 percent of the firms claimed to have some awareness, but most of them did not know any details about current or planned availability. The large residual group, almost 96 percent of the firms answering these questions, said that they were not aware of electronic credentialing, or were not sure whether or not they had heard of it.

#### Opinions About Electronic Credentialing

Given this general lack of awareness, a potentially important influence on opinions about electronic credentialing is obviously the manner in which the survey described the concept to respondents. Here is what the questionnaire said:

<sup>15</sup> The sample numbers of the two components of this category – the current users and those with high stated propensity to use in the future – were too small to examine separately.

<sup>16</sup> Table J.

“ . . . electronic (computer-to-computer) methods for obtaining credentials or permits *directly from any of the states* for which your company needs credentials. This “electronic credentialing” is the situation where you would send your information electronically direct to the state’s registration agency, *not* to an outside company who would then file the application on your behalf.”<sup>17</sup>

We then asked

“In some states, certain motor carriers do have the option of using electronic (computer-to-computer) methods for obtaining credentials or permits. Here are some opinions from other motor carriers about electronic credentialing methods. Please circle a number between **0** and **10** to show how much you personally agree or disagree with each statement below. A **0** would mean that you *disagree completely*, and a **10** would mean that you *agree completely*. A **5** means that you *neither agree nor disagree*, or that you have no opinion.”

For the purposes of this report, we rescaled the opinion scores by subtracting 5 from them, thus making zero the neutral point, while negative values up to -5.0 indicate *disagreement* levels and positive values up to +5.0 indicate *agreement*. Table 7-6 summarizes the mean scores for the various opinion statements.

For the sample as a whole, the mean scores can be characterized as ranging from weak agreement to even weaker disagreement. Even so, all but the four statements with mean sample-wide scores of -0.2 or -0.3 are significantly different from zero at the 95 percent confidence level.

It is noteworthy that of the five statements with which the sample as a whole expressed agreement on average, four make negative comments about electronic credentialing, or about the firm’s interest in using electronic credentialing. There is concern about the potential link with the expansion of state government regulation and standardization. There is some concern also that “we are too small” to benefit, and that the cost savings might not exceed the additional outlays. However, there was significant agreement that “I would expect the turnaround time to be *much* quicker,” even if on average the respondents did not agree that electronic credentialing would result in significant time or cost savings, or in the fairer, more accurate calculation of fees.

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<sup>17</sup> Prior questions had addressed the use of third party assistance, and so we felt it important to stress that this was not the phenomenon under discussion here.

**Table 7-6. Opinions About Electronic Credentialing**

Statement	Mean agreement score			
	All firms	Heavy staff burden	Dissatisfied currently	Uses outside firm
+5 means “agree completely”; -5 means “disagree completely”; zero is “neutral”				
“I’m concerned that electronic credentialing will help the states to <i>expand</i> regulation and charges in new ways”	+1.7	+1.9	+1.0	+2.5
“Electronic credentialing would require us to use state-mandated standards, formats, or equipment”	+1.7	-2.3	-0.1	+1.3
“With electronic credentialing, I’d expect the turnaround time to be <i>much</i> quicker”	+1.4	+3.9	+2.7	+1.2
“We’re too small to justify thinking about electronic credentialing”	+1.2	-4.7	-3.0	+2.1
“Electronic credentialing is likely to cost my company more than we’d save”	+0.8	-2.8	-1.0	+0.3
“Training our existing staff to do electronic credentialing would be very difficult”	-0.2	-4.4	-2.7	-0.7
“Electronic credentialing would result in more accurate and fairer calculation of fees”	-0.2	+4.3	+0.8	+1.4
“I expect we’d make significant time and cost savings from using electronic credentialing”	-0.2	+3.4	+1.6	+0.4
“The only major beneficiaries of electronic credentialing will be the state agencies”	-0.3	-4.7	-2.9	-1.2
“Electronic credentialing would help me run a safer trucking operation”	-0.7	+2.3	-0.3	+1.2
“If we let our computers talk directly to the state’s computer, I’d be worried about privacy”	-0.9	-1.9	-1.9	-0.1
“Electronic credentialing would allow us to reorganize how we run the business, and help put more trucks on the road for more hours”	-0.9	-0.0	-1.3	-1.1

Source: Table K

The firms devoting more than 50 FTE days annually to credentials administration (12 percent of the total industry) were the most strongly enthusiastic of the subgroups examined.

Table 7-6 shows that their mean agreement scores were markedly more variable than for the sample as a whole, endorsing the positive and rejecting the negative statements more strongly than the other respondents. Other pockets of support illustrated in the table were the firms expressing dissatisfaction with their current credentialing processes (about one in three firms), and more guardedly, the 28 percent of firms currently using outside assistance to obtain at least some of their needed credentials.

**Claimed Likelihood of Using Electronic Credentialing**

We asked respondents to express a likelihood, on a scale from zero through ten, that the respondent’s firm would opt to use electronic credentialing if “within the next twelve months your company has the opportunity to start using electronic means to obtain credentials or permits

from at least one of the states with which you must register.” Of the firms replying to this, about 30 percent expressed some positive likelihood of doing so, as indicated by a score of six or greater.<sup>18</sup> About 20 percent indicated that they were “very likely” to do so by picking a score of ten, although almost all of these respondents had been unaware of electronic credentialing prior to reading the questionnaire. Another 31 percent chose zero to indicate that their firm would be “very unlikely” to use the new method. The mean of the likelihood scores was 4.5.

The subgroups with the highest mean likelihood scores were the firms currently devoting over 50 FTE days a year to credentialing (mean score 9.3), those with over 3 million annual fleet miles (8.7), and intermediate sized firms – those with 11 to 70 drivers (7.6) or 11 to 50 powered units (7.5). Least likely to use were the firms most satisfied with their current credentialing arrangements (1.9), those operating entirely within the same state (3.1), and those expending 5 or fewer FTE days on credentialing per year (3.5).

Given an open-ended invitation to explain their likelihood responses, respondents giving scores of six or higher most commonly mentioned better tracking of their “paperwork”<sup>19</sup> (44%), saving time (27%), or saving money (24%).<sup>20</sup> The most popular reasons for lower scores were limited computer equipment or expertise (18%) and fear of tracking problems (8%).<sup>21</sup> The former reason was particularly marked for intrastate and low fleet mileage carriers. The full set of verbatim answers to this question is listed in Appendix C.4.

### The Respondents’ Experience of Roadside Inspections

About 45 percent of firms keep data on roadside inspections, but less than a third of those routinely prepare summaries of the data.<sup>22</sup> For the most part, therefore, responses to our questions about the frequency of, and time involved in, roadside weight and safety checks were based on guesses rather than on data maintained by the firm.

For a recent twelve-month period, the average firm providing information about roadside checks estimated 168 size and weight checks (ones requiring the vehicle to stop) for its fleet, and 24 safety inspections. The estimated average amount of time spent per inspection was 19 minutes for size and weight checks and 45 minutes for safety checks.<sup>23</sup>

For those firms providing this information, we used their estimates of the numbers and the average durations for both types of checks to compute respondent-specific estimates of the total fleet-wide time taken up in checks annually. Table 7-7 summarizes the mean and median values for the fleet-wide estimates, while Table 7-8 shows those statistics on a “per powered

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<sup>18</sup> Table L.

<sup>19</sup> This was particularly marked among private carriers.

<sup>20</sup> Table M1.

<sup>21</sup> Table M2.

<sup>22</sup> Table N1.

<sup>23</sup> Table N2. These figures compare with mean times of 22 minutes and 40 minutes, respectively, derived from a previous survey. See The ATA Foundation (1996), *Assessment of Intelligent Transportation Systems/Commercial Vehicle Operations (ITS/CVO) User Services: Qualitative Benefit/Cost Analysis*, Alexandria (VA): ATA Foundation.

unit” basis. Because the industry is so highly skewed by firm size, the means and medians are sometimes quite disparate.

**Satisfaction with Current Roadside Inspection Procedures**

Table 7-9 shows the mean satisfaction scores expressed for several aspects of roadside inspections, using a scale of -5 (“completely dissatisfied”) through +5 (“completely satisfied”). The question wording asked specifically

“Overall, how satisfied are you with each of the following aspects of roadside inspections, as your company experiences them in the states in which your vehicles operate most? We are not asking for your opinion about whether there should be roadside inspections at all; rather, given that the states decide to make roadside inspections, how satisfied are you with the ways in which the inspections are carried out?”

**Table 7-7. Firm-specific Estimates of Annual Time Spent Fleet-wide in Roadside Inspections**

	Total annual fleet miles		
	200 K or less	Over 200 K to 3 million	Over 3 million <sup>24</sup>
Size & weight checks			
median value (vehicle-hours)	1.0	4.0	63.0
mean value (vehicle-hours)	1.1	108.2	290.5
Safety inspections			
median value (vehicle-hours)	2.0	9.0	100.0
mean value (vehicle-hours)	1.5	19.4	105.6
All roadside inspections			
median value (vehicle-hours)	2.0	10.0	163.0
mean value (vehicle-hours)	2.1	113.1	391.6

Source: Tables O, P, & Q

<sup>24</sup> Estimates in this column are strongly influenced by the data for the very largest firms.

**Table 7-8. Roadside Inspections per Year per Powered Unit**

	Number per year per powered unit		Total time per year per powered unit (vehicle hours)	
	Mean value ( $\pm$ 95% confidence limits)	Median value	Mean value ( $\pm$ 95% confidence limits)	Median value
Size & weight checks				
All firms	9.0 $\pm$ 6.6	1.0	2.4 $\pm$ 3.0	0.5
10 or fewer powered units	8.8 $\pm$ 11.9	1.0	2.3 $\pm$ 5.9	0.5
11 to 50 powered units	9.0 $\pm$ 8.0	7.1	2.2 $\pm$ 2.0	1.8
Over 50 powered units	17.5 $\pm$ 35.7	0.03	6.8 $\pm$ 15.9	0.01
Safety inspections				
All firms	2.4 $\pm$ 0.6	1.0	1.9 $\pm$ 0.5	0.5
10 or fewer powered units	2.4 $\pm$ 1.6	1.0	1.8 $\pm$ 1.2	0.5
11 to 50 powered units	2.5 $\pm$ 0.5	2.9	2.2 $\pm$ 0.5	2.9
Over 50 powered units	0.8 $\pm$ 0.7	0.05	0.5 $\pm$ 0.4	0.03

Source: CRA calculations based on the statistics for each firm

**Table 7-9. Satisfaction with Roadside Inspections**

Statement	Mean satisfaction score		
	All firms	High time spent in checks	High vehicle mileage
<b>+5 means "completely satisfied"; -5 means "completely dissatisfied"; zero is "neutral"</b>			
The types of checks made	+1.0	+2.5	+2.3
The frequency of inspections	-0.1	-1.7	-2.3
The fairness of the inspection process	-0.2	-0.8	-1.0
The criteria for deciding which vehicles to inspect	-1.1	-3.3	-4.2
The time spent in vehicle inspection itself	-1.1	-3.3	-4.1
The time spent waiting for inspection	-2.0	-3.7	-4.0

Source: Table R

Except for "the types of checks made," for which the mean satisfaction score was +1.0, the average respondent (in the "All firms" column) expressed weak to medium levels of dissatisfaction with all of the other listed aspects of roadside checks. The mean scores were negative and more than two standard errors from zero for the last three aspects listed in the exhibit. The time taken up by roadside inspections, both the inspection itself and waiting for it to take place, are obviously major concerns.

Not surprisingly, the dissatisfaction levels are more pronounced for two groups that experience roadside inspection the most: the firms with over 3 million fleet miles per year ("High vehicle mileage"), and those with over 15 vehicle-hours spent annually in such inspections ("High time spent in checks"). Both groups were more satisfied than average with the types of checks being made, however, suggesting that while these firms see a need or usefulness for inspections, they see room for improvement in the way the inspections are carried

out. These types of sentiments are illustrated also by the verbatim responses included in Appendix C.4.

When asked what suggestions they had for improvements to roadside inspections, the one idea that was expressed by respondents representing the greatest part of the industry was better targeting of vehicles. Other suggestions or comments offered by respondents included greater consistency or uniformity in the way inspections are carried out or regulations enforced, taking steps to reduce evasion (greater side road coverage, more portable inspection units, etc.), better enforcement of regulations, and better inspectors.<sup>25</sup>

### Awareness and Use of Electronic Screening

Survey respondents were told that

“Some places are beginning to use a new method of roadside screening that is sometimes called ‘*Mainline screening*.’ This is where an electronic transponder on board the vehicle allows enforcement officials to identify vehicles as they travel along the road at highway speeds. Vehicles operated by carriers with good safety records will not be signaled to pull in or stop for safety checks. Carriers may pay an annual fee per vehicle, allowing an unlimited number of uses over the year (as with the ‘*NORPASS* program’), or they may be charged each time an equipped vehicle passes an inspection site (as with the ‘*HELP PrePass* program’).”

About two out of every three firms said that they had not previously heard about this development. Only 7 percent of the firms claimed to be using mainline screening already. The remaining firms (27 percent) had heard of electronic screening, but three-quarters of them did not expect to be using it within the next two years.<sup>26</sup>

Awareness increased with the size of the firm, with the amount of vehicle time currently spent in roadside inspections, and with the level of dissatisfaction with current screening procedures.

When asked, in an open-ended question, for “the most important reasons for or against your company participating in a program like this,” several themes emerged. The most common were potential time savings (43 percent of all mentions) on the positive side; and on the negative side, various concerns about aspects of privacy and “Big Brotherism,” (24 percent), and the costs of participation (24 percent).<sup>27</sup>

We also asked respondents whether they were aware that, in some states, inspection and enforcement staff might have information about an individual carrier’s safety history, or about individual vehicle condition and compliance, available to them in making screening and

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<sup>25</sup> Table T.

<sup>26</sup> Table U.

<sup>27</sup> Table V.

inspection decisions. Of the firms responding, 34 percent said they were aware that a carrier's safety history might be known to the inspector,<sup>28</sup> and 22 percent said that they were aware that the vehicle condition information might be known.<sup>29</sup>

### Opinions About Electronic Screening

In a similar manner to the comparable question about electronic credentialing, we asked respondents to indicate their levels of agreement or disagreement with nine different opinion statements, using an eleven-point scale. Table 7-10 summarizes the mean agreement scores.

Across all the respondents, there was a general tendency to agree with the statements, both positive and negative, about electronic screening. For all but the last three statements listed in the exhibit, the mean agreement score was greater than two standard errors from zero. The three statements garnering greatest agreement sample-wide were negative about electronic screening or its applicability to the respondent, but there was also a significant level of endorsement for "Even without equipping our vehicles, we would probably benefit if the inspection officials had better information" and "These types of changes will make the roadside inspection system significantly more fair."

Table 7-10 also shows the mean agreement scores for three subgroups who might be expected *a priori* to be interested in electronic screening to a greater extent than the average firm: those with more than 15 vehicle-hours spent annually in roadside checks fleet-wide, those expressing dissatisfaction with the current roadside inspection arrangements, and those with over 3 million fleet vehicle miles per year. With some interesting variations in the case of a few of the statements, it is generally true that these three groups were more strongly in agreement with the positive statements and less ready to endorse the negative statements. But despite the fact that there appears to be a significant constituency among trucking firms for fair, vigilant, and uniform enforcement, all groups appear to harbor concerns about the technology's ability to permit increased governmental regulation.

Finally, we asked whether "any recent changes in roadside inspection or enforcement policies in the states in which your trucks operate caused your company to spend additional dollars, either to take advantage of streamlined inspection procedures or to improve your compliance with the safety regulations?" For 65 percent of the firms responding, there had been no increase from the previous year. About 15 percent thought that they had spent additional amounts, and the residual 20 percent were not sure. Claims of increased spending were greatest for firms operating on a national or international scale, and those with over 15 vehicle-hours spent in roadside checks annually.<sup>30</sup>

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<sup>28</sup> Table W1.

<sup>29</sup> Table W2.

<sup>30</sup> Table Y.

**Table 7-10. Opinions about electronic screening**

Statement	Mean agreement score			
	All firms	High time spent in checks	Dissatisfied currently	High vehicle mileage
+5 means “agree completely”; –5 means “disagree completely”; zero is “neutral”				
“We’re too small to justify thinking about putting transponders in our units”	+2.8	–3.3	+1.6	–3.7
“Equipping all our units with transponders is likely to cost my company more than we’d save”	+2.7	+0.5	+2.6	+0.2
“I’m concerned that changes like these will help the states to <i>expand</i> regulation and charges in new ways”	+2.3	+2.6	+1.3	+2.3
“Even without equipping our vehicles, we’d probably benefit if the inspection officials had better information”	+1.9	+4.2	+1.4	+3.9
“I worry about government agencies having so much information about our vehicles”	+1.7	+2.3	+1.5	+2.6
“These types of changes will make the roadside inspection system significantly more fair”	+1.2	+3.6	+1.2	+4.2
“Even if the time spent in safety and weight inspections were halved, there’d be very little impact on our costs”	+0.4	–3.2	–1.0	–4.1
“I expect that our drivers would be pleased by these types of changes”	+0.3	+3.4	+0.4	+3.6
“If these new inspection methods were more widespread, I expect we’d make significant time and cost savings”	–0.0	+3.6	+0.9	+3.8

Source: Table X

**Driver Survey Overview of Findings**

This qualitative survey of truck drivers suggests the following conclusions:

- In discussing with these drivers the aspects of highway weight checks and safety inspections that concerned them (for example, in distinguishing between “good” and “bad” states), three themes recurred the most: the professionalism and attitudes of *inspectors*, the frequency and thoroughness of *inspections*, and the standards for *facilities and equipment*. The respondents spoke of differences between the states in the ways in which the inspection personnel treat them. They spoke about the level of detail of safety inspections; what was regarded by some as a good thoroughness was viewed by others as “pickiness,” or showing more concern with revenue-raising or enforcing the letter of the law than with safety.
- There was fairly universal condemnation of two practices that drivers regarded as inherently unsafe. The first is the setting up of temporary inspection sites at the side of the road, pulling over trucks for inspection. Drivers expressed the opinion that it should be feasible in many cases to conduct these inspections in safer places than immediately by the roadside. The second is the tailback of trucks at scalehouses

extending back out onto the highway. The drivers thought that when that occurred, it should be legal for newly-arriving trucks to pass by without stopping.

- Other changes that would improve inspections from the drivers' viewpoint include more standardization of rules and procedures across states (or greater cross-state coordination of inspection findings), and improved differentiation as to which vehicles or firms most merit inspection.
- Twenty-three of 59 drivers interviewed had some personal experience of electronic screening. In fact, only 11 of the drivers claimed that they had not heard of electronic screening before; the remaining 25 had heard of the concept and 11 of them had discussed it with drivers who had personal experience of using it. *PrePass* was much better known than other electronic screening systems.
- Among the drivers with personal experience of electronic screening, the opinions about it were markedly positive, in net. Time savings were the primary reason. Only one experienced driver was more negative about the concept than positive; he had apparently not realized significant time savings. The most frequently mentioned deficiency of electronic screening concerned the limited set of states currently allowing electronic screening, and the fact that the various systems were not interchangeable. Beyond that, there was a little concern about "big brotherism" and possible health risks from the technology, but these comments were much less frequent than the words of strong praise.
- A similar response was obtained from the drivers who had no personal experience of electronic screening but who had talked about it with drivers who had such experience. Among the group with a lower level of engagement (those previously unaware, or aware but who had not discussed it with experienced drivers), there was more skepticism, more of a "show me" attitude. While slightly more of them had a net positive response than a net negative response, they raised possible drawbacks that the others had not. One was a concern that safety might be impaired; another that drivers working for firms with poor records would not benefit; and there was also concern about whether or not the technology working properly
- On average, the 19 owner-operators in our sample each spent 11.9 person-hours per year and paid a little over \$340 per year in costs<sup>31</sup> to obtain credentials and permits.
- Awareness of electronic credentialing was much lower than for electronic screening. None of 18 respondents had any personal experience of using it. Only one had discussed it with a peer who had used it, and five more claimed to have heard of the idea, but not to have discussed it with anyone who had used it. The residual 12 owner-operators had not been aware of electronic credentialing prior to the interview.

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<sup>31</sup> This amount does not include the costs of the permits themselves, just the out-of-pocket costs associated with the registration and acquisition *process*.

- Nonetheless, the balance of the “top of the head” reactions was quite positive, many drivers expressing an interest in finding out more about it and foreseeing that it might help make their lives easier. There was no concern expressed about needing to be computer-literate to take advantage of the idea. Negative reactions focused mostly on “big brotherism” concerns.
- In summary, the overriding tenor of the driver survey responses to these two CVISN innovations was quite strongly positive.

## Driver Survey Results

### The Respondents' Experience of Roadside Inspections

All 61 of the respondents, owner-operators and employees alike, were questioned about roadside inspections. First, they were asked to list the US states in which they could remember “having been weighed or inspected during the last four weeks.” Responses ranged from just one state up to 46 (for one person, the states were too numerous to remember). The average number of different states reported was 6.7 for the Connecticut-intercepted (henceforth, CTI) drivers and 9.7 for the Kentucky-intercepted (KYI) drivers.

The states mentioned by more than a third of the respondents as ones where they had been weighed or inspected recently were Ohio (25 mentions); Georgia, Kentucky, Tennessee, and Virginia (each 23 mentions); and Illinois (20 mentions). Other frequently mentioned states (with 15 or more mentions) were Connecticut, Indiana, Michigan, Missouri, North Carolina, and Pennsylvania.

To set the stage before talking with the drivers about any inspection innovations, at the start of the interview we asked, “From your point of view, are there any states where weight and safety inspections are handled significantly better than others? And are there states where you think weight and safety inspections are handled particularly poorly?” States cited as particularly good included California, Kentucky, and Tennessee (7 mentions each); Georgia (6 mentions); Connecticut and Virginia (5 mentions); and New York (4 mentions). Particularly poor states, from the drivers’ viewpoints, were California (10 mentions); Ohio (7 mentions); Connecticut and Tennessee (6 mentions); and Kentucky, Missouri, and Virginia (4 mentions).

The duplication of five state names near the top of both the “good” and “poor” lists points up the diversity of opinion, and suggests that familiarity may be a major determinant of whether a state would be mentioned as particularly good or poor. When we ranked the states by their *net* positive mentions (number of times cited as one of the best minus the number of times cited as particularly poor), the states at the top of the list were Georgia, Kentucky, Maryland, Iowa, New York, and Arizona.

More interesting are the reasons the respondents gave for their choices, when asked “What types of differences between the states makes a state particularly good or bad?” Three themes recurred the most: the professionalism and attitudes of *inspectors*, the frequency and thoroughness of *inspections*, and the standards for *facilities and equipment*.

The aspects of *inspector* behavior eliciting most comment (negatively) was “attitude,” but some drivers also rated states highly because of good inspector characteristics:

“[CO, MD, OH are good because] their attitude to start with; they don’t have that ‘cop’ attitude. Friendly attitude and treatment.”

“[In NY] the officers are more friendly and personable; they act in a professional manner.”

“[In CA and NY, they have] older, more experienced patrolmen, better and more fair.”

“Attitude, the way they talk to drivers [in TN], like we don’t got good sense.”

“[In bad states, they’re] looking too hard for problems to write a ticket; a holier-than-thou attitude.”

“Tennessee has terrible officers, very uncooperative and smart-mouthed. They abuse their authority.”

“[In KS and MO] they don’t go by the rules looking for stuff. They go under the rig with a wrench then tell you you got brake problems. One guy’s with you looking in the back while the other one’s in the front going through your personal stuff.”

“[In NC and VA they are] strict. Attitude that they care strongly. Neat and clean uniforms; the officers are clean.”

The *frequency and thoroughness* of inspections was an aspect on which respondents differed. For many, thoroughness was a good thing, but what some saw as thoroughness others saw as “picky” behavior on the part of the inspectors, more interested in punishment or in revenue-raising than in furthering highway safety. The epitome of a thorough or nitpicky state, depending on viewpoint, was clearly California:

“[CA is the] most thorough; they hassle you. . . . They need to give you a chance to fix things. They write you up for tinted windows and other not important things.”

“[In CA] things that pass inspection in other states don’t pass here. They’re nitpicking, looking for revenue.”

“[In CA] they don’t care about safety, all they want is to write a ticket and fine you.”

“Good states [like CA, IN, KY] are more thorough. DOT officers are not a money-doing job, [and are?] without a bad attitude.”

“[In CA] they’re gonna find something wrong with nitpick – they’re out for the money. In Missouri, they give you breaks, no tickets – they’re not out for the money.”

“Some states [like CA, KY, MI] get really picky about insignificant, picky things. They’ll pull you out of service for minor violations which shouldn’t even be looked at.”

“[In CA and WY] scales are open more often. When they pull you in for an inspection they do a good job.”

“California is quite a bit stricter – well, a little too strict, like they get you for a minor oil leak.”

“[In CT] they’ll stop you and go around the trailers to check lights, tires, a full check-up on you – that’s good.”

Generally speaking, drivers appreciate inspection sites with better *facilities and equipment*. A few specifically mentioned weigh-in-motion and electronic screening systems (for example) as aspects that make a state relatively good:

“Lots of drivers don’t like Kentucky because the scales are always open. Kentucky has the supercoop – a full service inspection [where they] put you over a service bay and check every aspect.”

“[In good states, they have] good proper facilities; actually got underneath and looked.”

“Louisiana and Nebraska have weigh-in-motion. You don’t have to stop, and unless within 2,000-3,000 lbs. they won’t pull you in. Arkansas has *PrePass*.”

“[In LA] they’ve got the rolling scales. If you’re overweight they pull you around back. The scales are in the road on the right lane; you go across and you can bypass the scales.”

“In Virginia, it seems like it takes longer to get through their scales. That’s where the WIM scales help out; they’re quicker, and you roll right by.”

“[Good are] *PrePass* states; Iowa is going to have it.”

“The places with the newer facilities are the best. They’re easier and accurate.”

“[About CT: I like] the size of the station – you can easily get in and off, and then get back on the road. The facilities are well-maintained and well-lit. [In bad states,] too small, no lighting.”

“[Good states] have better scales, more sophisticated scales in the road.”

Relatedly, there were several grouses about what respondents perceived to be less-than-adequate arrangements for weight checks or safety inspections – portable scales, roadside pullovers, long lines for inspections backing out onto the highway, and long delays:

“Alabama doesn’t have any scales for trucks. Some places don’t have the equipment to do nothing.”

“Texas doesn’t have permanent stations; they just set up places along the road.”

“Some scales are old and outdated, and trucks back up to the highway and that is a hazard. Only holds 10 trucks; it’s bad and takes longer.”

“[In OH and MI] traffic is backed up, very dangerous. There’s not enough room to conduct inspections.”

“[Bad states:] portable weigh scales take longer and are not accurate.”

“Inspection on an emergency basis by the DOT is unsafe, it should be in a proper area. DOT or state troopers pull people over.”

“They pull you over on the side of the road; instead they could call you on the CB and tell you to take the next exit.”

“Connecticut takes too much time. If they have a problem with a driver they leave him in line and back everyone up.”

“[Bad states] don’t have any run-over scales, and they use portable which are more time-consuming.”

Many of the same themes were heard in response to the next question. We asked “If you could suggest or make changes to the ways in which roadside inspections are typically organized and conducted, that would not result in more unsafe vehicles on the roads, what would be your highest priorities?” Of the 55 drivers who offered suggestions, by far the most common “most important change” (from 21 of them) was to limit inspections to places where they could be done safely, most notably *not* on the hard shoulder at the side of the road:

“I don’t mind inspections, but I want them safe.”

“They need to move roadside inspections to off the road, like a rest stop or something else, but they do it right there on the side – real gutsy.”

Suitable locations were thought to be parking lots, weigh stations, rest areas, even exit ramps, but not at the side of the fast-moving highway itself.

A related suggestion (mentioned by seven drivers as their most important change) was to make sure that the backed-up queues of trucks at weigh stations do not stretch out onto the highway, thereby causing a safety problem. When the queue reaches the end of the ramp, it should be legal to bypass the facility, said most of these respondents.

The following were suggestions each made by five drivers as part of their most important improvements:

- More standardization of rules and procedures across states, or greater cross-state coordination of inspection findings:

“I was pulled over in Northern Kentucky and went right on down the road and got pulled in again in Ohio for another; they wouldn’t even accept the DOT papers.”

“Why can’t all systems work together? [On] I-75 they have *Advantage 75*; my transponder won’t work on it. More states should have *PrePass*. If you run legal like we do, [there’s] no reason to get pulled over or stop.”

“It would be good if they all did the same thing, you know, followed the same rules across the country. You got different rules in different states.”

“Use a sticker system to avoid being inspected again.”

- Improved differentiation as to which vehicles or firms most merit inspection (with small firms mentioned several times as justifying more inspection than larger firms).
- Not surprisingly in view of the earlier comments, some drivers thought that the most important improvement would be to focus on the quality, training, knowledge, or attitude of the inspectors.

Other suggestions receiving lower levels of endorsement by their peers but still worthy of recognition here included calls for more electronic screening; more weigh-in-motion scales; mandatory periodic inspections at a safely-located, well-equipped location; grace periods for the correction of deficiencies; greater differentiation with regard to potential deficiencies, focusing on things most important to safety; and more frequent, less intensive or time-consuming checks, focusing on particular items at particular times.

## Awareness and use of electronic screening

Survey respondents were next told that

“Some places are beginning to use a new method of screening trucks for weight, safety, and proper credentials that is sometimes called “*mainline screening*” or “*electronic screening*.” This is where an electronic transponder on board your truck allows the enforcement officials to identify your vehicle as you travel along the road at highway speeds. Vehicles operated by carriers with good records are less likely to be signaled to pull in or stop for safety checks. The programs like this that are best known are the “*NORPASS* program, the “*HELP PrePass* program,” and the “*Oregon Green Light program*.”

Of the 59 drivers answering a question about their awareness of this development, 11 drivers said that they had not heard of electronic screening before; 9 of these were Connecticut intercepts. Twenty-three drivers claimed personal experience of using electronic screening. This compares with 7 percent of the trucking firms nationally that claimed to be using mainline screening in answer to an almost identical question in the companion National Motor Carrier Survey. Remember, however, that the intercept locations were selected in part to improve our chances of finding drivers with personal experience of CVISN-type innovations. The remaining 25 respondents were aware of electronic screening, and eleven of them had talked with drivers who had used it.

We asked the 23 respondents who had personal experience of using electronic screening to tell us the details of that experience: in which states, with which electronic screening program, for how long, and so on. Sixteen of the 23 were employees of companies with 40 or more drivers, and 2 were from firms with fewer than 40 drivers. The remaining 5 respondents with personal experience of electronic screening were owner-operators, but all 5 of them appeared to be leasing their vehicles from a “brand name” firm.

For most of these people, electronic screening was relatively new. Their experience with it stretched back a matter of months or one or two years, for the most part; the longest claimed experience was four years. A couple of the drivers remarked that only some of the vehicles in their employers’ fleets were transponder-equipped.

Among the people mentioning various systems, *NORPASS* was mentioned by only one person and *Advance 75* by only one person. The awareness of *PrePass* appeared to be much higher than for any other system. Respondents ranged in their awareness from one (atypical) who had encountered a system

“ . . . in another truck, but hasn’t been used. I really don’t know enough to say about that stuff.”

to some who could readily reel off a list of the states where their system was used.

### Opinions about electronic screening

We asked the 23 drivers with personal experience of electronic screening and the 11 who told us they had talked about it with other drivers who had personal experience:

“From your own experience, or from what you have heard from other drivers, how well does mainline screening work? What are the good things and the bad things about it?”

The remaining 25 respondents who had been unaware of electronic screening, or aware but had not talked about it with anyone who had personal experience, were instead asked:

“From your viewpoint as a driver, what do you think about mainline screening? Do you think it would be a good idea or a bad idea? Why? What things do you think you would like most about it? What things would you like least? Why?”

By and large, the response from the people with direct personal experience of electronic screening was overwhelmingly positive, primarily because of the time savings:

“If I get stopped it allows me to move on, no down time. Should have started it years ago. [It’s a] good idea. Trucks are often backed up on the highway when scales are closed, and it causes accidents. The transponder allows trucks to keep moving.”

“It seems like a good idea. It saves time and it improves the flow of traffic. [I have] nothing negative.”

“Good. I don’t have to go in to scales. It saves time, I don’t have to wait. Only good. I got a little book about how it works from my company. It never malfunctions that I know of.”

“A great thing. You don’t have to sit out on the road in long lines, where accidents occur.”

“Excellent idea – more standards for more tolls. DOT should make it mandatory. I love the green light. I want to use it for all and not [just] some states. Since DOT is nationwide, why can’t *PrePass* be nationwide?”

“I love it. . . . The best thing there is, the finest. It cuts down a lot of time. Everyone should have it.”

“It’s very convenient; I drive through at 30 mph.”

“Excellent idea.”

“Best thing [they] ever came out with. I like it all.”

The most frequent negative comment concerned the limited set of states currently allowing electronic screening, and the fact that the various systems were not interchangeable. Beyond that, there were a couple of comments about “big brotherism”:

“They can electronically track you. They can look up there and tell where I am within three feet.”

“It’s a tattletale, it tells too much.”

One concern about possible health risks:

“It saves time, but it could be harmful for a driver’s health, like radar. It hasn’t really been tested.”

And finally, one user who was less than convinced on functionality grounds:

“I’ve been using for three months. Ten percent of states accommodate it. If the weight is balanced and not over gross, everything is OK. The transponder doesn’t save that much time. There’s just less chance of being harassed. It’s mounted in a bad spot on the windshield and creates a blind spot. It’s a joke.”

The comments were quite similar from the eleven drivers who did not have personal experience of electronic screening but had spoken about it with other drivers who did. Of the eleven, nine (perhaps ten) appeared to be broadly in favor, and the general sentiment was

“I wish my company had it.”

There was one clearly negative opinion:

“I don’t like it because it is like living in a fish bowl. I got DOT, the police, my company all after me. You’ve got that Qualcomm satellite and computer on my truck.”

And one somewhat mixed view that was also confusing electronic screening with other technologies and issues:

“[The bad part is the] logbooks. If we all had to run legal logbooks, we’d all go broke. I think it is a failure. We don’t want to be tracked. I think it works great as far as not having to stop at scales. It’s convenient for truckers as long as you stay in [good?] standing.”

For the group of 25 drivers with low levels of awareness of electronic screening, the opinions were decidedly more varied. On the basis of the balance of their comments, we classified one respondent as strongly positive, 13 as weakly positive, 6 as weakly negative, and one as strongly negative. The remaining four appeared neutral. The perceived positives of electronic screening were mostly time savings and the reduction of backup lines at scales.

Expressed concerns included “big brotherism” again, as well as the costs. But some new themes were also aired. One was a concern that safety might be impaired; another that drivers working for firms with poor records would not benefit; and there was also concern about the technology working properly:

“[The thing I like the least is] things [an inspector] may see that a driver hasn’t seen. If you bypass the scales, he wouldn’t see. It wouldn’t be as safe for the driver.”

“It’ll save truckers a few minutes but it won’t inspect trucks and some unsafe ones will get through.”

“[The thing I like the least is it’s] bound to get someone whose truck shouldn’t have been on the road but it’ll go through.”

“If a company has a good reputation they shouldn’t be inspected as much. My firm had a rep for being over hours and if they saw us they pulled us over.”

“If it’s electronic they may fail and cause more problems. It might fail like my dispatch system sometimes [does], even though they say it shouldn’t.”

There was some concern about owner-operators, and not just from the owner-operators themselves:

“We’ll figure out owner-operators aren’t getting checked up as often, and will target those types of drivers. Big firms need to be checked too because we don’t inspect the truck.”

“Bad idea. Just because it’s company-owned doesn’t mean they should pass by. We don’t do an inspection, we do a visual, kick the tires, etc. They’ll single out the owner-operators.”

“Bad idea. It’ll cost the independents. It won’t hurt companies too bad because they have more money.”

Eighteen owner-operators without personal experience of electronic screening were asked to characterize their likelihood of starting to use it if they had the opportunity to do so “in at least one of the states through which you travel regularly” within the next twelve months. Eight of the 18 classified themselves as “very likely,” one said “somewhat likely,” one said “somewhat unlikely,” and five said “very unlikely.” Two volunteered that it would depend on the costs, and one could not say.

With the exclusion of the five “very unlikely” respondents, the remaining owner-operators were asked whether they would prefer to pay for such a service on an “annual fee per truck” basis (4 positive responses) or on a “fee per inspection site passed” basis

(2 positive responses). For two respondents, it would depend on the costs, and the others were unable to express an opinion.

We also asked our respondents whether they were aware that, in some states, inspection and enforcement staff might have information about an individual carrier's safety history, or about individual vehicle condition and compliance, available to them in making screening and inspection decisions. Of the 59 drivers responding, 47 said they were aware that a carrier's safety history might be known to the inspector, and 38 said that they were aware that the vehicle condition information might be known. These awareness proportions are somewhat higher than those for company management, in responses to identical questions asked in the National Motor Carrier Survey. However, we caution about reading too much into this difference. The driver survey locations were chosen to increase our chances of finding drivers with experience of CVISN-type initiatives, and we also suspect that drivers might be more inclined to over-claim their awareness in response to a question like this.

### The Respondents' Experience of Credentialing

We asked the 19 owner-operators in the sample to estimate the total time that they needed to devote annually to acquiring stickers and credentials, including any time spent traveling to and from registry offices. Fourteen people ventured estimates ranging from 40 person-hours per year down to zero. In the latter case, offered by four respondents, some mentioned that credentialing matters were handled by someone else on their behalf. The mean number of person-hours spent was 11.9 per year.

We also asked these owner-operators whether, disregarding the fees paid for the permits themselves, they incurred any other out-of-pocket costs to handle credentialing matters (such as fees paid to agents). Some could not say because the credentialing costs were bundled with the lease of the vehicle. Five owner-operators offered estimates ranging from \$300 to \$1,860 per year, and averaging \$1,092 per person making such payments. Including the owner-operators with no out-of-pocket credentialing expenses, the mean was a little over \$340 per year per owner-operator.

### Awareness and use of electronic credentialing

The owner-operators were told

“Some states are now using electronic (computer-to-computer) methods for obtaining credentials or permits. This electronic credentialing is the situation where you would send your information electronically direct to the state's registration agency, *not* to an outside company who would then file the application on your behalf.”

Twelve of 18 respondents told us that they had never heard of electronic credentialing before. None of the 18 had any personal experience of using it. Five had heard of the idea, but had not talked with any driver who had used it. Only one had spoken with another driver with personal experience of electronic credentialing. These incidences are quite consistent with the very low levels of awareness and experience found in our National Motor Carrier Survey.

### Opinions about electronic credentialing

Given this general lack of awareness before the interview, respondents' impressions of electronic credentialing would obviously be influenced by what (little) the interviewers had said in describing the concept. But the first impressions were substantially favorable:

“Good idea – get rid of the paper and time. This is a time-sensitive business. [A] bad thing might be it doesn't allow you to cut corners and loopholes; it may be too restrictive.”

“That would be nice, to sit at a computer and send it in electronically. It'd be easier and more convenient for me.”

“Good idea, but I'd have to know more about it. Anything that cuts time, costs, and red tape are always good.”

“From what you're saying, it'd be a good idea. It would save time and money. Big firms don't care because they have lots of money. I'm one driver with one truck, and I have to watch my money.”

“Run[ning] it through the computer would be a good deal.”

“A good idea. The fact that I can file everything before I leave [would be] very convenient. Convenience is the key.”

“Very interested. [It's a] pretty decent idea.”

“Good idea. Save time and travel; that's it, it saves gas money.”

“Very interested as long as it will streamline the process.”

Somewhat surprisingly, no one mentioned being fazed by needing a computer. There were several comments of the “big brotherism” variety, but generally these were from people whose first reaction was still favorable. Of the two totally negative responses, one was from an owner-operator whose credentialing was currently handled by the vehicle lessor:

“Not interested. I want someone else to do it, then if it's wrong it's their fault.”

while the second opined

“I don't trust the electronic end of it. Someone else could get your information. I prefer U.S. Mail, or straight to the office.”

### **Administrator and Roadside Enforcement Overview of Findings**

A separate DOT/FHWA report (2000) outlines the lessons learned from ITS CVO deployment, according to state administrators. Among the findings are the following:

- State commercial vehicle enforcement agencies recognize that *safety information exchange* technology facilitates the inspection process and helps focus inspection resources on high-risk carriers (i.e., those with poor safety records). Almost all states are deploying Aspen or equivalent software because state safety officials believe that the use of safety information at the roadside enhances the inspection process and helps inspectors focus on high-risk carriers. The major issues include the technical challenges involving communication between the roadside and state offices using wireless technologies. The cost and technical challenges to deploy CVIEW and SAFER Data Mailbox (SDM) are also major concerns with state administrators. However, the general reactions of states using CVIEW and SDM are positive.
- The potential benefits of *electronic screening* are widely acknowledged, but several key issues may affect further deployment of electronic screening. Most people in the CVO industry agree that interoperability, or the ability for a vehicle to operate with the same equipment and under similar rules as it travels from state to state, is critical to increased participation.
- Although most states are committed to deploying *electronic credentialing*, these systems have not yet achieved the same level of widespread deployment as seen with roadside systems. This result primarily stems from the many technical challenges involved in establishing interfaces between new and legacy, or archival, databases and software systems.

The final evaluation report on the I-95 and SAFER Data Mailbox FOTs (2000) describes the methods used and presents detailed findings from the survey of roadside enforcement personnel. Among the findings are the following:

- Using Safety Information Exchange technology has become integral to the jobs of most roadside inspectors who participated in surveys and focus groups as part of the I-95/SDM evaluation. This technology can save time and improve the speed and accuracy of data reporting. Other benefits reported include more uniform reporting and greater credibility with the motor carriers.
- Motor carrier inspectors perceive that ISS helps them to identify high-risk carriers.
- Inspectors reported high levels of satisfaction with the laptop computer system for inspection reporting, citing the legibility and professional appearance of reports as a major benefit. Inspectors reported using a core of computer-based services related to Aspen, ISS, and SAFER. Among the software applications, ISS enjoys the most widespread use in inspections.
- Computer-based inspections are seen to represent a significant improvement over previous, paper-based systems, making the work of inspectors more efficient. Overall, inspectors tended to speak in terms of more immediate, day-to-day benefits rather than long-range impacts on highway safety.

### **7.3 REFERENCES**

“Evaluation of the I-95 Commercial Vehicle Operations Roadside Safety and SAFER Data Mailbox Field Operational Tests,” Draft Evaluation Report from Battelle to U.S. DOT ITS Joint Program Office, June 29, 2000.

“What Have We Learned About Intelligent Transportation Systems?,” U.S. DOT Federal Highway Administration Report, Chapter 6, EDL No. 13316, December 2000.

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## CHAPTER 8. CVISN BENEFIT/COST ANALYSIS

This chapter describes a comprehensive benefit/cost analysis (BCA) that has been carried out for the CVISN MDI. Benefit/cost analysis is a public sector evaluation tool that compares all of a project's benefits to society to all of the project's costs to society. The question to be answered in a BCA is: Do these benefits exceed the costs? If the answer is yes, the benefit/cost ratio (BCR) is greater than one, and the project is said to be *economically* "feasible" or economically "justified." *Commercial* feasibility, the analogous private sector criterion, is much narrower in the benefits and costs it compares. Benefits are restricted to commercial *revenue*, and costs are limited only to those paid directly by the project developer.

### 8.1 APPROACH

In the case of CVISN, considerable public benefits can be expected. However, revenue paid by CVISN users is essentially zero since CVISN is intended to make a regulatory system operate at lower cost and increased effectiveness to both its users and to society. The benefits quantified for inclusion in this BCA do not include every conceivable public benefit of CVISN, but they do include the major categories of *benefits*:

- Roadside Enforcement [including safety information exchange (SIE) and electronic screening]
  - Crashes avoided
  - Transit-time savings [including operating and maintenance (O & M) and air and noise pollution]
- Electronic Credentialing
  - Operating cost savings to states
  - Operating cost savings to carriers
  - Inventory cost savings to carriers

The *costs* included in the BCA include:

- Roadside Enforcement
  - One-time start-up costs to states
  - Replacement capital costs to states in future years
  - Increased operating costs to states
  - Increased operating costs to carriers
  - Increased out-of-service (OOS) costs to carriers

- Electronic Credentialing<sup>1</sup>
  - One-time start up costs to states
  - Replacement capital costs to states in future years

All costs and benefits occurring each year between 2000 and 2025 are included in the BCA and each is discounted back to 2000 using both a 4 percent and 7 percent real discount rate to calculate the present values of the benefits and costs in 1999 dollars. The use of a 4 percent real discount rate in these benefit/cost calculations has been recommended by economists in both the public and private sector.<sup>2</sup> The use of a 7 percent real discount is a more stringent test and has been required for nearly two decades for use in BCAs of federal programs by the U.S. Office of Management and Budget (OMB).

The categories of benefits and costs are different and more limited for electronic credentialing (EC) than for roadside enforcement (RE). For the former, they include only costs and cost savings, while for roadside enforcement, the over-the-road operations of motor carriers are directly affected. This leads to a more extensive array of costs and benefits including crashes avoided and truck transit-time savings. For these reasons, we have conducted the BCA separately for three CVISN roadside enforcement (RE) scenarios and two electronic credentialing (EC) scenarios. The scenarios represent varying options and layers or phases of CVISN deployment, and also various possible effects that CVISN technologies may have on state enforcement and motor carrier/driver behaviors and operations. Each scenario is described below.

### **Roadside Enforcement Scenarios**

Three national scenarios are evaluated for CVISN's roadside enforcement element. These consist of increasingly more comprehensive application and effectiveness of CVISN components.

*Scenario RE 1.* Upgrade of fixed inspection sites to Aspen capability, including PCs and printers to provide improved data for selecting high-risk vehicles for inspection. However, no electronic screening capability is included.

*Scenario RE 2.* Electronic screening and all inspections focused on high-risk vehicles, with no assumed change in compliance rates. Improvements include those in Scenario RE 1 plus automated vehicle identification, mainline weight-in-motion, electronic signs, loop detectors, electronic snapshot capability, wireless communication, SAFER mailbox, CVIEW or equivalent, and in-truck transponders for low-risk vehicles.

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<sup>1</sup> Start-up and replacement capital costs to carriers are assumed to be small or zero since only a personal computer (PC) is required, which essentially all carriers have.

<sup>2</sup> E.g., U.S. EPA, "Guidelines for Preparing Economic Analyses," June 11, 1999, Chapter 6: recommends a real rate of 2 to 3 percent for some public projects.

*Scenario RE 3.* Scenario RE 2 with the assumption of a 25 percent decrease in motor carrier safety regulation violation rates.

Finally, to assess the sensitivity of the findings to changes in assumptions, one additional roadside scenario is defined as

*Scenario RE 3\*.* Scenario RE 2 with the assumption of a 10 percent decrease in motor carrier safety regulation violation rates.

## **Electronic Credentialing Scenarios**

Two scenarios are evaluated for electronic credentialing.

*Scenario EC 1.* End-to-end IRP credentialing for those states with in-house credentialing interface systems (i.e., currently not using VISTA), as well as end-to-end IFTA and the IRP clearinghouse.

*Scenario EC 2.* End-to-end IRP credentialing *with* VISTA for those states currently using VISTA, as well as (again) end-to-end IFTA and the IRP clearinghouse.

Descriptions, deployments, and costs of each of these improvements are presented in detail in Chapters 2, 3, and 6.

Section 8.1 summarizes the results of the BCA. Section 8.2 gives additional background on the factors used in the BCA, and the approach to analyzing these factors. Section 8.3 details the results of the analysis as projected for the years 2000 to 2025. Section 8.4 presents the results of a qualitative discussion of reduced pavement damage as a related benefit of increased targeting of overweight trucks. Supporting data and economic modeling tables for the BCA appear in Appendices D.1 through D.3.

## **8.2 SUMMARY OF RESULTS**

Tables 8-1a to 8-1e summarize the results of the BCA for each of the five scenarios using the more stringent 7 percent discount rate.

For the three roadside enforcement scenarios, Tables 8-1a to 8-1c show that the BCRs range from 0.62 to 5.0, depending on the scenario. For the simplest roadside enforcement scenario, RE 1, which is the upgrade to Aspen without electronic screening, the BCR is less than 1.0, showing that Aspen by itself is economically not worthwhile. For the two roadside enforcement scenarios that involve electronic screening, RE 2 and RE 3 (and RE 3\*), the BCRs increase considerably, as do the present values (NPVs) of the net benefits of these improvements. For Scenario RE 2, which assumes no change in compliance behavior, the NPV is over \$2.5 billion. With improved compliance behavior, which is an important objective of these systems, the increase in the NPV is truly impressive, totaling \$5.7 and \$10.4 billion for Scenarios RE 3\* and RE 3, respectively. Therefore, the systems involved in the two roadside enforcement scenarios that include electronic screening and travel time savings to carriers are

economically well justified, even with the use of the more stringent 7 percent real discount rate. All costs are expressed as U.S. dollars in 1999.

**Table 8-1a: Scenario RE 1: Upgrade to Aspen Only**

Total Benefits	\$69,076,000
Total Costs	111,591,000
Net Present Value	\$42,515,000
Benefit/Cost Ratio	0.62

**Table 8-1b: Scenario RE 2: Electronic Screening with No Change in Violation Rates**

Total Benefits	\$5,301,300,000
Total Costs	2,635,900,000
Net Present Value	\$2,665,400,000
Benefit/Cost Ratio	2.0

**Table 8-1c: Scenario RE 3 (RE 3\*): Electronic Screening with a 25 percent (10 percent) Decrease in Safety Violation Rates**

	RE 3	RE 3*
Total Benefits	\$12,995,000,000	\$8,379,000,000
Total Costs	2,601,000,000	2,622,000,000
Net Present Value	\$10,394,000,000	\$5,757,000,000
Benefit/Cost Ratio	5.0	3.2

**Table 8-1d: Scenario EC 1: EC in States without VISTA**

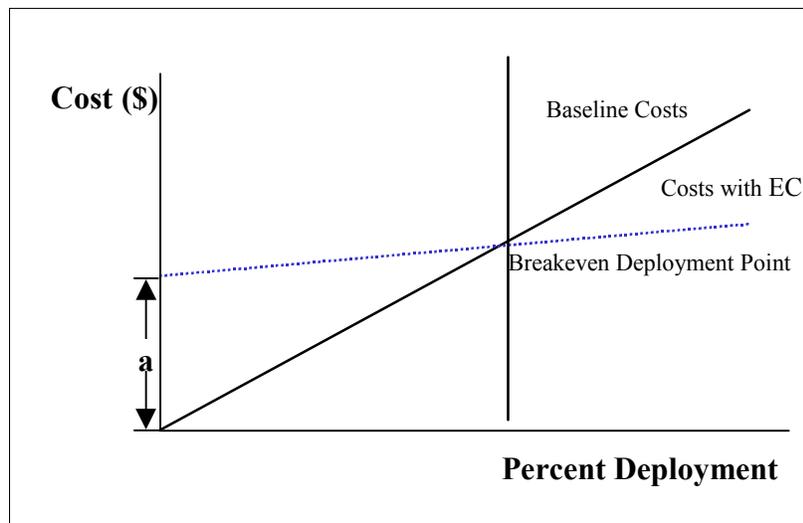
Total Benefits	\$557,700,000
Total Costs	44,500,000
Net Present Value	\$513,200,000
Benefit/Cost Ratio	12.5

**Table 8-1e: Scenario EC 2: EC in States with VISTA**

Total Benefits	\$339,300,000
Total Costs	8,400,000
Net Present Value	\$330,900,000
Benefit/Cost Ratio	40.4

The electronic credentialing scenarios are characterized by huge BCRs as shown in Tables 8-1d and 8-1e. For Scenario EC 1, the benefit/cost ratio is 12.5, meaning the total benefits of electronic credentialing for states not using VISTA are over 12 times as large as the total costs. For states using VISTA (Scenario EC 2), Table 8-1e shows that the BCR is over 40. Therefore, the electronic credentialing elements of CVISN easily pass the important BCA criterion for determining whether such systems are economically justified.

Finally, as noted earlier, electronic credentialing’s impacts are all costs or cost savings. This allows us to report the BCA results of electronic credentialing as a function of the level of deployment, as shown in Figure 8-1. The figure also shows that the benefit/cost ratio will vary with the percent deployment (i.e., percent of accounts/transactions handled electronically) and that there is a breakeven deployment percentage at which the BCR will equal 1.0 [i.e., at which the costs of EC will equal the baseline (pre EC) costs].



**Figure 8-1. Costs of Electronic Credentialing With and Without CVISN**

Where a = one-time statewide start-up costs to deploy EC.

For EC in states currently operating without VISTA, the breakeven deployment size in percentage terms is less than 10 percent. This is easily seen from Table 8-1d when it is considered that the total costs are start-up and replacement capital costs that are fixed statewide, while the cost saving benefits vary linearly with the number or percent of carriers using EC. Thus, the line representing “Costs with EC” in Figure 8-1 is really flat. For Scenario EC 1, the breakeven percentage deployment (equal to the inverse of the BCR) is 8 percent at a 7 percent real discount rate. Similarly for EC in states with VISTA (Scenario EC 2), the breakeven percent deployment is only 2.5 percent. At deployments above these levels, electronic credentialing is economically justified with rapidly increasing BCRs, reaching the BCRs in Tables 8-1d and 8-1e at 100 percent deployment.

### **8.3 BACKGROUND AND APPROACH**

An important objective of this evaluation of the Commercial Vehicle Information Systems and Networks (CVISN) Model Deployment Initiative (MDI) is to conduct a rigorous benefit/cost analysis (BCA) to determine the net economic benefits, if any, of the CVISN MDI. This chapter describes this BCA. In the public sector, BCA helps maximize economic efficiency, or the total net benefits to the public from an investment. The electronic credentialing and roadside enforcement elements of CVISN are expected to make commercial vehicle credentialing less costly, and safety inspections more effective. The electronic screening of commercial vehicles is also expected to save transit time for trucks with good safety compliance records by enabling them to bypass inspection stations at highway speeds in most cases. It is also hoped that this benefit will motivate carriers to improve their safety compliance behavior.

Trucks bypassing inspection stations will not only experience time savings for themselves and their cargo, but also they provide energy savings and air and noise pollution benefits for the public. Of most importance to the public, however, are the cost savings and productivity increases of electronic credentialing to the states and carriers, and the improved targeting for inspection of unsafe vehicles enabled by the new information systems that make up the roadside enforcement element of CVISN. The benefits of crashes avoided by removing unsafe trucks from highways include the value of lives saved, injuries avoided, reduced property damage to trucks, their cargo, and to other vehicles, and reduced delay to all vehicles from congestion due to crashes. These public benefits from CVISN are obviously important in justifying the expenditures needed to implement and operate these systems.

The question to be answered in this BCA is whether all the benefits exceed all the costs. This means that all the benefits and costs input to a BCA must have some inherent value to society. It is important for government to consider all such impacts, even if the private sector does not. And, while the actual summing of the benefits and costs in a BCA is straightforward, identifying the right inputs and observing or estimating their values is not.

In particular, for a benefit or cost to be included in a BCA, it must be:

- Quantifiable
- Monetizable
- Not duplicative
- Not a transfer.

Benefits must be quantifiable in order to attach a monetary value to them. However, not all quantifiable benefits have economic value to society. Not duplicative means that we cannot double count the same benefits and costs, even though they may appear to some not to be duplicative. And, finally, transfers between affected groups are not net changes in benefits to society, and, therefore, cannot be included in a BCA.

Each of the benefits and costs in a BCA is discounted to a present value over the economic life of a project. For the CVISN MDI, benefits are assumed to begin immediately with the one-time start-up costs in the year 2000, and extend for a 25-year period through 2025. This allows 25 years of economic returns for the project, which will include one or more replacement cycles for equipment and software at appropriate intervals.

### **The Benefits and Costs Included in the BCA**

The benefits included in this BCA are as follows:

- Roadside Enforcement (including safety information exchange and electronic screening)
  - Crashes avoided
  - Transit-time savings (including operations and maintenance and air and noise pollution)
- Electronic Credentialing
  - Operating cost savings to states
  - Operating cost savings to carriers
  - Inventory cost savings to carriers

The costs included in the BCA are:

- Roadside Enforcement
  - One-time start-up cost to state
  - Replacement capital costs to states
  - Increased operating costs to states
  - Increased operating costs to carriers
  - Increased out-of-service (OOS) costs to carriers
- Electronic Credentialing<sup>3</sup>
  - One-time start-up cost to states
  - Replacement capital costs to states in future years

All of the benefits and costs included in the BCA are derived from the hypothetical impacts of the CVISN pilots on the customers of CVISN. The CVISN project may alter the administration of commercial vehicle enforcement and regulatory processes in various ways, but the net economic benefits cannot be assessed until the impacts are translated into the measures listed above. These impacts are the result of changes in accidents, administrative and compliance costs, motor carrier behavior, and other changes in commercial vehicle regulatory administration and transportation activities. These evaluation measures determine the type of data that need to be collected and analyzed in the CVISN evaluation. The process of identifying

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<sup>3</sup> Start-up and replacement capital costs to carriers are assumed to be small or zero since only a PC is required, which essentially all carriers have.

the benefit measures listed above is described below for each of the five traditional ITS goal areas (safety, efficiency, productivity, mobility, and energy/environment).

Since the five ITS goal areas double count some benefits, and include benefits that make no contribution to *economic* efficiency (and, thus, have no economic value), only four of the five ITS goal areas include potential benefits (or disbenefits) that should be input to the CVISN BCA. The reasons for this are explained below under efficiency benefit measures.

### BCA Safety Benefit Measures

The anticipated safety benefits of CVISN from increased motor carrier compliance with state safety regulations are extremely important. The benefits consist primarily of reductions in truck-related crashes caused by violations of vehicle or driver safety regulations. The crashes are avoided either because additional trucks or drivers are placed out of service due to more efficient enforcement practices or the number of violations is reduced in response to enhanced enforcement (the indirect effect). The safety benefit will take the form of decreased fatalities and personal injuries, and decreased property damage costs from accidents. Note that in quantifying this benefit, we include the total cost to society of crashes, including the losses and delays to other motorists due to these accidents<sup>4</sup>. We do not subtract the costs covered by insurance from the cost savings since the cost savings will lower insurance costs for everyone and all the accident cost savings should be included in this benefit.

### BCA Efficiency Benefit Measures

A major source of confusion on the proper inputs to an ITS BCA stems from the fact that economists and engineers sometimes use the same term to mean different things. Most importantly, in economics, efficiency means maximizing total net benefits from an investment or policy. This means that the economic efficiency goal includes *all* the ITS goals that have (a dollar) value to society. However, engineers use the term efficiency much more narrowly to mean *more output per unit of input* (“engineering efficiency”).

The efficiency goal that is well accepted as one of the five major ITS goals is the *engineering efficiency goal, not the economic efficiency goal*. Measures of achievement of the engineering efficiency goal do not enter into a BCA. This is because increased output per unit of input is best measured in transportation as increased throughput or capacity (e.g., vehicles per hour, inspections per hour, inspections per person-hour). Converting this benefit to a dollar value to society falls under the productivity goal in the form of cost savings.

### BCA Productivity Benefit Measures

Productivity means *lower costs to produce a given level of output*. Cost savings are an important measure of achievement of the CVISN productivity goal (e.g., cost per vehicle

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<sup>4</sup> See the “Literature Search on Valuation of CVISN Benefit Measures” in Appendix D.1.

registration, reduced truck transit time, etc.). This benefit includes the savings to motor carriers and government agencies that result from CVISN. These cost savings certainly have value to society and enter into a BCA to calculate the net worth of CVISN investments.

With regard to roadside enforcement, the productivity-related cost savings to compliant motor carriers results from saving time by bypassing inspection sites at highway speeds. We do not assume any shortening of the time to inspect each truck selected for inspection, nor is it assumed that the number of truck inspections will change. Rather, CVISN may be expected to result in a better targeting of truck inspections since more of these trucks will have been prescreened for violations using the real-time access to timely and accurate data for targeting high-risk carriers provided by CVISN. Therefore, rather than a cost savings to states, the benefit to the states is increased numbers of out-of-service (OOS) violations and improved compliance resulting in fewer crashes. Cost savings to states are foregone for the benefit of *increased output* from the inspection process in the form of *increased safety* as measured by fewer crashes. This increased output provided by CVISN is an important benefit. Government officials, including law enforcement officials, would like to be evaluated not only by the costs they cut, but by what they do. On the other hand, there will be a cost to some motor carriers to improve their compliance and/or deal with increased numbers of OOS violations.

With regard to electronic credentialing, the benefits of CVISN to both states and motor carriers are limited to cost savings (possibly substantial). States can change their credentialing output only with legislative changes in the number of transactions required. Such changes are exogenous to the CVISN MDI and do not enter this BCA. Similarly, motor carriers can benefit from the cost savings that electronic credentialing's speed and increased operating flexibility provides them. The benefits include both direct operating cost savings and increased fleet utilization from the increased speed with which carriers can get their trucks on the road due to faster credentialing.

With regard to the latter, this BCA assumes carriers can register new trucks faster and, thus, save on truck inventory costs. Registration renewals are assumed to be scheduled, with or without EC, to keep existing truck fleets in service. Also, oversize/overweight (OS/OW) permits were not included in the EC portions of the CVISN MDI, so no benefits for faster credentialing of these permits were included in the BCA. Finally, significant or measurable levels of increased revenue to motor carriers from goods shipped are not anticipated as a result of the CVISN program. This is discussed in the mobility section below.

Another potential productivity cost savings to states is pavement cost savings (increased pavement life or productivity) from fewer un-permitted overweight trucks on the road. This is a savings that can be expected to materialize over the long term, well beyond the term of the CVISN MDI. For these reasons, we exclude it from the quantitative results of this BCA. However, a discussion of this issue with some rough benefit estimates is included in this chapter.

Other productivity-related outcome measures may have economic value to some, but should be excluded from a BCA because they represent transfers of benefits. For example, CVISN may increase the fee revenue "production" from more effective regulatory enforcement

and compliance with CVISN. However, this should not be treated as a net benefit that enters into a BCA, since it is really a transfer from the carriers to state government.

Finally, as explained under the mobility and energy/environment goal areas below, certain benefits that fall under other goal areas are included in the calculation of productivity benefits due to the way unit costs are calculated in the available literature. Examples of these are:

- Reduced delay to the motoring public from CV accidents (mobility goal area benefit included in accident cost saving)
- Gallons of fuel saved by motor carriers (energy goal area cost included in the truck transit-time operating cost saving).

### BCA Mobility Benefit Measures

Mobility is measured by the net benefits to travelers or other transportation consumers from a transportation improvement. To avoid double counting, the most important measure of achievement of the mobility goal is purposely omitted as an input to our BCA. This is the portion of the CVISN motor carrier productivity cost savings benefit (if any) that is passed on to the shipper/receiver (e.g., a value-added manufacturer, wholesaler, retail store), or to the final consumer. We can avoid the very difficult problem of collecting data on some elusive cost savings passed on to customers by including in the BCA the entire direct CVISN productivity benefit (the cost savings to motor carriers). Whether these cost savings are passed on to customers is immaterial for the BCA since the total benefit to society is the same.

Three non-motor carrier cost saving mobility measures *are* valid inputs to a CVISN BCA:

- Reduced highway delays to the public due to reduced motor carrier (truck) crashes.
- Reduced time in transit that reduces shipper/receiver inventory costs.
- Increased shipper/receiver satisfaction with carriers (e.g., use of safety rating data).

The first measure impacts the public in a different way than the CVISN productivity measure, (i.e., it impacts public benefits differently from the costs of the shipped goods). It is included in the accident cost saving benefit since the literature includes this in the cost of accidents. Similarly, the value to shippers/receivers of decreasing time in transit to reduce inventory costs is included in the motor carrier value of truck travel time. With regard to the third measure, to the extent that shippers are willing to pay separately for (i.e., that they value) the safety rating data, this benefit is additive to the carrier cost savings from reduced accidents. However, we have not been able to measure it in this evaluation. Also, the third measure can affect the volume of carrier business and, therefore, revenues. However, additional revenues are

presumably mostly transfers, not increases in output or total goods shipped. Therefore, they do not provide net benefits for input to a BCA.<sup>5</sup>

**BCA Energy and Environment Benefit Measures**

Energy savings in the form of decreased fuel use are included in the value of transit-time-related operating cost savings to motor carriers. Similarly, the values of air and noise pollution reductions from CVISN are separately calculated, but included in the transit-time-related benefits input to the BCA.

**Benefits Summary**

Table 8-2 summarizes the evaluation benefit measures for input to the CVISN BCA arranged by the customers who benefit. States and motor carriers are the primary beneficiaries of the most important productivity (cost saving) and safety benefits. Shippers/receivers and the public benefit as well from these impacts of CVISN. However, the BCA values these benefits in the aggregate to assess the total net worth of a project. This minimizes any tendency to double count these benefits.

**Table 8-2. Classifications of Benefits and Their Incidence**

Benefit Description	Customer Impacted		
	State	Carriers (and Shippers)	Public
<i>Roadside Enforcement:</i>			
• Safety			
- Crashes avoided		✓	✓
• Productivity/Mobility			
- Cost savings			
o Transit-time savings (including O&M)		✓	✓
- Increased output (included in safety benefit)		✓	✓
• Energy/Environment			
- Fuel use (included in transit-time savings)		✓	
- Air/noise pollution (included in transit-time savings)			✓
<i>Electronic Credentialing:</i>			
• Productivity			
- Cost savings			
o Faster credentialing	✓	✓	
o New truck inventory		✓	

<sup>5</sup> To the extent that additional revenues accrue to more efficient, profitable (and compliant) carriers, there is a net benefit to society. However, evaluating the relative profitability of different carriers is well beyond the scope of this evaluation.

The benefits of CVISN's *roadside enforcement* noted in Table 8-2 are:

- **Safety:** Crashes avoided through improved inspection, plus reduced accident costs, including delays to the motoring public from fewer truck accidents.
- **Productivity/Mobility:** Cost savings to motor carriers from electronic screening transit-time savings, including O&M. Reduced delays to the motoring public from accidents (mobility goal area benefit included in accident cost savings). Increased output from more productive inspections measured by crashes avoided with benefits (again) to motor carriers and the public.
- **Energy/Environment:** Energy/fuel savings to motor carriers included in value of transit-time savings. Air and noise pollution savings from transit-time savings calculated separately, but included in the value of transit-time savings.

Some of the above benefit measures are in natural units other than dollars. They are converted to dollar values ("monetized") for input to the BCA using the values found in the "Literature Search on Valuation of CVISN Benefit Measures" which is included as Appendix D.1.

Table 8-2 shows a relatively simpler set of benefits of CVISN's *electronic credentialing*, namely, cost savings to both the state and to motor carriers, and improved carrier fleet utilization from faster credentialing of new trucks.

## Costs

The five ITS goal areas deal only with benefits (including cost savings). The cost of CVISN for the purpose of this BCA consists of the one-time start-up costs and the ongoing costs of CVISN programs, including equipment replacement at appropriate intervals. More specifically, these CVISN costs include the incremental capital and operating costs of the hardware and software, including computers and electronic data communications, and labor and administrative overhead costs for performing the functions associated with CVISN. In contrast to defining the cost saving benefits of CVISN, defining the incremental expenditures of resources on CVISN is relatively straightforward. Chapter 6 of this report provides our detailed findings on CVISN costs.

Table 8-3 shows who bears the costs for CVISN.

**Table 8-3. Classification of Costs and Their Incidence**

Cost Description	Customer Impacted		
	State	Carriers (and Shippers)	Public
<i>Roadside Enforcement:</i>			
• CVISN start-up costs:			
- Equipment/housing/training	✓		
• CVISN replacement capital costs	✓		
• CVISN operating costs	✓	✓	
• (Increased) costs of compliance:			
- Out-of-service (OOS)		✓	
<i>Electronic Credentialing:</i>			
• CVISN start-up costs:			
- Equipment/housing/training	✓		
• CVISN replacement capital costs	✓		

For both roadside enforcement and electronic credentialing, there are start-up and replacement capital costs in future years to both the states and carriers. However, for roadside enforcement, it is assumed that a vendor will charge \$45 per year per truck<sup>6</sup> for all costs, including in-truck equipment required for electronic screening, thus eliminating start-up or replacement capital costs for carriers.

For purposes of the benefit-cost analysis, this \$45 is treated as the annual operating cost to motor carriers for electronic screening. However, this simplifying assumption is not expected to remain valid as the various electronic screening programs expand and evolve. Furthermore, it does not apply to all participating carriers and states. For example, motor carriers enrolled in PrePass pay a fee of 99 cents per pass, up to a maximum of \$4 per day. Also, NORPASS and Green Light states are free to adjust or eliminate the fees they charge motor carriers to encourage them to enroll in the program.

For electronic credentialing, it is assumed that essentially all carriers have PCs, and, therefore, that the start-up and replacement capital costs are essentially zero for carriers. States, on the other hand, need to install the equipment and software to enable electronic credentialing to take place. Finally, there are costs to the carriers from improved roadside enforcement. These will take the form of increasing OOS violations for high-risk carriers, and possible indirect costs of changing their behavior to improve their compliance rates. The latter cost has not been possible to estimate in this evaluation. However, since less compliant carriers are more likely to incur increased OOS costs, this cost is likely to be included at least partly in their increased OOS cost.

For a variety of reasons, we have conducted the BCA separately for the two CVISN MDI components. These reasons include the fact that the categories of benefits and costs are different and more limited for electronic credentialing (EC) than for roadside enforcement (RE). For the

<sup>6</sup> Based on NORPASS annual charges to carriers.

former, they include only costs and cost savings, while for roadside enforcement (including SIE), the over-the-road operations of motor carriers are directly affected. Also, investment decisions are likely to be made separately for these two CVISN elements. In fact, a variety of investment *scenarios* can be envisioned for each of these CVISN elements.

## **8.4 RESULTS**

All benefits and costs occurring each year between 2000 and 2025 are included in the BCA and each is discounted back to 2000 using both a 4 percent and 7 percent real discount rate to calculate the present values of the benefits and costs in 1999 dollars. The use of a 4 percent real discount rate in these benefit/cost calculations has been recommended by economists in both the public and private sector.<sup>7</sup> The use of a 7 percent real discount is a more stringent test and has been required for nearly two decades for use in BCAs of federal programs by the U.S. Office of Management and Budget (OMB).

### **Roadside Enforcement**

Tables 8-4 to 8-7 show the results of the BCA for the three roadside enforcement scenarios. The tables show the present values of all the benefits for roadside enforcement that we have included in the BCA and compare these to the total system costs. Listing the benefits and costs in the format in these tables show how they are aggregated in their common dollar units to calculate the net benefits and the benefit/cost ratio (BCR) for each investment alternative or scenario. In each case, the benefits and costs that are received and paid at different times over the course of the next 20 years have been discounted back to 1999 dollars using both four (4) and seven (7) percent real discount rates. Discounting future values to calculate a present value in 1999 dollars is necessary to be able to compare these future streams of costs and benefits.

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<sup>7</sup> E.g., U.S. EPA, "Guidelines for Preparing Economic Analyses," June 11, 1999, Chapter 6: recommends a real rate of 2 to 3 percent for some public projects.

**Table 8-4. Benefit/Cost Comparison for Roadside Enforcement (Present Value in \$1999). Scenario RE 1**

	Discounted at 4%	Discounted at 7%
<b>Benefits</b>		
Crashes avoided	\$90,740,000	\$69,076,000
Transit-time savings (including O&M and air and noise pollution)	\$0	\$0
<b>Total benefits</b>	<u>\$90,740,000</u>	<u>\$69,076,000</u>
<b>Costs</b>		
One time start-up cost to states	\$30,980,000	\$30,980,000
Replacement capital costs to states	\$72,890,000	\$51,208,000
Increased operating costs to states	\$12,490,000	\$9,512,000
Increased operating costs to carriers	\$0	\$0
Increased OOS costs to carriers	<u>\$26,130,000</u>	<u>\$19,891,000</u>
<b>Total costs</b>	<u>\$142,490,000</u>	<u>\$111,591,000</u>
<b>Total (Net Present Value)</b>	° \$51,750,000	° \$42,515,000
<b>Benefit/Cost Ratio</b>	0.64	0.62

**Table 8-5. Benefit/Cost Comparison for Roadside Enforcement (Present Value in \$1999). Scenario RE 2**

	Discounted at 4%	Discounted at 7%
<b>Benefits</b>		
Crashes avoided	\$636,000,000	\$484,300,000
Transit-time savings (including O&M and air and noise pollution)	<u>\$6,328,000,000</u>	<u>\$4,817,000,000</u>
<b>Total benefits</b>	<u>\$6,964,000,000</u>	<u>\$5,301,300,000</u>
<b>Costs</b>		
One time start-up cost to states	\$99,500,000	\$99,500,000
Replacement capital costs to states	\$124,700,000	\$86,400,000
Increased operating costs to states	\$234,700,000	\$178,700,000
Increased operating costs to carriers	\$2,800,500,000	\$2,131,900,000
Increased OOS costs to carriers	<u>\$183,100,000</u>	<u>\$139,400,000</u>
<b>Total costs</b>	<u>\$3,442,500,000</u>	<u>\$2,635,900,000</u>
<b>Total (Net Present Value)</b>	\$3,521,500,000	\$2,665,400,000
<b>Benefit/Cost Ratio</b>	2.0	2.0

**Table 8-6. Benefit/Cost Comparison for Roadside Enforcement (Present Value in \$1999). Scenario RE 3**

	Discounted at 4%	Discounted at 7%
<b>Benefits</b>		
Crashes avoided	\$10,742,000,000	\$8,178,000,000
Transit-time savings (including O&M and air and noise pollution)	<u>\$6,328,000,000</u>	<u>\$4,817,000,000</u>
<b>Total benefits</b>	<b>\$17,070,000,000</b>	<b>\$12,995,000,000</b>
<b>Costs</b>		
One time start-up cost to states	\$99,500,000	\$99,500,000
Replacement capital costs to states	\$124,700,000	\$86,400,000
Increased operating costs to states	\$234,700,000	\$178,700,000
Increased operating costs to carriers	\$2,800,500,000	\$2,131,900,000
Increased OOS costs to carriers	<u>\$137,300,000</u>	<u>\$104,500,000</u>
<b>Total costs</b>	<b>\$3,396,700,000</b>	<b>\$2,601,000,000</b>
<b>Total (Net Present Value)</b>	<b>\$13,673,300,000</b>	<b>\$10,394,000,000</b>
<b>Benefit/Cost Ratio</b>	<b>5.0</b>	<b>5.0</b>

**Table 8-7. Benefit/Cost Comparison for Roadside Enforcement (Present Value in \$1999). Scenario RE 3\***

	Discounted at 4%	Discounted at 7%
<b>Benefits</b>		
Crashes avoided	\$4,680,000,000	\$3,562,000,000
Transit-time savings (including O&M and air and noise pollution)	<u>\$6,328,000,000</u>	<u>\$4,817,000,000</u>
<b>Total benefits</b>	<b>\$11,008,000,000</b>	<b>\$8,379,000,000</b>
<b>Costs</b>		
One time start-up cost to states	\$99,500,000	\$99,500,000
Replacement capital costs to states	\$124,700,000	\$86,400,000
Increased operating costs to states	\$234,700,000	\$178,700,000
Increased operating costs to carriers	\$2,800,500,000	\$2,131,900,000
Increased OOS costs to carriers	<u>\$164,800,000</u>	<u>\$125,500,000</u>
<b>Total costs</b>	<b>\$3,424,200,000</b>	<b>\$2,622,000,000</b>
<b>Total (Net Present Value)</b>	<b>\$7,853,800,000</b>	<b>\$5,757,000,000</b>
<b>Benefit/Cost Ratio</b>	<b>3.2</b>	<b>3.2</b>

The discount rates of 4 and 7 percent are applied to the future benefits and costs estimated in real (constant 1999) dollars, not inflated dollars. If the future benefits and costs were estimated in inflated (current) dollars, the “nominal” discount rate would have to be 4 percent or 7 percent *plus* the rate of inflation. If we assume today’s modest 2.5 percent annual inflation rate going forward, the 4 percent and 7 percent real discount rates are equivalent to 6.5 percent and 9.5 percent nominal discount rates, respectively.

For the three roadside enforcement scenarios, Tables 8-4 to 8-7 show that the BCRs using the more stringent 7 percent discount rate range from 0.62 to 5.0, depending on the scenario. For the simplest roadside enforcement scenario, RE 1, which is the upgrade to Aspen without electronic screening, the BCR is less than 1.0, showing that Aspen by itself is economically not worthwhile.

For the roadside enforcement scenarios that involve electronic screening, RE 2, RE 3, and RE 3\*, the BCRs increase considerably, as do the NPVs of the benefits of these improvements. For Scenario RE 2, which assumes no change in compliance behavior, the NPV ranges from \$2.6 billion to \$3.5 billion, depending on the discount rate used. With improved compliance behavior, which is an important objective of these systems, the increase in the value of the net benefits (NPV) is truly impressive, ranging from nearly \$3 billion to over \$13 billion for Scenarios RE 3 and RE 3\*, depending on the discount rate and the level of improvement in FMCSR compliance rates that is achieved. Therefore, the systems involved in the two roadside enforcement scenarios that include electronic screening are economically well justified, even with the use of the more stringent 7 percent real discount rate. The detailed tables listing the actual year-by-year benefits and costs and their discounted values using 4 and 7 percent real discount rates is included in this report as Appendix D.2.

The make up of the benefits and costs varies, depending on the roadside enforcement investment scenario. Table 8-4 for Scenario RE 1, which involves only Aspen with no electronic screening (ES), shows there are no transit-time savings for low-risk carriers, and no costs to the carriers for using ES to bypass inspection and weigh stations. The costs involved in this RE scenario are small compared to the RE 2 and 3 scenarios involving ES, with less than 20 percent of the costs borne by the carriers in increased out of service (OOS) costs. The importance of the increased OOS rate in scenario RE 1 is reflected in the value of the crashes avoided benefit, which is well over 3 times the higher OOS cost to the carries.

Tables 8-5 and 8-6 show the differences between scenarios RE 2 and RE 3 (or RE 3\*) to be only in the values of the crashes avoided benefit and the increased OOS costs to the carriers. This results from the 25 percent (10 percent) decrease in violation rate assumed as the only difference between the scenarios. Otherwise, the costs to implement the “investments” are the same, and no change is assumed in the number or percentage of trucks deemed to be low-risk and, therefore, able to benefit from (and pay for) the electronic screening. Note that in RE 3 (RE 3\*), the increased OOS cost to carriers decreases from the cost in RE 2 by the 25 percent (10 percent) decrease in violation rate, while the crashes avoided benefit increases dramatically with the assumed change in compliance behavior. This shows the potential benefit from the combined “carrot” (ES) and “stick” (better inspection targeting) incentives possible with CVISN. The carrot is actually much larger than shown in Tables 8-5 and 8-6. These tables reflect the assumption of *no* change in *total* time spent by all trucks in inspection and weigh stations, since this is indeed the case—the same number of trucks are inspected. Only the targeting of high-risk trucks for inspection is improved. In a BCA, we use the total costs and benefits to society to evaluate the investment alternative.

However, if the 52 percent of trucks that earn the right to bypass the inspection stations (saving 2.81 minutes per bypass<sup>8</sup>) also avoid spending an (weighted) average of 22.21 minutes being weighed and/or inspected, their benefit is valued at nearly \$3.3 billion per year. This is nearly 20 times the \$168 million cost per year to the low-risk carriers to equip their 52 percent of the nation's 7.2 million heavy trucks at \$45 per truck per year. This is a powerful incentive to carriers to increase their compliance behavior and make the nation's highways safer.

### **Electronic Credentialing**

Tables 8-8 and 8-9 show that the two electronic credentialing scenarios are characterized by huge BCRs. For Scenario EC 1, the BCR is 12.5 using the 7 percent discount rate, meaning that the total benefits of electronic credentialing for states not using VISTA are over 12 times as large as the total costs. For states using VISTA (Scenario EC 2), Table 8-9 shows that the BCR is over 40. However, an examination of the make up of the benefits and costs of the two EC scenarios shows the major contribution to the difference in the BCR is the much lower start-up cost to the states with VISTA. VISTA provides credentialing services to the states under contract so that its capital costs are amortized over time as operating charges to the states. The present value of the non-VISTA scenario, EC 1, is actually about 50 percent higher than the VISTA scenario, EC-2, in part because the number of trucks and carrier accounts is much greater in the non-VISTA system than in the VISTA system. In any event, both the VISTA and non-VISTA scenarios for the electronic credentialing element of CVISN easily pass the important BCR and positive NPV criteria for determining whether such systems are economically justified.

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<sup>8</sup> See Table D.1-8 in Appendix D.1.

**Table 8-8. Benefit/Cost Comparison for Electronic Credentialing without VISTA (Present Value in \$1999). Scenario EC 1**

	Discounted at 4%	Discounted at 7%
<b>Benefits</b>		
Operating cost savings to states	\$338,800,000	\$257,900,000
Operating cost savings to carriers	\$74,500,000	\$56,700,000
Inventory cost savings to carriers	<u>\$319,300,000</u>	<u>\$243,100,000</u>
<b>Total benefits</b>	\$732,600,000	\$557,700,000
<b>Costs</b>		
One time start-up cost to states	\$42,140,000	\$42,140,000
Replacement capital costs to states	<u>\$3,460,000</u>	<u>\$2,340,000</u>
<b>Total costs</b>	\$45,600,000	\$44,480,000
<b>Total (Net Present Value)</b>	\$687,000,000	\$513,220,000
<b>Benefit/Cost Ratio</b>	16.1	12.5

**Table 8-9. Benefit/Cost Comparison for Electronic Credentialing with VISTA (Present Value in \$1999). Scenario EC 2**

	Discounted at 4%	Discounted at 7%
<b>Benefits</b>		
Operating cost savings to states	\$316,300,000	\$240,800,000
Operating cost savings to carriers	\$24,500,000	\$18,600,000
Inventory cost savings to carriers	<u>\$104,900,000</u>	<u>\$79,900,000</u>
<b>Total benefits</b>	\$445,700,000	\$339,300,000
<b>Costs</b>		
One time start-up cost to states	\$7,200,000	\$7,200,000
Replacement capital costs to states	<u>\$1,800,000</u>	<u>\$1,200,000</u>
<b>Total costs</b>	\$9,000,000	\$8,400,000
<b>Total (Net Present Value)</b>	\$436,700,000	\$330,900,000
<b>Benefit/Cost Ratio</b>	49.5	40.4

Finally, as noted earlier, electronic credentialing's impacts are all costs or cost savings. This allows us to report the BCA results of electronic credentialing as a function of the level of deployment, as shown in Figure 8-1 (presented earlier). The figure also shows that the BCR will vary with the percent deployment (i.e., percent of accounts/transactions handled electronically) and that there is a breakeven deployment percentage at which the BCR will equal 1.0 (i.e., at which the costs of EC will equal the baseline (pre EC) costs).

For EC in states currently operating without VISTA, the breakeven deployment size in percentage terms is less than 10 percent. This is easily seen from Table 8-7 when it is considered that the total costs are start-up and replacement capital costs that are fixed statewide, while the cost saving benefits vary linearly with the number or percent of carriers using EC. Thus, the line representing "Costs with EC" in Figure 8-1 is really flat. For Scenario EC 1, the breakeven percentage deployment (equal to the inverse of the BCR) is 8 percent at a 7 percent real discount rate. Similarly for EC in states with VISTA (Scenario EC 2), the breakeven percent deployment is only 2.5 percent. At deployments above these levels, electronic credentialing is economically justified with rapidly increasing BCRs, reaching the BCRs in Tables 8-7 and 8-8 at 100 percent deployment. Thus, even with a slow take-up of electronic credentialing, with or without VISTA, it is prudent to proceed with deploying such systems.

## 8.5 COST SAVINGS FROM REDUCED PAVEMENT DAMAGE: AN ADDITIONAL ROADSIDE ENFORCEMENT BENEFIT

As discussed earlier, a significant benefit of improved targeting of overweight trucks is a reduction in the rate of pavement deterioration. This is a (pavement) productivity benefit that can be expected to materialize over the long term, well beyond the term of the CVISN MDI and our ability to observe this benefit directly. For this reason, and because a detailed study quantifying this benefit in the abstract is well beyond the scope of this evaluation, we have not included it in the BCA. Rather, we provide here a qualitative discussion of this additional roadside enforcement benefit, with some rough estimates to highlight its importance.

A large body of evidence demonstrates that heavy trucks cause a major portion of pavement wear.<sup>9</sup> An often quoted rule of thumb is that pavement damage increases as the fourth power of axle weight. Thus, a 10 percent increase in axle weight would result in a 46 percent increase in pavement wear. Expenditures solely for pavement rehabilitation and reconstruction are not reported separately in national spending statistics. However, it is likely that such expenditures in the U.S. total several billion dollars annually today.<sup>10</sup> A number of studies and the annual cost of increasing allowable axle loadings, or allowing 80,000-pound GVW trucks on all main roads, estimate annual national pavement damage cost increases in the tens and hundreds of millions of dollars.<sup>11</sup>

The roadside enforcement scenarios included in this BCA resulted in 8 percent and 30 percent increases in OOS orders for Scenarios RE 1 and RE 2, respectively, and Scenario RE 3 assumed a 25 percent decrease in overall violation rates. If we assume an average overloaded condition of 10 percent for an OOS order, and that 10 percent of trucks in use are weight checked on any given day, a rough calculation of the percent of trucks put out-of-service due to an OW condition for Scenarios RE 1 and RE 2 would be 0.08 percent and 0.3 percent, respectively. Scenario RE 3 assumes a 25 percent decrease in violations for 100 percent of the trucks. If pavement damage due to trucks increases by 46 percent for a 10 percent increase in loading, Scenarios RE 1, 2 and 3 would result in 0.4 percent, 1.4 percent, and 11.5 percent reductions in pavement wear due to large trucks, respectively. If pavement wear due to large trucks was, say, half of all pavement wear, and \$10 billion per year is being spent on pavement rehabilitation, the annual cost savings benefit could range from \$20 million to nearly \$600 million per year. These are in the same range as the cost impacts of the earlier mentioned proposals to allow increased axle loadings or use of more non-interstate roads by heavy trucks (but in the opposite direction).

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<sup>9</sup> AASHTO, Our Highways; Why Do They Wear Out? Who Pays for Their Upkeep? Washington, D.C., 1984.

<sup>10</sup> "New Trucks for Greater Productivity and Less Road Wear," TRB Special Report 227, Washington, D.C., page 23, 1990.

<sup>11</sup> Ibid., Table 2-6.

Discounted at the 7 percent real interest rate, the NPV of these pavement cost saving benefits equals approximately \$250 million, \$900 million, and \$8 billion for the three RE scenarios, respectively. These benefits (with the assumptions stated above) are greater than the value of the annual crashes avoided benefit for the first two RE scenarios, and approximately equal to the crashes avoided benefit for RE 3. These are, of course, very significant benefits.

## CHAPTER 9. DISCUSSION

The intent of the CVISN MDI evaluation effort was to furnish information to various stakeholders on the desirability of making investments in CVISN or related transportation programs. This information came in two forms: a comprehensive benefit/cost analysis, which considers the relationship between total costs and total benefits to society, and a detailed information on costs and benefits (especially in terms of increased highway safety) that are of interest to specific stakeholders. Below we discuss some implications of our major findings and present a view CVISN's future deployment plans.

### 9.1 IMPLICATIONS OF FINDINGS

For stakeholders, such as Congress or U.S. DOT, who are concerned with the relative costs and benefits of investments in Intelligent Transportation Systems, the CVISN benefit/cost analysis (Chapter 8) presents a comprehensive economic comparison of costs (including start-up and recurring costs) versus the value of the total benefits. The analysis was performed by projecting the costs and benefits of deploying CVISN on a national scale based on measured costs and benefits obtained from the earliest deployments of CVISN. Other stakeholders, such as states and motor carriers, are concerned with costs to their own organizations and the way in which CVISN impacts their operations. To illustrate how the benefits and costs vary under different levels and types of deployment, our analysis was performed for two different scenarios involving electronic credentialing and three scenarios for roadside enforcement.

While there may be some uncertainties related to certain start-up costs or the small numbers of states and motor carriers that were able to provide useful cost information, the analysis of credentialing operations demonstrates that electronic credentialing is a worthwhile investment. Even at 50 percent deployment (i.e., 50 percent of credentialing transactions handled electronically), the benefits (i.e., cost savings) exceed the costs by factors of 6 to 20, depending on certain operating features. Furthermore, the benefit/cost ratio is expected to be even larger once states deploy electronic credentialing for special permits. Our analysis considered only the IRP and IFTA credentialing operations because cost information related to special permits, such as oversize/overweight and HAZMAT, were not available. But most believe that costs to deploy the additional systems will be relatively small because the special permit systems are built as add-in modules based on the IRP infrastructure, while the benefits can be substantial—especially to the motor carrier who requires fast turnaround on such applications.

Even though electronic credentialing has demonstrated the *potential* for significant cost savings, much needs to be done before these cost savings can be realized. Although there is a strong commitment from states to deploy electronic credentialing, only three or four states have achieved any level of success. This is because of the many technical challenges in integrating diverse computer systems. Also, the solution in one state might not be applicable to another because the systems differ from state to state. Nevertheless, some of the software systems developed for one state have found applications in other states.

Another factor affecting the success of electronic credentialing is the recruitment of motor carriers. The CVISN motor carrier survey (Chapter 7) suggests that most carriers are receptive to the idea of end-to-end electronic credentialing. But questions remain about how the carriers will communicate with the states electronically. One of the major architecture issues under consideration by the states, as well as FMCSA, is whether to use computer-to-computer interfaces between the state and motor carriers or a web-based person-to-computer interface. FMCSA is in the process of developing recommendations concerning these issues. However, it appears that both types of solutions may be needed to attract a sufficient number of carriers to make the investment economically feasible.

The benefit-cost analysis of CVISN roadside enforcement technologies demonstrates the need to integrate safety information exchange and electronic screening technologies. Three scenarios were presented and analyzed. The first scenario, representing an actual deployment involving the use of Aspen and ISS in combination with manual prescreening of trucks, produced a benefit-cost ratio of 0.6. Although this implies that the economic benefit of such a deployment does not justify the costs, it is important to understand that this scenario represents only a partial deployment of CVISN roadside enforcement technologies.

From a development perspective, it makes sense to think of safety information exchange (i.e., laptop computers, Aspen, ISS, SAFER Data Mailbox, CVIEW) and electronic screening (i.e., DSRC, transponders, AVI) as separate systems. However, these systems are designed for integrated application. In particular, it is not practical to use ISS to select vehicles for inspection without some automated means of identifying vehicles and making decisions. Our analysis of Connecticut's experience using ISS with manual pre-screening (the motivation for Scenario RE-1) demonstrated that inspection selection efficiency (number of out-of-service orders per 100 vehicles inspected) increased by 2 percent over pre-CVISN methods. It was estimated that deploying this type of system nationwide would reduce the number of truck-related crashes by only 84 crashes per year.

On the other hand, our simulation of using ISS in combination of with electronic screening (Scenario RE-2), which assumes that all low-risk carriers (determined by FMCSA's SafeStat rating system) enroll in the electronic screening system and will be permitted to bypass inspection sites, demonstrates that the inspection selection efficiency could be increased by greater than 11 percent. It was estimated that this type of deployment would eliminate 589 crashes per year.

The benefits of CVISN roadside enforcement technologies could be greatly enhanced in two ways. The first method was illustrated in Scenario RE-3. If motor carriers and drivers became aware that the states have significantly increased their ability to target inspections on high-risk carriers and drivers, the carriers might invest more in vehicle maintenance and the drivers might improve their compliance with safety regulations in order to avoid inspections and (more importantly) out-of-service orders. Although to date there is no evidence that this deterrence effect will occur, our analysis demonstrates that a hypothetical 25 percent reduction in violation rates, along with the use of ISS and electronic screening, will help avoid nearly 10,000 crashes.

The second way in which CVISN benefits could be enhanced is by improving the quality of data and analysis algorithms upon which inspection selection decisions are based. In initiating the Large Truck Crash Causation Study (LTCCS), FMCSA recognizes that new information is needed to understand the mechanisms that cause truck crashes. It is anticipated that data from the LTCCS can be used to identify the types of vehicle defects and driver violations that are responsible for large numbers of crashes. This will make it possible to develop more advanced inspection selection algorithms that can target carriers based on their compliance with these more relevant risk factors.

## 9.2 A VIEW OF THE FUTURE

As noted in a recent U.S. DOT report (*What Have We Learned 2000*), rapid changes in technology, especially in the areas of computer electronics and communication, make it difficult to predict where CVISN technology will be in 5 to 10 years. Some technologies used in roadside operations, such as weigh-in-motion (WIM) equipment, and software systems, such as Aspen (including ISS), are already widely deployed. FMCSA is planning to examine new technologies capable of identifying commercial vehicles not equipped with transponders. Automated inspection technologies, such as those used to detect defective brakes, are still being developed and tested.

Growth in electronic screening is expected to continue, both in terms of the number of states participating and number of screening sites. Carrier enrollment, a key to success, is heavily dependent on solving interoperability issues. Furthermore, as states decide the type of bypass criteria to use, they must communicate these criteria to the carriers and, to the degree possible, establish some level of uniformity within key corridors.

The types and amounts of safety information that will be used to support roadside inspections or to select vehicles for inspection are likely to change dramatically as faster and less costly wireless communication technologies become available. Systems like the SAFER Data Mailbox will permit greater use of vehicle-specific safety data (e.g., prior inspection results) during vehicle inspections. Collection and dissemination of other types of data, such as driver information and crash and citation data, will be integrated into roadside systems like Aspen and CVIEW—necessitating continued development and refinement of these systems.

Although electronic credentialing got off to a slow start, recent successes and the desire to reduce costs will help promote further deployment. It now appears that multiple solutions, including PC- and Web-based systems as well as current “paper” systems, will be needed to satisfy the various needs of a diverse industry. The International Registration Plan (IRP) and International Fuel Tax Agreement (IFTA) clearinghouses, which are being developed to facilitate distribution of funds among states, are still in the early stages of deployment.

One of the key lessons learned over the past few years is that collaboration among states and industry, in cooperation with the Federal Government, is key to success. Through the mainstreaming program and corridor coalitions, states have been working together to identify and solve technology problems. Many of the issues presented in this report were identified and

discussed extensively in such forums. As key stakeholders in the future deployment of CVISN, their views on what works and does not work must be considered in charting the future direction of this technology deployment.

Under the CVISN model deployment initiative, federal and state government agencies worked together with the motor carrier industry to develop and deploy cost-effective information systems and communication networks that support motor carrier safety. Working together, government, the motor carrier industry, and private sector stakeholders developed and are deploying a specific set of capabilities in the areas of safety information exchange, interstate (IRP/IFTA) credentials administration, and roadside electronic screening.

Building on this foundation, the federal government will continue to support state efforts to develop and implement CVISN Level 1 capabilities and explore additional capabilities beyond those identified for Level 1 deployment. Collecting additional safety and other ITS/CVO-related data electronically and sharing that information among the states and federal government will enhance roadside inspection and enforcement activities and will equip state and federal enforcement personnel with information to better identify unsafe and potentially suspect motor carriers, their drivers, and vehicles.

Finally, as a result of the events of September 11, 2001, our nation and, in particular, the U.S. Department of Transportation have focused attention on the need to ensure the security of our transportation system. Over the next decade, an environment in which timely and accurate motor carrier, commercial vehicle, and driver data are shared electronically among authorized stakeholders will be required. The CVISN information and communication systems were originally designed to improve transportation safety and the efficiency of commercial vehicle operations. However, the deployment of these systems presents opportunities to significantly improve transportation security at the same time. Information sharing is a critical enabler for helping to ensure transportation security while maintaining the efficiency of freight operations. For example, legitimate transporters of hazardous materials will be able to apply for and receive appropriate credentials in a timely manner and operate with minimal delays for roadside screenings and inspections. Also, the sharing of information among states and the federal government will enhance inspection and enforcement activities and allow enforcement personnel to better focus their efforts on the high-risk motor carriers, drivers, and vehicles as well as potential security threats that involve transportation of hazardous materials.

### **9.3 FUTURE DATA REQUIREMENTS**

Although the CVISN benefit/cost analysis demonstrated that CVISN is a good investment for the country, additional benefit and cost data are needed to promote and expand the deployment of CVISN. This information is needed by Congress and U.S. DOT to evaluate further investments at a national level. The information is also needed by participating states, especially those in the early stages of deployment, to assess expenditures and establish priorities at the state level. Also, because the magnitude of the benefits of CVISN depend on the level of deployment, it is important to monitor the progress of deployment closely across the country.

The CVISN cost analysis (Chapter 6) was based on actual cost data obtained from a few states that were among the first to deploy CVISN technologies and services successfully. The major cost elements included one-time start-up costs as well as annual recurring costs to operate CVO administrative and roadside services both before and after deploying CVISN. As CVISN technologies mature and expand and more efficient solutions are developed, this cost information will need to be updated and new analyses performed to help participating states forecast their costs and cost savings. Also, it is important to obtain cost data from many different states in order to provide more accurate cost information to states with different infrastructure and organizational structures. The initial cost analysis presented in this report provided a template for specifying the data elements to be collected from participating states; however, more detailed guidelines are needed to ensure consistent and accurate reporting of deployment and operational costs.

The primary benefits of CVISN roadside technologies include reductions in CMV-related crashes, which result from (1) improved efficiency of the vehicle selection process during roadside inspections (more OOS orders per vehicle inspected) and (2) improved compliance with driver and vehicle safety regulations. While it is important to continue collecting data on the frequency and causes of CMV-related crashes, additional kinds of data are needed to demonstrate that CVISN technologies are having the desired impacts. Examples of roadside enforcement data that are needed to document CVISN benefits include vehicle and driver OOS rates for motor carriers in different safety risk categories, electronic screening bypass rates, and trends in safety compliance rates as CVISN becomes more widely deployed. The latter requires specially designed studies to ensure that estimates are not biased by vehicle selection criteria.

Tracking the deployment of CVISN technologies and services is important for several reasons: (1) it measures one aspect of a successful program – user acceptance, (2) the deployment status in individual states is needed to help Congress and U.S. DOT in making future funding decisions, (3) the data can be used to identify additional sources of data for monitoring benefits and costs, and (4) the level of deployment is a key variable in estimating benefits and costs on a national scale. Examples of deployment tracking data that are useful for these purposes include numbers of

- Carriers participating in electronic credentialing
- Different types of credentials that can be processed electronically
- Credentials (by type) processed electronically
- States participating in IRP and IFTA clearinghouses
- Carriers/trucks enrolled in electronic screening programs
- Active electronic screening sites
- Inspectors using Aspen or equivalent to conduct inspections

- Vehicles screened using the Inspection Selection System
- Past inspection queries performed on trucks during inspections.

Previous studies (Radin 2000, PTI 2000) obtained deployment-tracking data during the early phases of CVISN. This information should be updated; however, it may be more efficient to request all three types of data (costs, benefits, and deployment status) at the same time, with appropriate guidelines and instructions.

#### **9.4 REFERENCE**

Pennsylvania Transportation Institute (PTI), Survey of Motor Carrier Safety Activities – Interim Technical Memorandum 2 (Pennsylvania State University, University Park, Pennsylvania), January 2000.

Radin, S., “Tracking State Deployments of Commercial Vehicle Information Systems and Networks: 1998 National Report,” EDL No. 13082 (U.S. DOT, Washington, D.C.), May 30, 2000.

*What Have We Learned About Intelligent Transportation Systems?* Chapter 6, “What Have We Learned About ITS for Commercial Vehicle Operations? Status, Challenges, and Benefits of CVISN Level 1 Deployment,” (Washington, D.C.: U.S. DOT, Federal Highway Administration, December 2000), [www.itsdocs.fhwa.dot.gov](http://www.itsdocs.fhwa.dot.gov), EDL No. 11316, pp 107–126.