EVALUATION OF THE INTEGRATION OF CVISN AT THE NOGALES PORT OF ENTRY

Final Report 535 (2)

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July 2008

Prepared for:

Arizona Department of Transportation
206 South 17th Avenue
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 in cooperation with
U.S. Department of Transportation
Federal Highway Administration

ATRC reports are available on the Arizona Department of Transportation's Internet site.

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
FHWA-AZ-07-535(2)		

4. Title and Subtitle
Evaluation Of The Integration Of CVISN at the Nogales Port Of Entry

5. Report Date
July 2008

6. Performing Organization Code
R0535 17P

7. Authors
Robert S. Done, Ph.D.

8. Performing Organization Report No.

9. Performing Organization Name and Address
Data Methods Corporation
805 N. Camino Miramonte
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10. Work Unit No.

11. Contract or Grant No.
SPR-PL-1-(61) 535

12. Sponsoring Agency Name and Address
Arizona Department of Transportation
206 S. 17th Avenue
Phoenix, Arizona 85007

Project Manager: John Semmens

13.Type of Report & Period Covered
FINAL
November 2004 – July 2008

14. Sponsoring Agency Code

15. Supplementary Notes
Prepared in cooperation with the U.S. Department of Transportation, Federal Highway Administration

16. Abstract

In 1995, the U.S. Congress directed the Federal Highway Administration to describe how and when it would design, deploy, and maintain a commercial vehicle information system network (CVISN). The CVISN conceptualization focused on inspections and safety ratings, out-of-service orders and registration denials, objectives and constraints, and data collection and use.

The three CVISN operation capabilities are safety information exchange, credentials administration, and electronic screening. A Level 1 implementation results in basic operation functionality in these three functional areas. A Level 2 implementation results in advanced operation functionality in these three areas. Using data collected by commercial vehicle inspection officers in Arizona, this study evaluates the integration of CVISN at the Nogales port of entry and identifies opportunities for improving operation effectiveness in the future.

The study analyzed commercial vehicle port entries and clearance rates from 2005 to 2007 with CVISN. The results indicate that the cost efficiencies of the port's inspection booths could potentially be improved by roughly 30 percent under the current conditions at the site.

17. Key Words
CVISN, evaluation, ports-of-entry, commercial vehicles, trucking, NAFTA

18. Distribution Statement
Document is available to the U.S. public through the National Technical Information Service, Springfield, Virginia 22161

23. Registrant's Seal

19. Security Classification	20. Security Classification	21. No. of Pages	22. Price
Unclassified	Unclassified	34	

SI (MODERN METRIC) CONVERSION FACTORS*

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	Inches	25.4	millimeters	mm
ft	Feet	0.305	meters	m
yd	Yards	0.914	meters	m
mi	Miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yards	0.836	square meters	m^2
ac	Acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	Gallons	3.785	liters	L
ft^3	cubic feet	0.028	Cubic meters	m^3
yd^3	cubic yards	0.765	Cubic meters	m^3
	NOTE: Volumes greater than 1000L shall be shown in m^3.			
		MASS		
oz	Ounces	28.35	grams	g
lb	Pounds	0.454	kilograms	kg
T	short tons (2000lb)	0.907	megagrams (or "metric ton")	mg (or "t")
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5(F-32)/9 or (F-32)/1.8	Celsius temperature	°C
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE AND PRESSURE OR STRESS		
lbf	Poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
M	meters	3.28	feet	ft
M	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
M^2	square meters	10.764	square feet	ft^2
M^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
M^3	cubic meters	35.315	cubic feet	ft^3
M^3	cubic meters	1.308	cubic yards	yd^3
		MASS		
G	grams	0.035	ounces	oz
kg	kilograms	2.205	pounds	lb
mg (or "t")	megagrams (or "metric ton")	1.102	short tons (2000lb)	T
		TEMPERATURE (exact)		
°C	Celsius temperature	1.8C + 32	Fahrenheit temperature	°F
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		FORCE AND PRESSURE OR STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

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ABBREVIATIONS AND ACRONYMS

ASAP	Automated Safety Assessment Program
ADOT	Arizona Department of Transportation
ASPEN	Software system to collect CVO inspection data
CAT	Carrier Automated Transaction
CDLIS	Commercial Driver's License Information System
CI	Credential interface
CVIEW	Commercial Vehicle Information Exchange Window
CVISN	Commercial Vehicle Information Systems And Networks
CVO	Commercial Vehicle Operations
CVSA	Commercial Vehicle Safety Alliance
DSRC	Dedicated Short Range Communication
EDI	Electronic Data Interchange
EFT	Electronic Funds Transfer
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FTE	Full time equivalent
ICC	Interstate Commerce Commission
IES	Information Exchange System
IFTA	International Fuel Tax Agreement
IRP	International Registration Plan
ITS	Intelligent Transportation Systems
MCDC	Motor Carrier Data Collection
MCMIS	Motor Carrier Management Information System
MCSAP	Motor Carrier Safety Assistance Program
MVS Express	Software to manage CVO credentials
NMVTIS	National Motor Vehicle Title Information System
POE	Port-of-Entry
PRISM	CVO status software application in use at Nogales POE
ROC	Roadside Operations Computer
SAFER	Safety And Fitness Electronic Records
SafeStat	Safety Status Measurement System
SafetyNet	Computer system supporting the MCSAP
SSWIM	Slow Speed Weigh-In-Motion
TARGATS	Tax and Revenue Group Automated Transaction System
VISTA	CVO status software application in use at Nogales POE
WIM	Weigh-In-Motion

EXECUTIVE SUMMARY

The evolution of federal commercial motor vehicle law played an important role in the development of the Commercial Vehicle Information Systems and Networks (CVISN). Earlier laws resulted in the development of various commercial motor vehicle data sources. Most recently, in 1995 federal law mandated the development of a plan to create and maintain an information system that integrated these various vehicle data sources. The Federal Highway Administration (FHWA) prepared a report that addressed issues in the development of a commercial vehicle information system and how such a system could be made operational.

The cornerstones of a commercial vehicle information system are the underlying data, data collection, and data distribution. In the proposed system, data would be accessed and reported on in a timely rather than real-time basis.

CVISN is not a new information system, but rather the integration of information systems at the national, state, and local levels. The primary objective of the CVISN program is to implement information systems that support safety information exchange, credentials administration, and electronic screening. States may implement CVISN with basic operation capabilities (Level 1) or with advanced operation capabilities (Level 2).

The Arizona CVISN implementation includes port of entry "superbooths" which are equipped with all of the requisite communication capabilities to interact with the designated intelligent transportation system (ITS) networks. Safety information is exchanged through the creating and querying of inspection data. Credentials such as vehicle registrations and fuel tax reports are administered electronically. Vehicles are electronically screened to identify the carrier, the vehicle, the driver, and to determine if a physical inspection is necessary.

This study examines data collected by inspection officers at the Nogales port of entry. Quantitative analyses yielded a conclusion that there is a statistically significant increase in the number of commercial vehicles that were cleared for travel there during 2005-2007. The data also indicate that seasonal variation in the percentage of commercial vehicles that are cleared for travel has stabilized.

As a result of the new CVISN procedures, shippers save an estimated $228,120 per year and the port operates with a 32.2% improvement in inspection efficiency. Other benefits may be experienced by shippers, consumers, taxpayers, and the Arizona Department of Transportation (ADOT) as well.

It is important to note that the improvements found during the 2005-2007 period may have depended on not only the implementation of CVISN but also the successful integration and cohesive operation of multiple state and federal inspection agencies located at the key Mariposa port of entry in Nogales. If these organizations, for whatever

reason, are unable to continue to maintain this level of coordination, then the observed improvements may not be consistently achieved in the future.

The following four steps are recommended to further improve operational effectiveness at the Nogales port of entry:

- Use the evaluation results to establish performance benchmarks. The results provide a quantitative baseline of gradually improving performance against which future performance targets and results can be compared.
- Use the evaluation results to plan inspection operations. The results reveal a predictable pattern of total inspection traffic as well as a consistent percentage of vehicles that require physical inspections.
- Implement a continuous evaluation process. The continuous evaluation of inspection performance at the port of entry will document the importance of CVISN and identify opportunities for improvement.
- Implement an evaluation-driven data collection protocol. The collection of specific data elements that will address predetermined evaluation questions will increase the benefit produced by data collection efforts.

1. INTRODUCTION

Commercial vehicle information systems and networks are the intelligent transportation systems that support commercial vehicle operations (CVO).

This research report begins with a summary of how the evolution of federal commercial motor vehicle law resulted in a congressional mandate for the development of CVISN. Then, the Federal Highway Administration’s conceptualization of the development and implementation of CVISN is described, followed by an outline of the specific information systems, operational capabilities, implementation levels, and implementation tasks required by CVISN.

The implementation of CVISN at the Nogales, Arizona, port-of-entry (POE) is described, including the specific systems that support safety information exchange, credentials administration, and electronic screening. Then, the effectiveness of inspections is analyzed and the results are presented along with recommendations for improvement.

2. FEDERAL COMMERCIAL MOTOR VEHICLE LAW

The evolution of federal commercial motor carrier law played an important role in the development of CVISN. As commercial motor vehicles became prevalent in the early 1900s, laws were established to prevent monopolies. Then in the 1980s, laws were enacted to deregulate the trucking industry as well as improve the safety of commercial motor vehicles and drivers. In 1995, federal law mandated the development of a plan to create and maintain an information system that integrated various commercial motor vehicle data sources. And in 1999, federal law created a new agency with the responsibility for CVISN. In this section, major federal commercial motor vehicle laws are described in more detail.

MOTOR CARRIER ACT OF 1935

The Motor Carrier Act of 1935[1] was primarily intended to regulate the trucking industry. This law gave the Interstate Commerce Commission (ICC) the authority to regulate motor carriers and drivers engaged in interstate commerce by controlling operating permits, establishing truck routes, and setting tariff rates and truck weights. In particular, Section 206(A) prohibited a motor carrier from engaging in interstate commerce unless it had been issued a Certificate of Public Convenience and Necessity by the ICC. These regulations were intended to reduce what was believed to be “predatory” and “ruinous” competition by forming trucking cartels under the supervision of the ICC. Effectively, the regulation raised tariff rates on all interstate motor carriers and increased the difficulty of creating or expanding motor carrier operations. This limited the number of motor carriers operating on interstate highways and reduced the options of shippers.[2]

MOTOR CARRIER ACT OF 1980

The Motor Carrier Act of 1980[3] removed some of the regulations imposed by the ICC. The law prohibited a rate bureau from interfering with a motor carrier's right to publish its own rates and eliminated several important restrictions. For example, motor carriers were not restricted as to the commodities they could carry, the routes they could use, and the geographic regions they could serve. Under this law, motor carriers were allowed to price freely within a “zone of reasonableness,” which meant that motor carriers could increase or decrease rates from existing levels by 15% without challenge. Moreover, motor carriers were encouraged to make independent rate filings with even larger rate changes. As a result of this law, the number of new motor carriers operating on interstate highways increased dramatically, especially low-cost, non-union carriers.[4]

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[1] The Motor Carrier Act of 1935 (Public Law 74-255, 49 Stat. 543)
[2] Breyer, Stephen G. *Regulation and Its Reform*. Cambridge MA: Harvard University Press, 1982.
[3] P.L. 96-296, 94 Stat. 793.
[4] Moore, Thomas Gale. *Trucking Deregulation*. The Concise Encyclopedia of Economics. 1st.ed. http://www.econlib.org/Library/Enc/TruckingDeregulation.html. Accessed July 16, 2008.

COMMERCIAL MOTOR VEHICLE SAFETY ACT OF 1986

The Commercial Motor Vehicle Safety Act of 1986[5] established standards for commercial driver's licenses and created requirements for motor carriers, operators, and vehicles. This law prohibited motor carriers from allowing operators to operate a commercial motor vehicle who had more than one driver's license (multiple driver's licenses allowed operators to conceal violation histories from carriers and enforcement officials) or who did not have a valid driver's license. Likewise, this law prohibited motor carrier operators from having more than one driver's license. The act also required an operator who was convicted of a moving violation to notify his or her employer as well as the state that issued his or her driver's license. Finally, the act required that trucks and truck tractors manufactured after 1980 to have operational brakes on all wheels.

DEPARTMENT OF TRANSPORTATION AND RELATED AGENCIES APPROPRIATIONS BILL OF 1995

The Department of Transportation and Related Agencies Appropriations Bill of 1995[6] called for the development of a commercial vehicle information system that would enable or promote:

- Targeting specific vehicles for inspection.
- Improving safety rating accuracy.
- Verifying compliance order completion.
- Enforcing registration denials.
- Increasing inspection effectiveness.

The bill also required the Federal Highway Administration (FHWA) to submit a report to Congress detailing how and when FHWA would design, deploy, and maintain a commercial vehicle information system, including:

- Objectives and milestones for system development and implementation.
- Stakeholder, technical, and financial constraints.
- Incorporation of intra- and interstate driver and vehicle data.
- Discussion of mandatory transponders in commercial vehicles.
- Accommodation of foreign drivers and vehicles.

MOTOR CARRIER SAFETY IMPROVEMENT ACT OF 1999

Most recently, the Motor Carrier Safety Improvement Act of 1999[7] was signed into law on December 9, 1999. The purposes of the act were to:

[5] P.L. 99-570, 100 Stat. 3207.
[6] P.L. 103-331, 108 Stat. 2471.
[7] P.L. 106-159, 113 Stat. 1766.

- Create the Federal Motor Carrier Safety Administration (FMCSA); and
- Reduce the number and severity of large-truck-involved crashes.

Once created, FMCSA assumed responsibility for CVISN. So while FHWA played a significant role in the creation of CVISN and figures prominently in this report, CVISN is now a program of FMCSA.

Thus, federal commercial motor vehicle laws responded to emerging needs existing in the trucking industry. Initial federal motor vehicle laws were intended to regulate competition in the trucking industry. Subsequent laws relaxed the regulations and focused on improving the safety of commercial motor vehicles and drivers. The data generated by the increased safety requirements remained divergent until recent federal commercial motor vehicle law required the development of a network that would integrate and synthesize these data into commercial vehicle information system.

3. THE CVISN CONCEPTUALIZATION

In response to the Department of Transportation and Related Agencies Appropriations Bill of 1995, the FHWA prepared a report[8] that addressed issues in the development of a commercial vehicle information system and how such a system could be made operational. The cornerstone of a commercial vehicle information system is the underlying data, how they are collected, and how they are distributed. The proposed CVISN was predicated on the expectation that data will be accessed and reported on a timely rather than a real-time basis. That is, data will be collected and distributed frequently, on a batch basis, rather than being continually and instantaneously available. The remainder of this section summarizes the FHWA conceptualization of the development and implementation of CVISN.

INSPECTIONS AND SAFETY RATINGS

Specific vehicles are most often targeted for inspection based on the carrier because carrier safety management policies have a strong influence on driver behavior and vehicle maintenance; because more comprehensive information exists for carriers than individual drivers or vehicles; and carriers are responsible for the performance of their drivers and vehicles. Nevertheless, individual driver or vehicle characteristics (e.g., out-of-service orders) may warrant an inspection regardless of the carrier history. During the 1992 and 1993 calendar years, 820,553 drivers were inspected 1,239,557 times. About two-thirds (69.9%) were inspected only once in that two-year period, but some drivers were inspected 10 or more times. Alternatively, an active Commercial Vehicle Safety Alliance (CVSA)[9] decal on a vehicle decreases the likelihood that the vehicle will be selected for inspection.

Carrier safety ratings are a function of the data collected during compliance reviews, roadside inspections, accident reports, and traffic stops. Because carrier safety ratings influence the likelihood of subsequent reviews and inspections, the accuracy and timeliness of the original data is paramount. Handheld and other locally operated computers are used to ensure that data collected on a particular driver or vehicle is

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[8] Report to Congress from the Administrator of the Federal Highway Administration. *Providing Carrier-, Driver-, and Vehicle-Specific Information to the Roadside*. Washington, DC, 1995. Also available online at: http://cvisn.fmcsa.dot.gov/downdocs/cvisndocs/1_general/omc23aug.pdf. Accessed July 16, 2008.

[9] CVSA is an international not-for-profit organization comprised of local, state, provincial, territorial, and federal motor carrier safety officials and industry representatives from the United States, Canada, and Mexico. Their mission is to promote commercial motor vehicle safety and security by providing leadership to enforcement, industry, and policy makers. CVSA member jurisdictions are represented by various departments of transportation, public utility and service commissions, state police, highway patrols and ministries of transport. In addition, CVSA has several hundred associate members who are committed to helping the alliance achieve its goals: uniformity, compatibility, and reciprocity of commercial vehicle inspections, and enforcement activities throughout North America by individuals dedicated to highway safety and security. http://www.cvsa.org/about/index.aspx. Accessed July 16, 2008.

associated with the correct carrier and to reduce data entry delays, errors, and costs. Inspection officers are interested in the accuracy of safety ratings because carriers with inaccurately low rates may experience fewer inspections than warranted. Likewise, carriers are also interested in the accuracy of safety ratings because carriers with inaccurately high rates may experience unnecessary inspections and resulting delay.

OUT-OF-SERVICE ORDERS AND REGISTRATION DENIALS

One possible outcome of a compliance review, roadside inspection, accident report, or traffic stop is that a driver or vehicle is placed out of service until the deficiency is corrected. The enforcement of out-of-service orders is important to encourage improvements in deficient drivers and vehicles and to protect the public from imminently dangerous drivers and vehicles. The commercial vehicle information system would be used to create out-of-service orders by enforcement officers at the time and place the driver or vehicle is originally placed out of service. The system would also be used by enforcement officers during subsequent inspections to determine the existence and status of out-of-service orders. Finally, the system would be used by drivers, carriers, and third party repair facilities to determine the requirements and status of out-of-service orders.

Motor carriers with poor safety records may be denied vehicle registrations based on their Safety Status Measurement System (SafeStat) score. SafeStat is a data-driven algorithm developed by the U.S. Department of Transportation's Volpe National Transportation Systems Center.[10] The relative safety of a motor carrier is reflected in its SafeStat score, which provides an objective, accurate, and efficient method for capturing a variety of safety factors. Although the denial of a vehicle registration is a bureaucratic process, enforcement officers and SafeStat scores have an interdependent relationship. SafeStat scores can only be as reliable as the data that are collected by enforcement efforts and reported into the commercial vehicle information system. Similarly, the efficiency and effectiveness of enforcement efforts depend on the reliability of the SafeStat scores.

OBJECTIVES AND CONSTRAINTS

The development of the commercial vehicle information system began with the identification of objectives and milestones which were consonant with the National ITS (Intelligent Transportation Systems) program plan and the CVO (Commercial Vehicle Operations) program plan. These two plans were also being prepared at the time CVISN was being developed. The primary objectives were to implement intelligent transportation system and commercial vehicle operations user services, improve commercial vehicle operations efficiency and effectiveness, promote consistency among processes and data, and improve the availability of timely, accurate information. The major milestones included the development of preliminary CVISN architecture in 1995, pilot testing in up to six states in 1996, and complete national deployment by 2000.

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[10] Sienicki, D. "Analysis and information online: An intranet application." *Public Roads* 62:61-62, March/April 1999.

The primary constraints of CVISN are stakeholders, technology, and financial motivation. Stakeholders (e.g., governments, carriers, drivers, and service providers) must be willing to express their requirements, understand the requirements of other stakeholders, and collaborate on mutually beneficial outcomes. The primary technical considerations are data and how they are communicated. Data standards for electronic data interchange (EDI) and electronic funds transfer (EFT) must be common among all stakeholders. Passwords and encryption tools were identified as ways to protect data integrity and privacy. Perhaps most fundamentally, the effect of CVISN on the revenues and expenses of stakeholders (both public and private sector) and their respective individual or organizational goals was recognized as a critical constraint.

DATA COLLECTION AND USE

CVISN was to be populated with driver and vehicle data through its pilot implementation in select states in 1995 and 1996 and through its final implementation at a national level by 2000. The driver, vehicle, and carrier safety and compliance data were to be propagated throughout CVISN over the Information Exchange System (IES) from electronic files in the Motor Carrier Management Information System (MCMIS), SafetyNet (a computer system used by states participating in the Motor Carrier Safety Assistance Program (MCSAP) and by the Federal Motor Carrier Safety Administration), and the Commercial Driver's License Information System (CDLIS). Data would also be reported on intrastate carriers operating in the pilot states during pilot testing and on intrastate carriers operating in all states during the final implementation at a national level.

Transponders[11] would provide a means for data on vehicles and carriers to be electronically transmitted to appropriately equipped checkpoints at mainline speeds. Based on these data, the vehicle may be required to stop for an inspection or allowed to pass. The purchase of transponder transmitters by carriers and of receivers by states would be voluntary, but would benefit both parties. For example, transmitters would reduce the uncertainty of inspection times for carriers, and receivers would reduce congestion around state checkpoints by reducing the number of vehicles required to stop.

In addition to transponders, smart cards[12] were recognized as an electronic means to verify driver credentials at checkpoints. Together, transponders and smart cards represent a collective way to increase the speed and accuracy of data collection from drivers and vehicles.

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[11] A transponder is a wireless communications, monitoring, or control device that picks up and automatically responds to an incoming signal. http://searchmobilecomputing.techtarget.com/sDefinition/0,,sid40_gci213219,00.html. Accessed July 16, 2008.

[12] A smart card resembles a credit card in size and shape, but the inside of a smart card usually contains an embedded microprocessor. http://computer.howstuffworks.com/question332.htm. Accessed July 16, 2008.

The development and implementation of CVISN would recognize the need to accommodate data collected from foreign drivers and vehicles, even though neither may be registered with U.S. authorities. Currently, the MCMIS contains data collected in the United States from foreign carriers and this data would be included in CVISN. Ultimately, CVISN would be expanded to allow access to and access by authorities and carriers in Canada and Mexico. The collection of data from foreign drivers and vehicles is especially important to maintaining national security without hindering opportunities for economic growth with Canada and Mexico. The travel of foreign drivers and freight through the United States presents several issues (e.g., citizenship, work authorization, tariffs, and taxes) that intersect with CVISN and how it could be utilized.

The effectiveness of commercial vehicle inspections should be increased with the implementation of a commercial vehicle inspection system. Such a system would increase ability of enforcement officers to execute and monitor out-of-service orders, which increases the reliability of carrier safety ratings. Carriers should be motivated to monitor their safety ratings and report discrepancies so that their drivers and vehicles are not subject to a higher likelihood of inspection and the resulting delays. The accuracy and timeliness of other types and sources of commercial vehicle data are also paramount. Delays and errors in data collection and reporting would be reduced with mobile or handheld technology that electronically transmits data to the larger system, and the same technology would allow enforcement officers to access carrier data in a timely manner.

4. THE CVISN IMPLEMENTATION

The primary objective of the Commercial Vehicle Information Systems and Networks (CVISN) program is to implement information systems that support safety information exchange, credentials administration, and electronic screening.[13] CVISN is not a new information system, but rather the integration of information systems at the national, state, and local levels. Once these information systems are able to communicate, they have the operational capability to exchange safety, credential, and electronic screening data.

States may implement CVISN with basic operational capabilities (Level 1) or with advanced operational capabilities (Level 2). And in order to implement CVSIN, states must accomplish the tasks of system coordination, development, and modification. In this section, each of these aspects of CVISN implementation is discussed in more detail.

INFORMATION SYSTEMS

The core infrastructure of CVISN requires several information systems operating at the interstate and national levels to manage safety and credential data. Safety data are managed in the MCMIS and the Automated Safety Assessment Program (ASAP), and snapshots of safety data are produced by the Safety and Fitness Electronic Records (SAFER) System for distribution to state systems. The CDLIS contains commercial driver data and the National Motor Vehicle Title Information System (NMVTIS) contains commercial vehicle data. Base state agreement data for interstate carrier vehicle registration and fuel taxation are administered through the International Registration Plan (IRP) and International Fuel Tax Agreement (IFTA) clearinghouses.

Information systems operating at the state level provide transaction support for carriers and enforcement officers. Safety inspection data are reported through the SAFETYNET and ASPEN systems. SAFETYNET is a database management system for inspection, crash, compliance review, assignment, and complaint data. ASPEN is an application that collects inspection details and electronically transfers that information to SAFER and SAFETYNET.

The Commercial Vehicle Information Exchange Window (CVIEW) system generates portions of the interstate carrier, vehicle, and driver snapshots. A credential interface (CI) system provides a single point of interface for credential transactions. Electronic screening requires short range communication (DSRC) systems to utilize transponders and weigh-in-motion (WIM) scales to capture vehicle weights.

[13] Richeson, K. E. *Introductory Guide to CVISN.* POR-99-7186. Laurel, MD: Johns Hopkins University, 2000.

Carrier information systems complement those at the intra- and interstate levels. Carriers report safety compliance information through the Automated Safety Assessment Program Motor Carrier Data Collection (ASAP MCDC) system. Dedicated applications such as Carrier Automated Transaction (CAT) systems communicate via EDI standards and allow carriers to obtain credentials, file fuel tax returns, and register vehicles. Secure transactions via the Internet may allow carriers to access government or commercial web sites to perform the same functions without the need for a dedicated application.

Electronic screening is supported with onboard information systems that transmit data via DSRC to inspection station systems. Finally, carriers may automate other elements of fleet and freight management such as hazardous materials control and fleet maintenance.

OPERATIONAL CAPABILITIES

The exchange of motor carrier safety information begins with the collection of data during roadside inspections and at weigh stations. Inspectors within a given state use the ASPEN system to prepare inspection reports and forward them to that state's CVIEW system. Likewise, data collected from transponders and WIM scales are transmitted to that state's CVIEW system. At the state level, inspection reports and compliance reviews are compiled in the state's SAFETYNET and transmitted to the state-level CVIEW for intrastate use and to the SAFER system for interstate use. At the national level, the SAFER system creates carrier and vehicle standardized snapshots of safety information based on data stored in MCMIS and from states' SAFETYNET and CVIEW systems. These snapshots are then distributed for use by states and roadside inspectors.

The exchange of motor carrier credential information begins with the collection of data from motor carriers as they apply and pay for licensing, permitting, and insurance credentials using a CAT system or some other interface with agencies that provide these credentials. Because carriers, credentialing, and financial agencies are likely to use different hardware and software systems, states must ensure that these systems support EDI standards. States themselves must support EDI standards because base state agreements require the communication of carrier credentials between states. Under these agreements, an interstate motor carrier secures all of its credentials from a single base state and then that state transmits those credentials and any associated revenue payments (e.g., fuel taxes) to other states in which that carrier operates.

The exchange of electronic screening information begins with the collection of data from a vehicle transponder as it approaches a weigh station. The roadside operations computer (ROC) uses this information to automatically retrieve a snapshot of safety and credential information about the carrier and vehicle. In addition, WIM scales collect axle and total vehicle weights and together with the safety and credential information the ROC determines whether or not the vehicle is required to stop.

If a vehicle has appropriate safety, credential, and weight information, then its transponder is sent a signal that allows the driver to continue past the station. If a vehicle does not have appropriate safety, credential, and weight information (or if the vehicle is randomly selected), then its transponder is sent a signal that requires the driver to stop at the station for manual inspection of the vehicle.

IMPLEMENTATION LEVELS

A Level 1 CVISN implementation results in basic operational functionality in the three capability areas. States with a Level 1 implementation have the capability to exchange safety information by accessing data and reporting inspection results on the ASPEN system, accessing and storing carrier and vehicle snapshots on the CVIEW system, and connecting to the SAFER system to share snapshots with other states. States also have the capability to administer credentials by connecting to the IRP and IFTA clearinghouses, to process at least 10% of IRP and IFTA transactions electronically, as well as the readiness to electronically administer other credentials (e.g., permits). The final capability of a Level 1 implementation is the utilization of electronic screening of at least one inspection site and the readiness to utilize electronic screening at other inspection sites.

The implementation of Level 2 CVISN results in advanced operational functionality in the three capability areas. States with a Level 2 implementation have the capability to exchange safety information with electronic collection of crash and citation data from at least 10% of enforcement officers, voluntarily participate in ASAP by at least 10% of carriers, and electronically monitor onboard safety conditions. In addition, states have enhanced credential administration capabilities such as electronic processing of payments, electronic issuance of all credentials (i.e., paperless vehicles), and electronic processing of at least 50% of credential transactions. Level 2 electronic screening involves functional interoperability among screening programs, implementation at all major weigh stations and inspection sites, and the readiness to replicate at all sites.

IMPLEMENTATION TASKS

States must perform three tasks to accomplish a core deployment of CVISN. Initially, coordination must be provided by three areas. First, the CVISN program formation is coordinated by the formation of a CVO working group (including motor carriers) according to the CVO business plan. Second, program management coordination is provided by the program manager, system architect, and program administrator according to the state CVISN program plan. Finally, system engineering is needed to coordinate the development of a top-level system design to support required business processes, the development of technical specifications for all subsystems (including EDI transactions), the development and implementation of comprehensive integration and testing efforts, and the design to of networks and communications to link all of the subsystems.

The second task for states is to acquire or develop new systems to collect, store, and communicate commercial vehicle data if these systems are not already in place, and provide end-user training on these systems. The requisite hardware and communication systems are needed for states to utilize the ASPEN system. Likewise, states need to acquire the hardware, software, and communication interface needed to utilize the CVIEW system. To fully engage motor carriers, states must develop or acquire carrier automated transaction (CAT) software and credentialing interface (CI) hardware, software, and communication linkages that allow EDI transactions for exchanging data. To accommodate transponders, states must develop or acquire the hardware, software, and communication support for dedicated short range communication (DSRC) standards.

Finally, states must modify four existing systems so that they will interface with the newly developed systems. Network and communication systems need to be modified so that all of the subsystems are connected. The IRP legacy system must be modified to accept supplemental and renewal transactions from the credentialing interface and to connect with the IRP clearinghouse. Similarly, the existing IFTA system must be modified to accept supplemental and renewal transactions and quarterly tax reports from the credentialing interface and to connect with the IFTA clearinghouse. Lastly, legacy weigh stations must be modified in three ways: scales and signage need to be adapted to interface with the e-screening system; power and communication facilities need to be expanded and improved; and traffic lanes may need to be reconfigured for e-screening.

Once the three deployment tasks have been completed, then states have core CVISN capabilities in four system areas. Most fundamentally, all systems will support EDI for communicating data. More specifically, the SAFER system will support the storage and exchange of carrier and vehicle data, vehicle and driver inspection report data, carrier profile data, and compliance, crash, and enforcement data. The IRP clearinghouse will perform remittance netting, use the banking system for electronic funds transfer, and will accept recap data from states. The IFTA clearinghouse will accept transmittal and profile data from states, provide resources (e.g., IFTA manuals, tax rate matrices, news, and calendar information), and generate reports. Finally, the licensing and insurance system will provide data to the SAFER system for licensing and insurance snapshots.

5. THE ARIZONA CVISN IMPLEMENTATION

The Arizona CVISN implementation includes Nogales port of entry 'superbooths' equipped with all of the requisite communication capabilities to interact with the designated ITS networks. As a commercial vehicle approaches the inspection queue, an inspection officer accesses safety, credential, and electronically screened data and determines whether or not a physical inspection of the vehicle should be undertaken. If the vehicle is not selected for a physical inspection, then it is released. If the vehicle is selected for a physical inspection, then it is directed to the required inspection stations where officers electronically access previous reports and file new reports.

A number of other inspection technologies are utilized in addition to CVISN, including slow speed weigh in motion (SSWIM) scales, cameras, and dynamic message signs. In this section, the three CVISN operational capabilities are described as they have been implemented in Arizona.[14]

SAFETY INFORMATION EXCHANGE

Querying and creating inspection reports are common forms of safety information exchange for Arizona commercial vehicle operations. An inspection report query is initiated when roadside officers use the ASPEN program to submit a query to SAFER's mailbox for all inspections tied to specific DOT numbers. SAFER then retrieves the query from its mailbox, processes the query, and retrieves relevant reports from data storage. An inspection report is created when roadside officers use ASPEN to submit a report to SAFER's mailbox. SafetyNet then retrieves the inspection report from SAFER and verifies the assigned DOT numbers and other data.

Once verified, SafetyNet transmits the verified report to MCMIS, which updates carrier summary information, computes carrier safety statistics, and transmits updated snapshot segments to SAFER on a batch basis.

Querying and maintaining carrier and vehicle snapshots are another common form of safety information exchange for Arizona commercial vehicle operations. Similar to an inspection report query, a snapshot query is initiated by roadside officers through SAFER, which receives, processes, and responds to the snapshot query. Snapshots are maintained with inspection report data as well as data from other systems.

The Arizona title and registration database provides carrier and vehicle identifiers, census and registration data, and check flags to the Arizona CVIEW. Likewise, the Tax and Revenue Group Automated Transaction System (TARGATS) database transmits carrier IFTA identifier and registration information as well as check flags to Arizona CVIEW.

[14] Arizona Department of Transportation. *CVISN Interoperability Test Plan*. Phoenix, AZ: Arizona Department of Transportation, 2003. Also available online at: http://cvisn.fmcsa.dot.gov/Deployment/AZ_CVISN_Test_Plan.doc.

Arizona CVIEW subsequently transmits snapshot data to SAFER on a batch basis, where it is merged with data transmitted by other states to SAFER.

CREDENTIALS ADMINISTRATION

Commercial carriers apply for registration renewal using a web browser and MVS Express. MVS Express[15] queries VISTA and PRISM[16] and reports back to the carrier any flags or conditions related to the registration renewal. Once acknowledged by the carrier, VISTA prepares an electronic invoice and the carrier submits electronic payment. VISTA then authorizes the credentials and carriers may then print cab cards locally.

On a nightly basis, VISTA transmits updated data to the title and registration database, the title and registration database transmits the updated data to Arizona CVIEW, and Arizona CVIEW transmits the updated data to SAFER. On a daily basis, VISTA receives updated data from PRISM and sends updated data to the IRP Clearinghouse. And finally, on a monthly basis the IRP Clearinghouse distributes payments to other jurisdictions.

Commercial carriers submit fuel tax reports by using a web browser to access the IFTA system. The IFTA system validates the account number, confirms the report accuracy, and then notifies the carrier of or credit due or taxes owed, including any penalties and interest. If taxes are owed, then the carrier submits payment to ADOT. If there is a credit due, then the carrier may request a refund or apply the credit balance to a future payment.

On a nightly basis, the IFTA system transmits updated data to the TARGATS database, the TARGATS database transmits updated data to CVIEW, and CVIEW transmits updated data to SAFER. Tax report data is then available to roadside officers to query in a snapshot format. In addition, current tax report data is transmitted on a nightly basis to the PrePass system to support the electronic screening of credentials.

ELECTRONIC SCREENING

Electronic screening is initiated when a commercial vehicle equipped with a transponder approaches the electronic screening area at an inspection station. Once the vehicle is in range, the transponder ID associated with the vehicle is transmitted from the on-board DSRC transponder to the roadside screening system and the ID is correlated with weight information as well as carrier and vehicle snapshot data. The inspection officer may use this information, as well as additional information available at the inspection station, to either allow the vehicle to pass or require the vehicle to stop for a physical inspection. The screening decision is communicated back to the vehicle and displayed to the driver on the transponder. Subsequently, SAFER receives updated interstate credential snapshots from Arizona CVIEW as well as completed inspection reports from ASPEN.

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[15] MVS Express is the trade name of software that processes, tracks and issue motor carrier credentials. http://www.mvsexpress.com/. Accessed July 16, 2008.

[16] VISTA and PRISM are software applications in use at the Nogales POE.

6. EVALUATION OF THE ARIZONA CVISN IMPLEMENTATION

The Arizona CVISN implementation at Nogales should result in an increase in efficiency with which vehicles are inspected. The integration of multiple data sources to support safety, credentialing, and electronic screening decisions should result in an increase in the percentage of commercial vehicles that are cleared at the superbooths.

The remainder of this research report focuses on the methods and results of an evaluation of the Arizona CVISN implementation.

METHOD

The data for the evaluation consisted of daily counts of the number of commercial vehicles processed and cleared at the Nogales port of entry during 2005-2007.

These data were subjected to a series of analyses to reveal any statistically significant differences. The data and analyses are described in detail below.

Data

Data were collected by inspection officers on a daily basis at the superbooths during the calendar years 2005-2007. These data included the overall quantity of commercial vehicles that were processed, and the number of those commercial vehicles that were cleared for entry.

The data were aggregated by month and the percentages of commercial vehicles that were cleared for entry were computed.

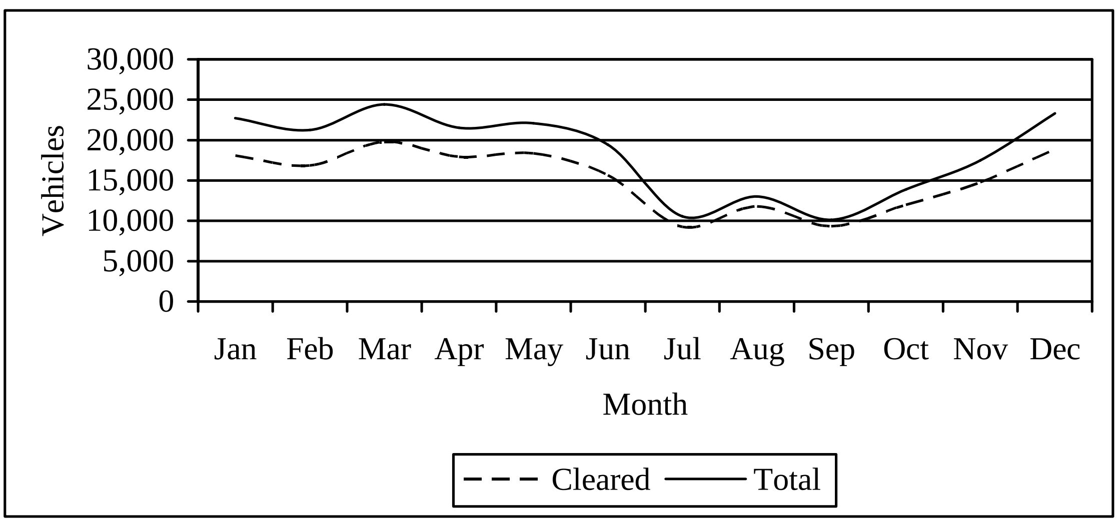
During 2005, the superbooths processed an average of 18,321 commercial vehicles per month and cleared an average of 15,222 commercial vehicles per month (see Table 1 and Graph 1 on the following page).

The percent of cleared vehicles ranged from 79.3% (February) to 92.3% (September) and averaged 84.1% for the year.

Table 1. 2005 Inspection Data

Month	Cleared	Total	Percent
Jan	18,075	22,725	79.5
Feb	16,874	21,273	79.3
Mar	19,772	24,429	80.9
Apr	17,939	21,528	83.3
May	18,352	22,074	83.1
Jun	15,644	19,435	80.5
Jul	9,248	10,549	87.7
Aug	11,793	13,040	90.3
Sep	9,339	10,113	92.3
Oct	11,975	13,883	86.3
Nov	14,771	17,492	84.4
Dec	18,884	23,310	81.0
Average	15,222	18,321	84.1

Graph 1. 2005 Inspection Data

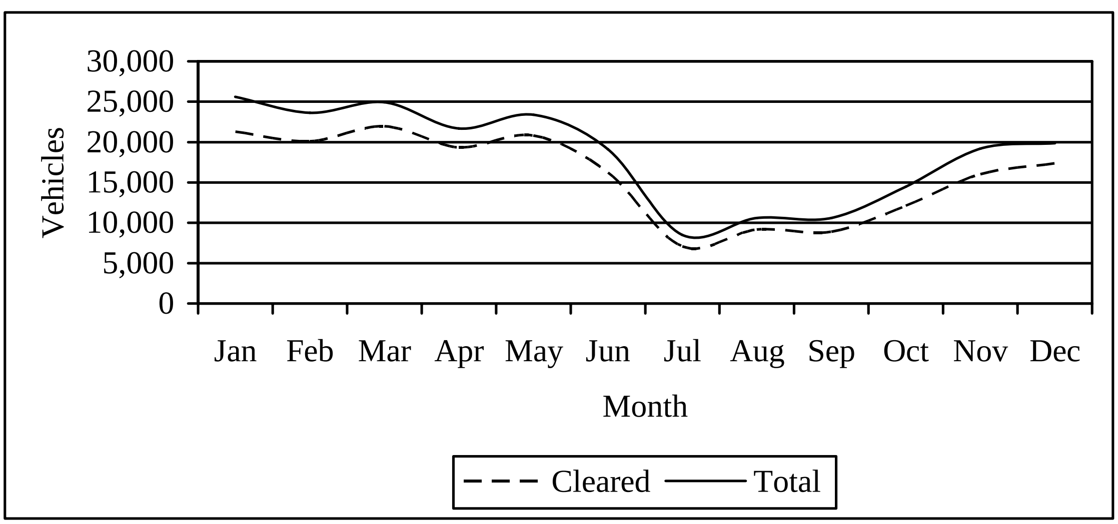


During 2006, the superbooths processed an average of 18,482 commercial vehicles per month and cleared an average of 15,871 commercial vehicles per month (see Table 2 and Graph 2). The percent of cleared vehicles ranged from 83.2% (January) to 89.3% (April) and averaged 85.6% for the year. Compared to 2005, the superbooths not only processed more commercial vehicles but also had a higher clearance rate.

Table 2. 2006 Inspection Data

Month	Cleared	Total	Percent
Jan	21,295	25,593	83.2
Feb	20,088	23,637	85.0
Mar	21,966	24,948	88.0
Apr	19,367	21,678	89.3
May	20,834	23,407	89.0
Jun	16,212	19,103	84.9
Jul	7,092	8,507	83.4
Aug	9,189	10,767	85.3
Sep	8,916	10,590	84.2
Oct	12,119	14,502	83.6
Nov	16,011	19,179	83.5
Dec	17,357	19,877	87.3
Average	15,871	18,482	85.6

Graph 2. 2006 Inspection Data

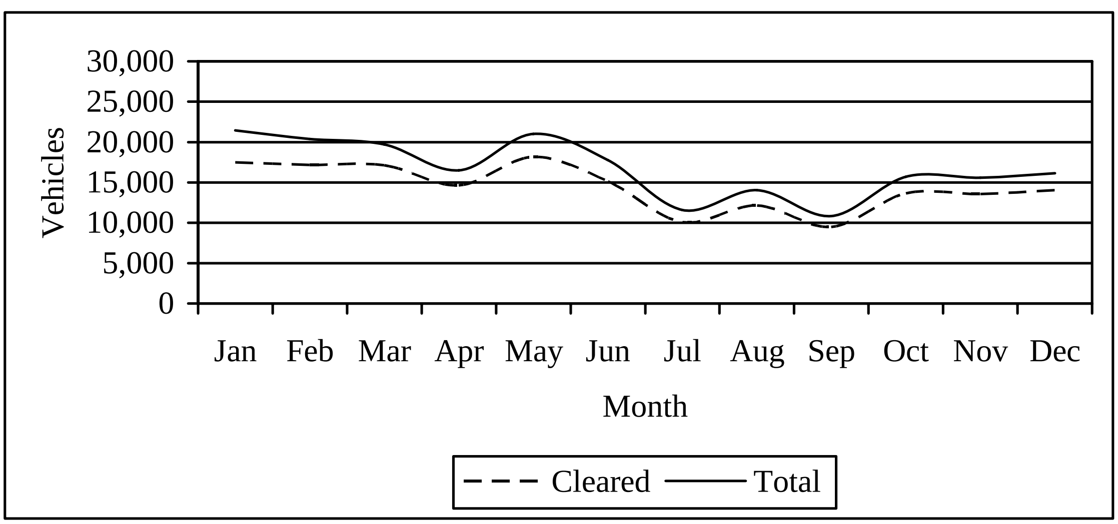


During 2007, the superbooths processed an average of 16,723 commercial vehicles per month and cleared an average of 14,401 commercial vehicles per month (see Table 3 and Graph 3). The percent of cleared vehicles ranged from 81.6% (January) to 88.7% (April) and averaged 86.3% for the year. Compared to 2005 and 2006, the superbooths processed and cleared fewer commercial vehicles but had a higher clearance rate.

Table 3. 2007 Inspection Data

Month	Cleared	Total	Percent
Jan	17,512	21,456	81.6
Feb	17,172	20,363	84.3
Mar	17,143	19,707	87.0
Apr	14,642	16,511	88.7
May	18,153	21,001	86.4
Jun	15,134	17,767	85.2
Jul	10,081	11,597	86.9
Aug	12,156	14,053	86.5
Sep	9,502	10,825	87.8
Oct	13,655	15,695	87.0
Nov	13,589	15,590	87.2
Dec	14,067	16,141	87.2
Average	14,401	16,723	86.3

Graph 3. 2007 Inspection Data



Thus, the number of commercial vehicles processed by the superbooths varied during 2005-07 and was likely driven by a variety of external forces (e.g., market conditions). Regardless of the number of commercial vehicles that are processed, increases in operational effectiveness would be characterized by increases in the percentage of vehicles that are cleared by the superbooths. Accordingly, the analyses will focus on the percentage rather than the number of cleared commercial vehicles.

Analyses

The percentages of commercial vehicles cleared for entry during 2005-2007 were subjected to a series of *t*-tests to detect statistically significant differences. Because it is predicted that there will be a statistically significant increase in the average percent of commercial vehicles cleared for entry, rather than any difference including a statistically significant decrease, a 'one-tail test' is appropriate. 'One tail' refers to the cumulative probability under one half of the normal distribution (the tip of which looks like a tail).

A one-tail test is used when the prediction includes the direction of difference. It is a more stringent test than a two-tail test. In this study, it was not just predicted that post-CVISN vehicle clearance would change (increase or decrease). Rather, it was predicted that that the post-CVISN clearance would not only change but would increase.

RESULTS

The results of the *t*-tests are reported below for the three possible combinations of years, including the sample means, *t* statistics, and *p* values. The results were considered statistically significant at or beyond $p < .05$.[17]

2005-2006 Clearance

The first *t*-test was of the clearance percentages for the years 2005 and 2006. As is indicated in Table 4, the average difference in percentages of commercial vehicles cleared for entry did increase, but this increase did not rise to a level of statistical significance beyond $p < .05$.

Table 4. *t*-test of 2005 and 2006

	2005	2006
Mean	84.1	85.6
Variance	18.5	5.2
n	12	12
df	11	
t Statistic	-0.96	
p	0.18	

[17] Meaning there is less than a 5% chance that the result is random.

2006-2007 Clearance

The second *t*-test was of the clearance percentages for the years 2006 and 2007. As indicated in Table 5, the average difference in percentages of commercial vehicles cleared for entry did increase, but this increase did not rise to a level of statistical significance beyond $p < .05$.

Table 5. *t*-test of 2006 and 2007

	2006	2007
Mean	85.6	86.3
Variance	5.2	3.4
n	12	12
df	11	
t Statistic	-1.1	
p	0.14	

2005-2007 Clearance

The third *t*-test was of the clearance percentages for the years 2005 and 2007. As indicated in Table 6, the average difference in percentages of commercial vehicles cleared for entry did increase, and this increase did rise to a level of statistical significance beyond $p < .05$.

Table 6. *t*-test of 2005 and 2007

	2005	2007
Mean	84.1	86.3
Variance	18.5	3.4
n	12	12
df	11	
t Statistic	-2.1	
p	0.03	

Thus, the clearance percentages increased each year and over the three-year period this increase proved to be statistically significant. In addition, the variance among the monthly percentages consistently decreased over each of the three years.

7. CONCLUSIONS

CVSIN increased the operational effectiveness of commercial vehicle inspections at the Nogales port of entry. The number of commercial vehicles processed by the superbooths will naturally vary from year to year depending on market conditions, and the number of commercial vehicles will naturally vary from month to month depending on the season.

These variations notwithstanding, the percentage of commercial vehicles cleared for travel increased each year, and the increase between 2005 and 2007 proved to be statistically significant. In addition to this primary conclusion, other empirical and logical conclusions can also be drawn and are described below.

CVISN increased the seasonal consistency of commercial vehicle clearances. The results contained in Table 1 indicate that there was a 13.0% range in the percent of vehicles cleared by the superbooths. The standard deviation of the average clearance percentage in 2005 was 4.3 vehicles (the standard deviation is the square root of the variance contained in Table 4). These two measures are consistent with Graph 1, which reflects a narrower gap between cleared and total vehicles during the lower volume months of summer than the high volume of months of late winter and spring.

By 2006 the range had dropped to 6.1% and the standard deviation had dropped to 2.3 vehicles. The consistency of this gap is depicted in Graph 2. In 2007 the range was 7.1% and the standard deviation had dropped to 1.8 vehicles (see also Graph 3). This increase in seasonal consistency results in a more uniform experience for shippers and supports more predictable management decisions at the port of entry.

CVISN increased the cost savings for shippers who used the Nogales port of entry in 2007 by an estimated $228,120 by clearing an additional 3,802 commercial vehicles that would have otherwise been subjected to a physical inspection. The additional number of cleared vehicles was computed as the 2.2% change in the average clearance percentage from 2005 to 2007, multiplied by the 14,401 average number of vehicles cleared per month in 2007, multiplied by the 12 months (2.2% x 14,401 x 12).

The cost savings were computed as the 3,802 additionally cleared vehicles, multiplied by the 60 average number of minutes required for an inspection, multiplied by the $1 average cost per minute[18] to operate a commercial vehicle (3,802 x 60 x $1).

In addition to the savings enjoyed by the commercial users of the POE, the taxpayers of Arizona also benefit by the increased productivity of POE employees. Because the new procedure enables each employee to accomplish more, the POE operates with fewer staff hours than would be required using the older methods. That is, the new procedure

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[18] Federal Highway Administration. *CVISN Deployment Program: Benefits of CVISN Level 1 Deployment.* Washington, DC, 2001.

reduced the need to take on more staff. Given the data in this study, it is estimated that two more full-time employees would have been required under the old methods.

By way of illustration, it takes an average of an hour to conduct a physical inspection, so 3,802 hours of physical inspections are being saved by CVISN. With 2,000 hours in a work year, this equates to 1.9 full time equivalent (FTE) employee (3,802 ÷ 2,000). If the current full cost to the state of an inspector (e.g., salary, benefits, etc.) is $50,000 per year, then $95,000 (1.9 FTE x $50,000) per year is being saved by CVISN.

Therefore, if each of the four superbooth operators represents a cost to the state of $50,000 per year, then for a staff total cost of $200,000 the port processes the same amount of commercial vehicles would otherwise cost $295,000 to process. Thus, CVISN has resulted in a 32.2% improvement in inspection efficiency (1 - (200 ÷ 295)).

Although not quantifiable with the data or analyses presented in this report, other benefits can be logically attributed to truckers, the public, and ADOT. For example, both truckers and the public benefit from a reduction in crashes resulting from improved screening and inspections. Savings in transit time also benefit shippers (reduced inventory cost) and the public (reduced shelf price). ADOT (and Arizona taxpayers) will benefit from reduced pavement wear caused by overweight vehicles. Finally, truckers benefit from reduced fuel consumption while vehicles idle during inspections, and the public benefits from reduced air pollution consequent to the reduced idling.

It is important to note that the improvements found during the 2005-2007 period may have depended on not only the implementation of CVISN but also the successful integration and cohesive operation of multiple state and federal inspection agencies located at the key Mariposa port of entry in Nogales. If these organizations for whatever reason are unable to continue to maintain this level of coordination, then the observed improvements may not be consistently achieved in the future.

8. RECOMMENDATIONS

ADOT utilizes CVISN to increase the effectiveness of commercial vehicle inspections. The results of the evaluation indicate that the percentage of commercial vehicles that are cleared for travel is steadily increasing. This improvement in operational effectiveness not only validates the integration of CVISN at the Nogales port of entry but also provides other meaningful benefits.

The following recommendations, indicated by the promising results of the evaluation, represent some opportunities for improvement:

- <u>Use the evaluation results to establish performance benchmarks.</u> The results provide a quantitative baseline of gradually improving performance against which future performance targets and results can be compared.
- <u>Use the evaluation results to plan inspection operations.</u> The results reveal a predictable pattern of total inspection traffic as well as a consistent percentage of vehicles that require physical inspections.
- <u>Implement a continuous evaluation process.</u> The continuous evaluation of inspection performance at the port of entry will document the importance of CVISN and identify opportunities for improvement.
- <u>Implement an evaluation-driven data collection protocol.</u> The collection of specific data elements that will address predetermined evaluation questions will increase the benefit produced by data collection efforts.

DISCUSSION

The CVISN concept was the result of federal legislation that intended to integrate various commercial vehicle data sources. This concept required the expansion of data that were collected, the regular distribution of updated data, and the use of the data by officers. National standards were developed for the integration of the data sources, levels of CVISN implementation, and implementation tasks. The Arizona implementation included safety information exchange, credentials administration, and electronic screening.

The results of the analyses support empirical and logical conclusions. CVISN does improve the operational effectiveness of commercial vehicle operations. The percentage of commercial vehicles that are cleared for travel is not only improving, but is also becoming more consistent. These improvements result in measurable savings for shippers as more vehicles are cleared for travel. Other likely benefits include increased safety, reduced costs for shippers and consumers, and savings for taxpayers and ADOT.

The results of the analyses suggest specific recommendations for improving commercial vehicle inspections at the Nogales port of entry. The results underscore the importance of data collection as well as performance benchmarks and operational management. The ongoing nature of the inspections provides ample data to support a continuous evaluation process. Nevertheless, specific evaluation questions should be formulated and data elements should be identified and collected that will address those questions.