



Investigation of ITS-CVO Technologies

Report Number: KTC-26-09

DOI: <https://doi.org/10.13023/ktc.rr.2026.09>





Kentucky Transportation Center
College of Engineering, University of Kentucky, Lexington, Kentucky

in cooperation with
Kentucky Transportation Cabinet
Commonwealth of Kentucky

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Research Report

KTC-26-09

Investigation of ITS-CVO Technologies

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October 2025

1. Report No. KTC-26-09	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle Investigation of ITS-CVO Technologies		5. Report Date October 2025	
		6. Performing Organization Code	
7. Author(s) Mallory Brown, Andrew Martin, Valerie Keathley-Helil, Jennifer Walton		8. Performing Organization Report No. KTC-26-09	
9. Performing Organization Name and Address Kentucky Transportation Center 176 Raymond Building University of Kentucky Lexington, Kentucky 40506-0281		10. Work Unit No.	
		11. Contract or Grant No. RSF 104	
12. Sponsoring Agency Name and Address Kentucky Transportation Cabinet 200 Mero Street Frankfort, Kentucky 40622		13. Type of Report and Period	
		14. Sponsoring Agency Code	
15. Supplementary Notes Prepared in cooperation with the Kentucky Transportation Cabinet.			
16. Abstract Staff shortages and reduced budgets have made transportation agencies increasingly reliant on intelligent transportation systems (ITS) for commercial motor (CMV) vehicle enforcement activities. Technologies such as license plate readers, US Department of Transportation (USDOT) number readers, weigh-in-motion scales, static scales, and preclearance systems like PrePass and Drivewyze help automate enforcement and free up personnel to focus on inspecting those vehicles most likely to pose compliance and/or safety risks. To document adoption rates of different technologies, researchers surveyed transportation agencies, vendors, and law enforcement agencies. Survey responses provided useful insights into how jurisdictions are approaching the use of advanced technologies to improve enforcement. Although license plate readers and USDOT readers are gaining popularity, their use remains less common than different types of scales and preclearance systems. Price could be a stumbling block to wider adoption as readers can exceed \$500,000 per installation. Most jurisdictions routinely evaluate the accuracy of data generated by advanced technologies. However, many outsource assessments to vendors. Survey respondents commented that, overall, their jurisdictions are satisfied with the performance and accuracy of the technologies they have acquired to improve CMV enforcement. The Kentucky Transportation Cabinet (KYTC) and other agencies can use the findings of this report to inform future investment decisions, build more robust partnerships with private sector stakeholders and across jurisdictional lines, facilitate data exchange, and coordinate enforcement activities.			
17. Key Words intelligent transportation systems, commercial vehicle operations, compliance, automation		18. Distribution Statement Unlimited with approval of the Kentucky Transportation Cabinet	
19. Security Classification (of this report) Unclassified	20. Security Classification (of this page) Unclassified	21. No. of Pages 65	22. Price

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Executive Summary

Most commercial motor vehicle (CMV) enforcement activities have historically occurred at roadside weigh stations. This approach to enforcement, however, is becoming less viable due to staff shortages and budget cuts, both of which limit the number of hours weigh stations can operate each day. Transportation agencies and law enforcement agencies have responded to this development by adopting intelligent transportation systems (ITS) that can at least partially automate some facets of CMV enforcement. Drawing on surveys with transportation agencies and law enforcement agencies, this report analyzes the current technological landscape of CMV enforcement. Specifically, it documents how different technologies are being used to screen vehicles, facilitate safety enforcement, improve motor carrier compliance with regulations, and improve efficiency at weigh stations and other inspection sites. Technologies of particular interest included weigh-in-motion (WIM) scales, license plate readers (LPRs), US Department of Transportation number (USDOT#) readers, and preclearance systems (e.g., PrePass, Drivewyze). These systems fall under the heading of ITS-Commercial Vehicle Operations (CVO) technologies.

Despite low response rates (ranging from 0% to 37%), surveys generated insights that Kentucky's Innovative Technology Deployment (ITD) program team can use to improve CMV enforcement outcomes. WIM scales, static scales, and preclearance systems have been embraced widely. While many states have adopted LPRs and USDOT# readers, some rely on other technologies (e.g., transponders) to mitigate privacy concerns. One benefit of LPRs and USDOT# readers is that they can screen all CMVs, not just those enrolled in bypass programs. However, they are the most expensive ITS-CVO technology, with individual installations costing more than \$500,000 (see [Table 5.1](#) for prices paid for different systems). Fees typically include site preparation, system installation, system maintenance, and warranties. Most of these technologies are installed near or around weigh stations, including weigh station ramps or along mainlines in front of weigh stations. Overall, jurisdictions are satisfied with the performance of ITS-CVO technologies, and most are performing accuracy assessments. In many cases, agencies have outsourced these assessments to vendors. Similarly, agencies remain dependent on vendors to operate and manage LPRs and USDOT# readers rather than developing internal capacity to perform these functions.

The Kentucky Transportation Cabinet (KYTC) and other agencies can use findings presented in this report to inform their future investment decisions, identify opportunities for partnerships with private sector stakeholders and other jurisdictions, facilitate cross-jurisdictional data exchange, and coordinate enforcement activities. Future research could supplement this study by developing standardized methods for analyzing the benefits and costs of ITS-CVO technology investments; identifying robust methods for improving data sharing practices among jurisdiction, federal agencies, and vendors; and establishing standardized reporting protocols and expectations for performance assessments to ensure outcomes are measured consistently across jurisdictions. With technology evolving rapidly, tools such as AI-based optical character recognition, predictive analytics, and mobile screening system are likely to play an outsized role in future CMV enforcement activities. As such, it is essential to determine the long-term scalability and effectiveness of these technologies. Ultimately, states, federal partners, and vendors pursuing collaborative research will be key to building more transparent data-sharing practices, consistent performance evaluation methods, and sustainable investment strategies that will benefit CMV operations and safety.

Chapter 1 Introduction and Background of ITS-CVO

Intelligent transportation systems (ITS) can improve commercial vehicle operations (CVO) through the application of technologies which facilitate the exchange of safety-related data, electronic screening, and electronic credentialing for commercial motor vehicles (CMVs) (Agrawala & Kallianpur, 2009).

In the United States (US), most products are shipped via trucks. Freight tonnage is expected to reach 25 billion tons by 2045 (Bureau of Transportation Statistics, 2016). But growth in commercial freight increases roadway congestion, degrades safety, and places more stress on pavement and infrastructure (Austin, 2015). Increased traffic makes it more challenging to monitor CMV safety, enforce credential requirements, and enforce regulations related to vehicle weights and dimensions.

Most CMV enforcement activities occur at roadside weigh stations. But this model of enforcement has limitations. For example, budget cuts in many states thwart CMV enforcement agency efforts to maintain appropriate staffing levels and operate weigh stations for an adequate number of hours each day. Table 1.1 captures declining trends in CMV inspections at Kentucky weigh stations.

Table 1.1 Inspections Completed at Fixed Weigh Stations and Roadside in Kentucky (2017 – 2019)

Year	Fixed	Roadside	Total
2017	46,072	37,849	83,921
2018	44,075	35,033	79,108
2019	31,630	32,488	64,118
Total	121,777	105,370	227,147

Limited operating hours at Kentucky weigh stations are caused by staff shortages. There are not enough officers and inspectors to conduct inspections at all hours. And hiring new inspectors is a challenge because of the low pay rate. Figure 1.1 indicates the percentage of time the state's weigh stations were open between 2012 and 2020.

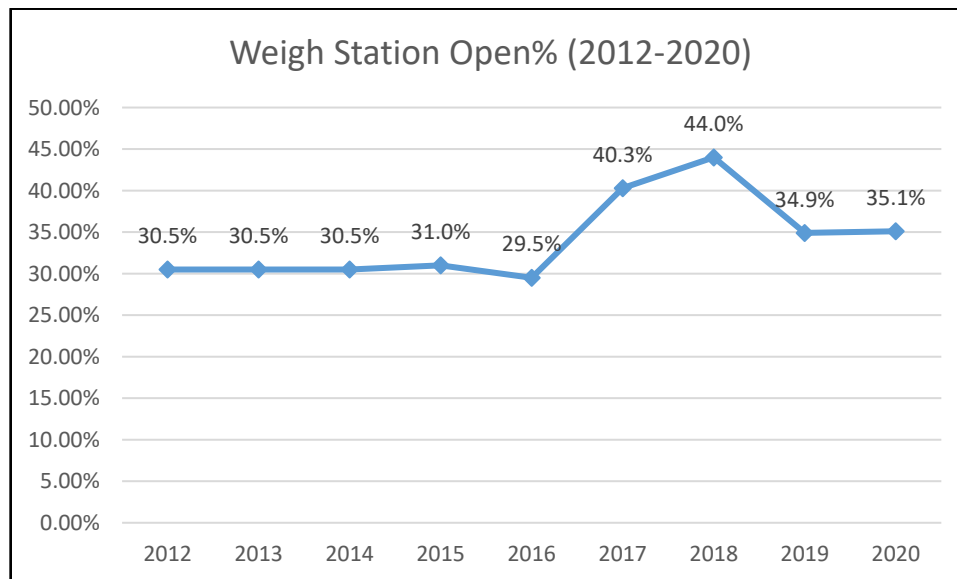


Figure 1.1 Weigh Station Open % (2012 – 2020)

Weigh station staff must complete many tasks during a vehicle inspection. While some roadside facilities solely focus on weighing CMVs to verify they comply with weight and height restrictions, many facilities conduct safety inspections and monitor compliance with permits to enforce tax and credential requirements (Federal Motor Carrier Safety Administration, 2025).

To increase the number of truck inspections, states are investing in automated ITS-CVO technologies. Automated systems increase efficiency, protect infrastructure, prevent roadway backups around weigh stations, limit delays, and bolster productivity. Automated ITS-CVO systems let weigh station personnel concentrate on addressing non-compliant trucks and rewarding compliant carriers with bypasses (Benekohal, et al., 1999; Kroeger, Stern, Kamyab, & McCall, 1998). These systems typically include weigh-in-motion (WIM) scales and e-screening technologies, which utilize transponder-based screening, geofencing, license plate readers, and USDOT number (USDOT#) readers to screen for safety records and credentials. Table 1.2 lists the number of vehicles screened by Kentucky Automated Truck Screening (KATS) systems between 2017 and 2020.

Table 1.2 KATS Vehicle Screenings (2017 – 2020)

Year	Vehicles
2017	6,358,449
2018	6,598,150
2019	6,305,078
2020	6,173,539

1.1 ITD

The Innovative Technology Deployment (ITD) program is the bedrock of ITS-CVO implementation in the US and has several goals (Federal Motor Carrier Safety Administration, 2025):

- Improve safety and productivity of motor carriers, CMVs, and their drivers
- Improve the efficiency and effectiveness of CMV safety programs by using data to determine which carriers pose the greatest safety risk
- Improve the security and sharing of CMV data within states and between states and FMCSA
- Simplify enforcement by automating data collection, transfer, and display
- Reduce costs associated with enforcing federal and state safety regulations
- Achieve nationwide deployment of the program

The ITD Program seeks to improve the exchange of data on motor carrier safety ratings and credentials between state and federal governments. It encourages the use of automated screening systems that interface with the state Commercial Vehicle Information Exchange Window (CVIEW), and this program provides the bulk of funding for the development of these systems through grants.

Deployment of new technologies under the ITD Program reduces CMV crashes by encouraging data sharing and automated screening, both of which help law enforcement select better candidate vehicles for inspection, leading to increased out-of-service orders and improved detection of safety violations (Brand, Parody, Orban, & Brown, 2004). The ITD Program's emphasis on automatic credentialing is also more cost-effective for states and motor carriers than paper-based credentialing (Brand, Parody, Orban, & Brown, 2004). The program also encourages states to be proactive and innovative in updating their safety and credentialing databases (Pines & Fang, 2008).

1.1.1 Core ITD

States achieve Core ITD compliance by (1) adopting e-screening technologies in roadside inspection activities (automated screening for safety, weight, and credentials); (2) participating in safety information exchange with other states through CVIEW and SAFER and using inspection software (e.g., ASPEN) to record inspection data; and (3) transitioning to electronic credentials administration for IRP and IFTA as well as data exchange and funds transfers for the IRP and IFTA Clearinghouses. Only Hawaii, Minnesota, and Pennsylvania are not Core ITD compliant, but they are deploying core ITD functionality (Federal Motor Carrier Safety Administration, 2025).

1.1.2 Expanded ITD

States that are compliant with Core ITC can pursue Expanded ITD status, which emphasizes automated screening beyond transponder-based options. Under Expanded ITD, FMCSA lets states choose technologies best suited to the context of their CMV safety enforcement environments (Federal Motor Carrier Safety Administration, 2025). ITD Expanded specifies robust goals for data collection and dissemination, including the use of advanced technologies for traffic conditions, weather, truck parking, truck routes, tolling, and emissions.

States working toward Expanded ITD status are encouraged to adopt more advanced systems that enable sharing of information about drivers, such as adding driver information to CVIEW or other technologies connecting drivers to CDL data biometrics (Federal Motor Carrier Safety Administration, 2025). Other examples of Expanded ITD projects include virtual weigh stations that incorporate WIMs and cameras, LPRs, expanding electronic credentialing to include OW/OD permitting and route planning, and developing one-stop shops or electronic portals that provide a user-friendly option that enables motor carriers to manage IRP, IFTA, and OW/OD credentials (Federal Motor Carrier Safety Administration, 2025).

1.2 ITD Data Exchange

The two most important developments of ITD/CVISN are the Safety and Fitness Electronic Records (SAFER) federal database and CVIEW. The former houses safety and registration data on motor carriers with interstate operations (including crash and inspection data) (FMCSA, n.d.). Several states also provide safety record information for intra-state motor carriers. Users of SAFER's Company Snapshot query tool can search for individual motor carriers using the carrier's name, USDOT number, or operating authority number (MC or MX number). A company snapshot query returns data on motor carrier size, commodities transported by the carrier, and the safety record information (e.g., out-of-service rates, ISS scores, crash rates).

1.2.1 CVIEW

CVIEW is a state-based repository that houses commercial vehicle credentialing and tax system information on interstate carriers and vehicles, including carrier safety histories and performance metrics (Figure 1.2). Vehicle, carrier, and driver information are derived from state enforcement activities. CVIEW facilitates data transfers between state roadside inspection sites and the SAFER database as well as other state databases for tax purposes (e.g., Kentucky's weight-distance tax (KYU) database). CVIEW lets enforcement and state administrators view records without visiting multiple databases. Many states use ITD funding to develop and expand their CVIEW systems.

CVIEW ✓ PASS

Carrier: 21800 Carrier Name: -- State -- KYU # KIT # KYTC # Tax ID IFTA # IRP # Permit # SEARCH

Overview

DBA:
Last MCMIS Update: 10/30/2020

USDOT: USDOT Status: USDOT Status Date: Carrier Name: DBA Name: Tax ID Number: Tax ID Type: Street: City: State: Zip: Phone: Fax: Email: Mailing Address: PRISM Targeted:	Federal OOS: NQ (real-time) Class Code: 01 - Authorized For Hire ISS2 Score: 25 ISS2 Indicator: S - Safety Hazmat Status: C - Carrier Entity Type: C - Carrier Interstate: 1 - Yes Intrastate (Non-HM): 0 - No Intrastate (HM): 0 - No Quantity Power Units: 121929 Quantity Drivers CDL: 22807 MCS150 Update Date: 10/30/2020 MC Number 1: 115495 MC Number 2: 63063 MC Number 3: 116200
--	---

LOOK UP CARRIER DATA AT SAFER PHMSA SEARCH

Figure 1.2 CVIEW Screen

1.2.2 PRISM

CVIEW exchanges data with the Performance Registration and Information Systems Management (PRISM) program, a federal-state partnership that helps states identify motor carriers with poor safety records and remove out-of-service vehicles from highways. The PRISM database is connected to the International Registration Plan (IRP), a registration reciprocity agreement among the continental US states, District of Columbia, and Canadian provinces. Interstate motor carriers deemed unfit under the PRISM program can be denied the ability to register vehicles and obtain apportioned registration plates. Carriers targeted by the PRISM program have their vehicles inspected more often due to poor safety records.

1.3 Automation and Weight Enforcement

Many states use WIM scales to weigh CMVs as they pass through weigh stations or along mainlines. If they detect an overweight vehicle, weigh station personnel can direct it to stop. The scales bolster efficiency by increasing the number of vehicles that can be weighed and decreasing the amount of time drivers spend in line waiting, decrease pavement wear and tear, and increase safety around weigh stations by preventing backup on the highways (Pines & Fang, 2008).

1.4 Automation and Vehicle Screening

Most safety inspections and credential checks occur at roadside weigh stations. Automated ITS-CVO technologies can identify vehicles that should be inspected, which focuses enforcement on vehicles with observable problems rather than every vehicle. E-screening systems include transponder technologies, geofencing, and optical character recognition (OCR) technologies.

1.4.1 Transponder Technologies

Transponder-based systems leverage radio frequency Identification (RFID) and use a truck's identification information to verify compliance with safety regulations and credentials. If the system detects a problem, the device displays a red light indicating the vehicle cannot bypass and must pull into a weigh station for a possible inspection.

Even if trucks are cleared, random pull-ins are conducted for preclearance system members. PrePass is the most widely deployed transponder-based bypass system. Smaller regional transponder screening systems do exist, such as the North American Preclearance and Safety System (NORPASS). Achieving interoperability among transponder programs and PrePass has been an ongoing effort so drivers do not have to carry multiple transponder units. If a PrePass member participates in other transponder programs, they can use a PrePass unit to obtain bypass and pull-in signals for those programs.

1.4.2 Commercial Mobile Radio Services (CMRS)

In 2013, FMCSA authorized the use of commercial mobile radio services (CMRS) devices for truck bypass and screening to meet CVISN/ITD requirements. CMRS use wireless mobile data devices such as cellular phones, tablets, and onboard telematics systems (Ferro, 2013). These systems adopt the same operational model as PrePass, using dedicated short-range communication (DSRC) to screen vehicle data and transmit them to enforcement personnel. Drivers are informed via a mobile device if they can bypass a weigh station or must stop for a possible inspection. Because CMRS uses geofencing technology, states do not have to install as much infrastructure to support the system as PrePass. The best example of CMRS is Drivewyze, the largest bypass system in the US. Drivewyze has an application process that requires prospective subscribers to demonstrate they meet safety standards and credential requirements before their membership can be approved.

1.4.3 License Plate Readers and USDOT# Readers

Many states have installed license plate readers (LPRs) and/or USDOT# readers that use OCR cameras to decode alphanumeric identifiers on CMVs, including the USDOT number and vehicle registration plate string (Office of Justice Programs; Vaxtor, 2025). Unlike PrePass and Drivewyze, trucks must depart the mainline and traverse weigh station ramps for screening. These systems often include an additional camera to capture an image of vehicles for descriptive purposes. The Kentucky Automated Truck Screening (KATS) system is an example of an e-screening system that uses LPR and USDOT# readers.

1.5 Federal Regulations for E-Screening

Although FMCSA lets states use e-screening technologies best suited to their needs (Federal Motor Carrier Safety Administration, 2020), what determines whether a driver has to pull into a weigh station for an inspection is the Inspection Selection System (ISS) score. These scores are based on roadside safety inspections, state crash reports, and federal motor carrier census data from the past 24 months stored in FMCSA's Safety Management System (SMS) (Federal Motor Carrier Safety Administration, 2012). As Table 1.3 shows, the higher the ISS score, the higher the priority for inspecting a vehicle.

Table 1.3 ISS Scoring Rubric

Inspection Priority/Recommendation	ISS Score
Inspect	75 to 100
Optional (But recommended)	50 to 74
Pass	1 to 49

1.6 E-Screening Caveats

Sixteen states limit the use of LPRs and/or data gathered from LPRs due to concerns about accuracy and privacy (National Conference of State Legislatures, 2022). Privacy advocates express concerns about drivers being falsely accused of violations due to inaccuracies in LPR data if the LPR decodes plate strings incorrectly (Diaz & Levinson-

Waldman, 2020). Most legislation that addresses LPR use seeks to restrict opportunities for misusing data by establishing protocols for data retention, specifying which agencies can access and share data, and restricting the amount of time LPR data can be stored.

1.7 Accuracy Rates and E-Screening

The overall accuracy rate of transponder-based systems like PrePass is 99.99% (PrePass, 2019). Because Drivewyze requires that users have a stable cellular signal, many vehicles are not screened if a state only relies on transponders or CMRS (FreightWaves, 2018). While LPR and USDOT# readers can scan all trucks that go through weigh stations, accuracy rates are 80 – 85% (Federal Motor Carrier Safety Administration, 2020). Lighting, poor weather, condition of the registration plate, and camera location all impact a reader's ability to decode plates and USDOT numbers. Because federal regulations are relatively vague, motor carriers may use text fonts or colors which are difficult for USDOT# reader cameras to interpret, preventing the OCR system from accurately capturing data. Misreads increase the time needed to complete screenings and inspections because enforcement officials require longer to re-screen a CMV if the system produces misreads or no data. OCR-based systems may also decrease efficiency at weigh stations because compliant vehicles could be detained unnecessarily while non-compliant vehicles are not stopped.

1.8 Recent E-Screening Developments

Public-private partnerships are developing advanced vehicle safety mechanisms for e-screening technologies. Advances include automated technologies such as in-cab alert systems to prevent crashes, detect defective brakes, identify tire problems, and monitor hazmat loads.

1.8.1 In-Cab Alert Systems

PrePass and Drivewyze mobile systems now generate in-cab safety alerts. The PrePass Motion mobile app issues PrePass alerts warning drivers with audio and visual alerts when approaching work zones, steep grades, hazardous weather, traffic accidents, and traffic congestion (PrePass, 2021) (Figure 1.3). PrePass has also developed location-specific alerts. For example, through a partnership with the Colorado DOT, Colorado State Patrol, and Colorado Motor Carriers Association, PrePass developed alerts for I-70 that notify drivers of areas where they need to check their brakes, put tire chains on during winter, and impending steep grades (PrePass Safety Alliance, 2019).



Figure 1.3 In-Cab Alert - PrePass

Drivewyze Safety Notifications provide visual and audio alerts in areas with steep grades, high rollover rates, and low bridges (Figure 1.4). Additionally, Drivewyze offers in-cab truck parking alerts. These notifications are connected to state truck parking systems in seven states — Kentucky, Iowa, Kansas, Minnesota, Wisconsin, Virginia, and Michigan (Drivewyze, 2025). Drivewyze safety alerts are customizable, so carriers can tailor alerts to specific needs or preferences.



Figure 1.4 In-Cab Alert - Drivewyze

1.8.2 Tire Anomaly and Classification System

Inspectors use the Tire Anomaly and Classification System (TACS) to identify vehicles with missing or underinflated tires and thus prevent crashes (Wieck, 2018). TACS can be installed on inspection facility ramps or on the mainline. Some systems can also collect historical data on vehicles in a central database, which helps states monitor pavement longevity (Malhotra, 2018).

1.8.3 Thermal Imaging Systems

Thermal imaging systems detect defective brakes and flat or underinflated tires using thermal signatures (Malhotra, 2018). Several states are transitioning to automated thermal imaging cameras, including Delaware and Montana. For example, Montana has adopted the Smart InfraRed Inspection System (SIRIS), which uses temperature signatures to detect defective brakes, underinflated tires, and broken wheel bearings. Automated thermal imaging cameras can scan vehicles in a few seconds, whereas scans with manual thermal imaging camera systems take at least 45 minutes. Automated thermal imaging cameras let inspectors focus their efforts on vehicles likely to have defective brakes, but which do not require additional inspection personnel (Delaware Department of Transportation, 2023).

1.8.4 Other Advanced Technologies

Hazardous goods identification and tracking uses high-resolution cameras and OCR technologies to read four-digit numbers on hazmat placards. Data are transmitted to inspection facilities, where staff members confirm that vehicles have the correct permits and are proceeding on a route that allows transport of the hazardous materials (Malhotra, 2018). Another advanced technology is the automated under vehicle area scanner, which makes it possible for inspectors to inspect vehicle undercarriages to check for damage as well as hidden explosives, weapons, or controlled substances (Malhotra, 2017).

1.9 Conclusion

With freight volumes continuing to grow and states having fewer resources to dedicate to enforcement activities, traditional roadside inspection models alone are no longer sufficient to protect infrastructure, ensure compliance, and maintain safe operations. Programs such as ITD and tools like WIM scales, electronic screening, and credentialing systems help automate routine tasks, prioritize high-risk carriers, and reward compliant operators. These technologies make enforcement more efficient while reducing congestion and economic losses associated with delays.

But successful ITS-CVO deployment depends on more than technical innovation. Whether new technologies fulfill their potential hinges on adoption rates, system accuracy, interagency collaboration, the endurance of public-private

partnerships, and inspector training. ITS-CVO technologies are most powerful when integrated into a broader strategy of data-driven enforcement, cross-border cooperation, and adaptive policymaking that prepares the transportation system for the demands of the future.

Chapter 2 State Survey of Technology for Commercial Vehicle Enforcement

We administered a 16-question online survey to gather information from ITD Core Compliant states on their LPR and USDOT# reader systems. The survey included 11 multiple choice questions, one yes/no question, two open-ended questions, and two demographic questions (state and email address). Agencies from 19 states participated — a 37% response rate.

2.1 LPR and USDOT Reader Deployment

Sixteen states reported using both LPRs and USDOT# readers. Three only used LPRs, and three said they used neither (Figure 2.1).

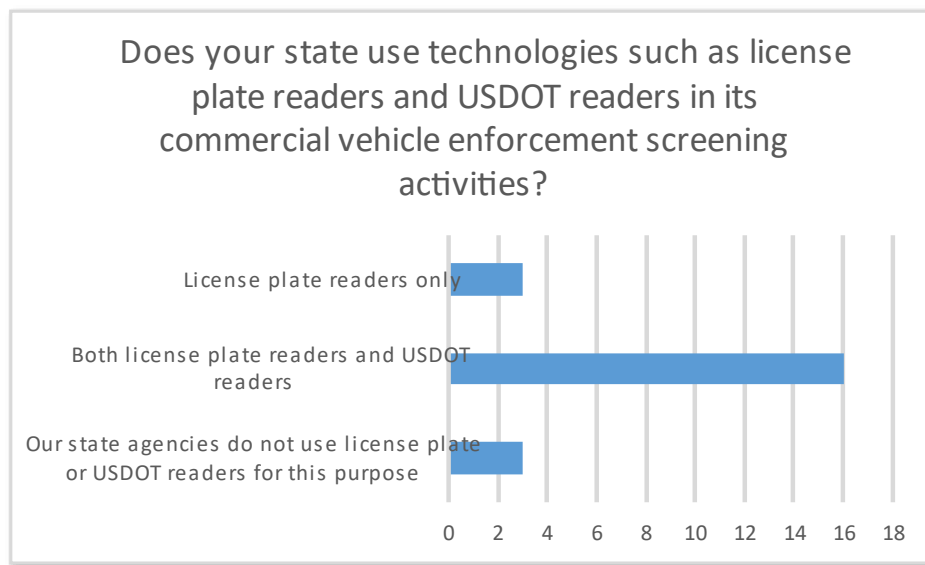


Figure 2.1 LPR and USDOT# Readers for CMV Enforcement

2.2 Number of Deployed Systems

States that reported using LPRs and USDOT# readers were asked two additional questions about the number of units deployed. Most respondents (n=9) reported having 1 – 5 LPR units deployed in their states, while three said 6 – 10 units were in use (Figure 2.2). Distributions for USDOT# readers and LPRs matched, indicating that many states deployed LPRs and USDOT# readers alongside one another to maximize screening capacity (Figure 2.3).

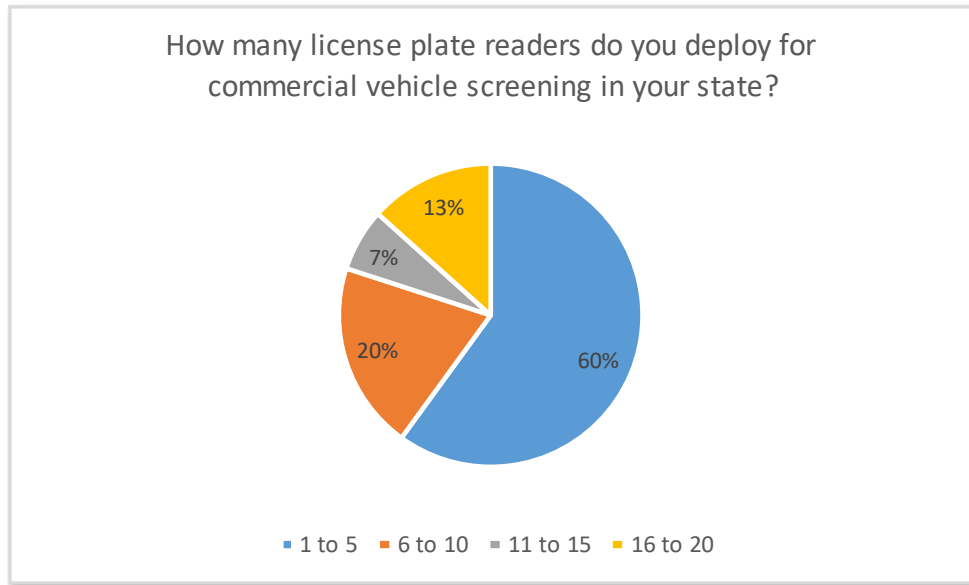


Figure 2.2 Number of Deployed LPRs

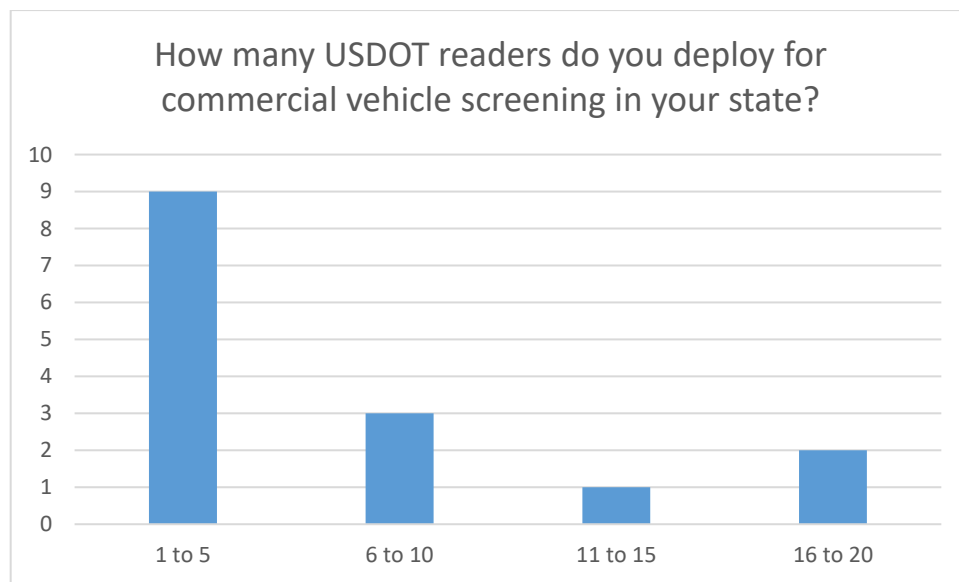


Figure 2.3 Number of Deployed USDOT# Readers

2.3 Accuracy Rates of OCR-based Technologies

Most respondents (56%) said their states did not evaluate the accuracy of OCR-based technologies. Four respondents answered our question about which parties are responsible for evaluating the accuracy of OCR technologies. Three respondents said vendors conducted accuracy evaluations. The other respondent said internal staff performed accuracy checks. We asked respondents whose states evaluated the accuracy of OCR technologies to indicate LPR levels of accuracy. Just one respondent reported an accuracy rate of 75% or less. Levels of accuracy for USDOT# readers were 81 – 90% (n = 4).

Although we did not ask respondents to specify why their states did not evaluate accuracy rates, a potential reason is that agencies lack the necessary staff or funding. Given the benefits of OCR-based screening systems, however,

we recommend that more states measure performance to improve accuracy and reduce misreads. Improving accuracy can build enforcement personnel’s confidence in system reliability and increase usage. Quantifying the number of misreads also increases highway safety and helps capture revenue states lose when trucks are not screened. Outsourcing accuracy checks to vendors is potentially problematic because vendors are motivated to cast their products in the best possible light.

2.4 Cost of LPR and USDOT# Readers

A 2015 FHWA report provided estimates for installing and maintaining different OCR-based technologies (Table 2.1). To compare FHWA estimates to real-world costs, we asked respondents to indicate the cost of their most recently acquired LPR or USDOT# reader system. Thirteen respondents submitted a response (Figure 2.4). Five respondents said their agencies paid at least \$500,000, with others indicating less. Using the Consumer Price Index from the U.S. Bureau of Labor Statistics, each cost was adjusted for 2025 inflation (U.S. Bureau of Labor Statistics, 2025).

Table 2.1 Deployment Costs for ITS-CVO Technologies

System	Cost Range for One Lane		Cost Range for Annual Maintenance	
	Low	High	Low	High
WIM	\$64,000	\$208,000	\$3,500	\$22,500
LPR	\$125,000	\$208,000	\$11,250	\$18,750
USDOT Reader	\$125,000	\$208,000	\$11,250	\$18,750
Total	\$314,000	\$624,000	\$26,000	\$60,000

Source: FHWA (2015), U.S. Bureau of Labor Statistics (2025)

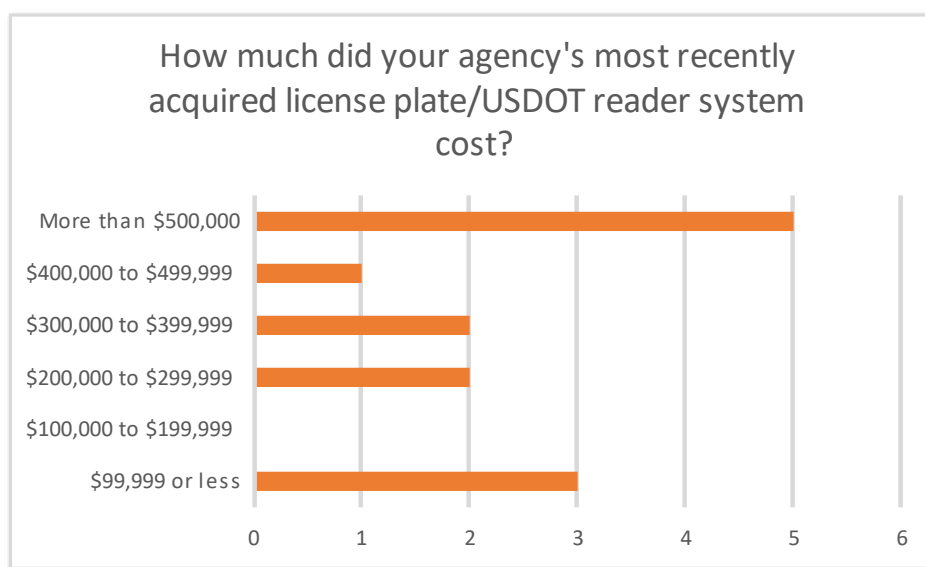


Figure 2.4 Cost of LPR/USDOT# Reader Systems

2.4.1 Components Included in Price

We asked respondents to specify elements included in the cost of their most recently acquired LPR or USDOT# reader (Figure 2.5). Again, we received 13 responses. Elements most often included in the cost were site preparation and installation of the LPR/USDOT reader, followed by additional equipment and system maintenance. Alabama's system

cost included tire anomaly sensors. Missouri's system had a turn-key electronics package without a WIM and installation.

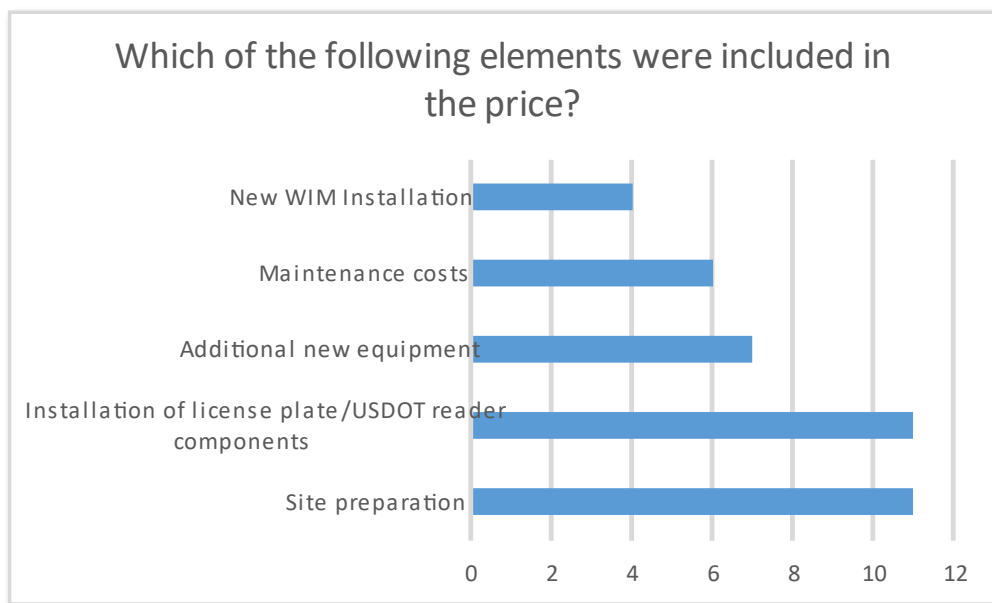


Figure 2.5 Elements Included in Most Recently Acquired LPR/USDOT# Reader System

2.5 Managing OCR-Related Technologies for CMV Enforcement Activities

Respondents said that vendors and independent contractors were most often involved in site preparation, equipment installation, system testing, calibration, and system maintenance (Figure 2.6). A respondent from Virginia said the state also employed an internal chief WIM technician for managing these processes.

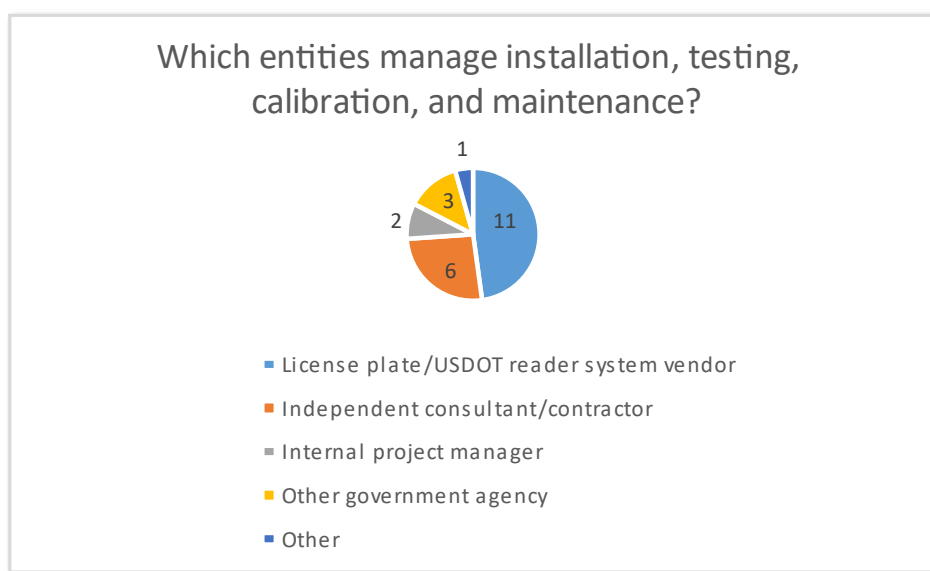


Figure 2.6 Entities that Manage LPRs/USDOT# Reader Systems

2.6 Locations of LPR and USDOT# Readers

Survey participants said the most common installation sites for LPRs and USDOT# readers are weigh station entrance ramps, followed by virtual weigh stations and the weigh station mainline (Figure 2.7). One jurisdiction reported using mobile LPRs.

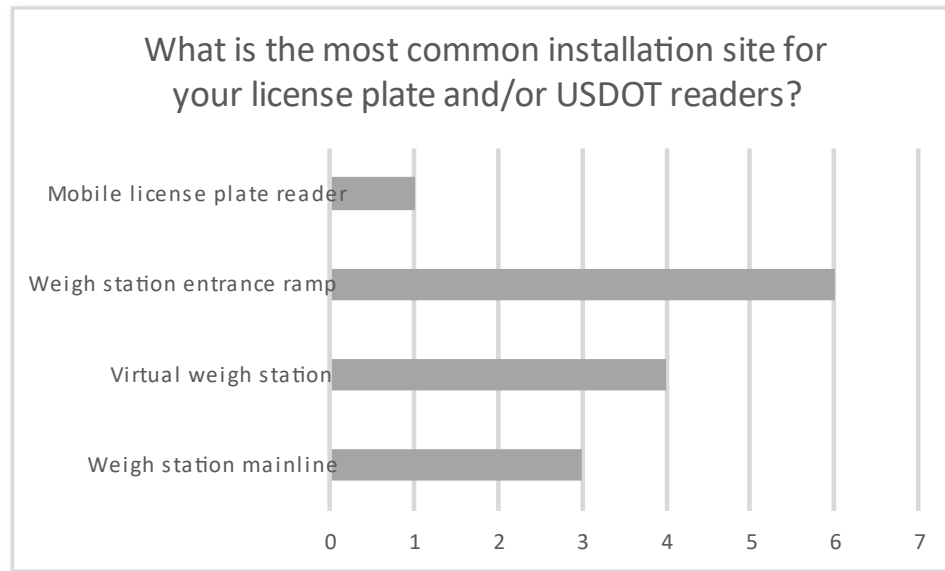


Figure 2.7 Installation Sites for LPRs and USDOT# Readers

2.7 Vendors

Despite OCR-based technology systems integrating multiple components, all respondents said a single vendor was responsible for installing, configuring, and maintaining LPRs and USDOT# readers.

2.8 Best Practices

Four respondents described policies or best practices other state agencies should consider adopting:

- Mississippi
 - Enforcement officers are instructed to use virtual sites as often as possible.
- Missouri
 - Not currently using its LPRs and USDOT# readers. While the state has successfully implemented these technologies, reporting excellent performance while significantly impacting motor carrier safety, the systems were taken offline due to political considerations and need to develop consistent best practices and deployment parameters. The state wants to resume utilization of these technologies, but the anticipated return to service date is unknown. Missouri's current strategy is using tire defect detection systems to augment enforcement efforts.
- New York
 - Asked the LPR vendor to survey of CMVs at a given site prior to installation and to optimize OCR software to more accurately recognize the top-10 jurisdictions operating there. New York also removed jurisdiction as part of OCR interpretation. The system can identify the jurisdiction based on the license plate character string once checked against federal and state databases.

2.9 Conclusion

Most states have deployed both LPRs and USDOT# readers, but some rely on other technologies (e.g., transponders, CMRS) to mitigate privacy concerns. Of the states that reported using LPRs and USDOT# readers, most deployed 10 or fewer systems.

Unlike transponder or CMRS technologies, LPRs and USDOT# readers can screen all CMVs, not just those enrolled in bypass programs. While OCR tools show promise, challenges with accurate character interpretation prevent states from realizing their full potential. At the same time, most CMV screening programs do not regularly measure OCR technology accuracy rates. In states that do, assessments are often conducted by vendors, but not all employ rigorous methodologies, potentially resulting in biased evaluations. We recommend that states explore funding independently or data quality assessments led by in-house staff. New York offers an innovative model, where an OCR vendor measures accuracy and then works to improve accuracy by refining its algorithm, focusing on the 10 jurisdictions which log the most miles in the state.

States deploying LPRs and USDOT# readers rely on contracts with a single vendor that cover site preparation, installation, and maintenance. Contracts often bundle additional technologies (e.g., WIMs or TACS). States are deploying OCR systems primarily on weigh station ramps or mainlines, with far fewer reporting the use of virtual weigh stations or mobile units. However, an emphasis on fixed sites limits opportunities to detect non-compliant carriers that bypass weigh stations. Overall, agencies remain very dependent on vendors to operate and manage LPRs and USDOT# readers rather than developing internal capacity to perform these functions.

Chapter 3 ITS-CVO Vendor Survey

3.1 Survey Development

We distributed a survey to ITS-CVO vendors that covered a number of technologies. We categorized ITS-CVO technologies to provide a consistent framework for gathering information. The list of technologies is not exhaustive, but it did reflect the project team's collective agreement on the most relevant and practical groupings for the purposes of the survey. Technologies were grouped into six categories:

Readers/Cameras

- License plates
- USDOT numbers
- Hazardous materials
- Infrared detection
- Driver-focused compliance

Weights/Measures

- WIM scales
- Static scales
- 3D truck screening
- Width/height screening

Detection Technologies

- Tire pressure screening
- Radiation detection panels
- X-ray machines

Traffic Counters

- Traffic counters
- Traffic counting classification

Screening Inspection

- Truck screening software (KATS)
- Truck inspection software (RIMS)
- Feature of truck inspection software
- CVIEW

Other

- Preclearance
- Electronic log device (ELD)
- Tolling
- Vehicle onboard systems

The survey included the following questions:

1. Under what category or categories do the ITS-CVO technologies and/or services you offer fall?

2. What types of clients does your company work with to provide ITS-CVO technologies?
3. What role does your organization play in the following steps of the system design, creation, and implementation process?
4. Approximately how often do you provide technical and/or logical support for customers for a given ITS-CVO product or service?
5. Which methods do you use to communicate with clients?
6. What kind of screening data is utilized by your ITS-CVO technology?
7. Approximately how many different ITS-CVO clients have you served during the last 5 years?
8. Do you have any recommended best practices for states looking to enhance their ITS-CVO technology applications?

3.2 Survey Distribution and Outcome

After sending the survey to 32 vendor representatives, we received zero responses. There may be several explanations for this. First, information related to ITS-CVO technologies is often proprietary, and vendors may be reluctant to disclose information on the system cost, design, or operations outside of formal procurement processes which protects confidentiality. Second, we relied on publicly available contact information because we lacked direct relationship with vendors. This approach likely worked against us, since vendors are more inclined to engage when outreach comes through established contacts or formal channels.

Chapter 4 State Law Enforcement Survey

4.1 Survey Development

We surveyed law enforcement officials responsible for CMV enforcement activities to identify technologies states use in addition to or in lieu of LPRs and USDOT# readers. The survey contained nine questions and employed the ITS-CVO technology categories used in the vendor survey:

1. Which state do you currently represent?
2. Which of the following technologies does your state use in its commercial vehicle enforcement screening activities? Please choose all that apply.
 - a. Total number of *chosen technology* deployed for commercial vehicle enforcement in your state.
3. Does your state assess the accuracy of *chosen technology*? If yes...
 - a. Who assesses the accuracy of *chosen technology*?
 - b. How satisfied are you with the accuracy rate of *chosen technology*?
4. On average, how much did *chosen technology* cost?
5. What elements were included in *chosen technology* cost?
6. What entities does your agency commission to manage site preparation, *chosen technology*?
7. What is the most common installation site for your *chosen technology*?
8. How many different vendors does your agency work with to provide driver *chosen technology* system installation, configuration, maintenance, and evaluation?
9. Does your state have what you believe to be an innovative, seldom utilized, or otherwise unique technology other states might find value in exploring for future use? If yes...
 - a. Would you be open to providing an in-person demonstration of that technology to members of the Kentucky's Innovative Technology Deployment team?
 - b. Who should we contact to schedule a visit?

4.2 Survey Distribution

We pulled contact information from the Commercial Vehicle Safety Alliance (CVSA) website and distributed survey invites in April 2025. Of the 69 invitation emails sent, we received 18 full or partial responses. Fifteen respondents were from the US; the remaining three were from Canadian jurisdictions (Figure 4.1). To preserve the confidentiality of the respondents, our analyses do not attribute responses to specific states or jurisdictions.

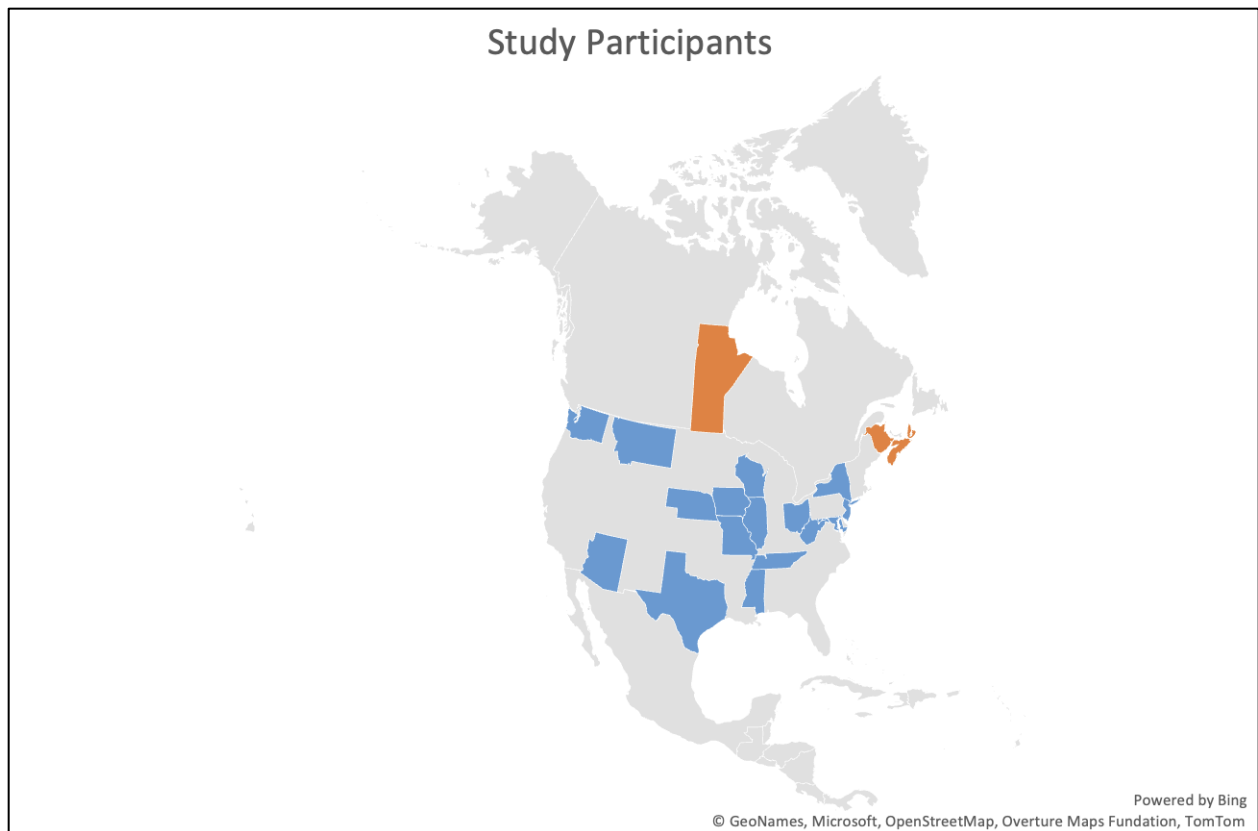


Figure 4.1 Study Participants

4.3 Survey Responses

Figure 4.2 captures technology adoption rates. All jurisdictions use WIM and static scales. Preclearance systems are the next most popular technology. Radiation panels, hazardous materials tracking/identification systems, wireless roadside inspection/FMCSA Level VIII technology, and 3D truck screening systems are used rarely. On average, each jurisdiction reported using six ITS-CVO technologies.

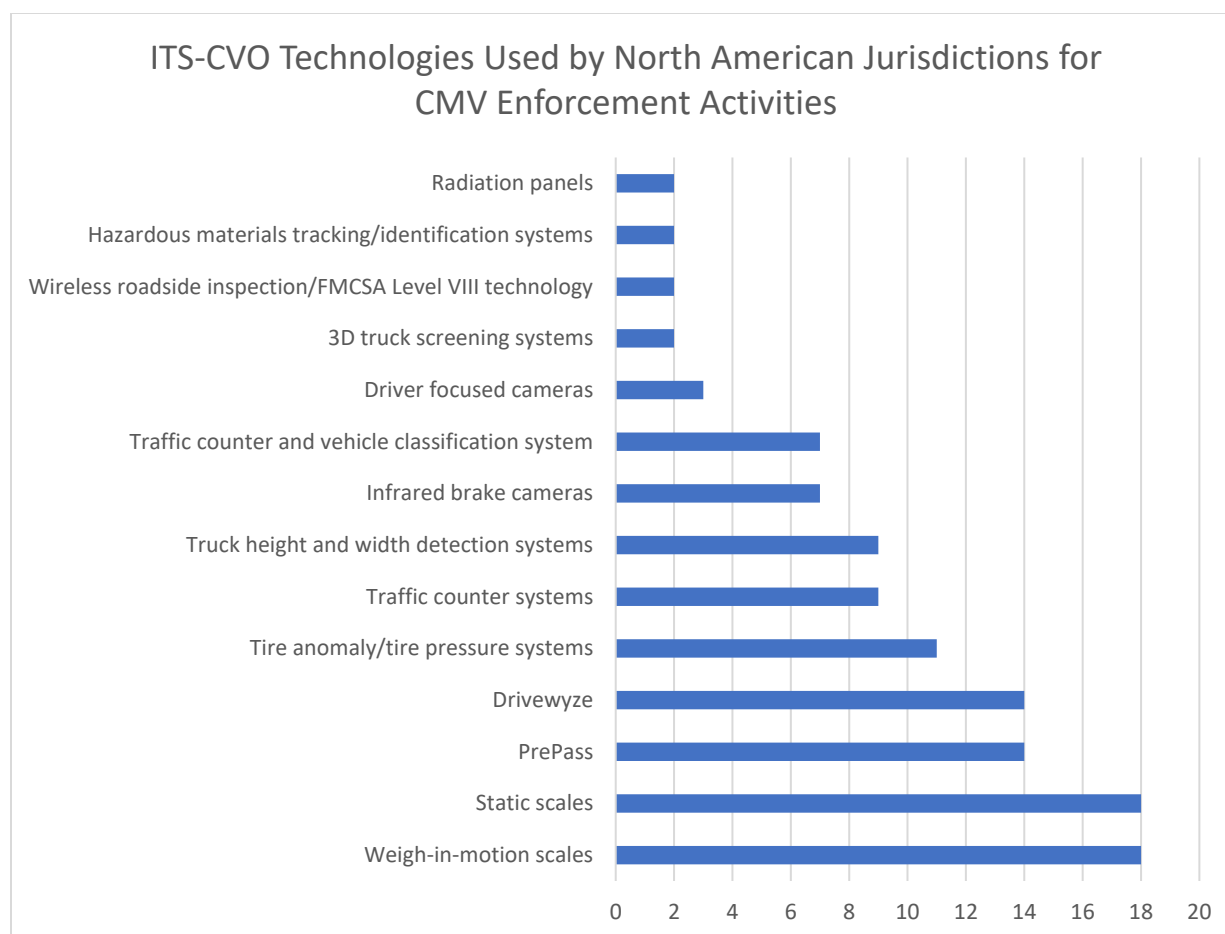


Figure 4.2 ITS-CVO Technologies Used by North American Jurisdictions for CMV Enforcement Activities

4.3.1 Preclearance Systems

4.3.1.1 PrePass

Table 4.1 summarizes data on PrePass systems. Thirteen jurisdictions use them, and the average number of installed systems per jurisdiction is 10.7. Three jurisdictions do not evaluate system accuracy, while nine do (one respondent did not answer). Most systems cost less than \$25,000, which generally covered site preparation, installation, and maintenance. The most common installation site is the weigh station mainline.

Table 4.1 PrePass Usage Summary

Systems Deployed	Assess Accuracy?	Who Assesses Accuracy?	Satisfaction with Accuracy	Cost	Items Included in Cost	Most Common Installation Site	# of Vendors
14	Y	MCSAP agency	Very satisfied	\$0–\$25,000	Site preparation, Installation, Maintenance, Enhancements, Additional equipment, Warranty	Weigh station mainline	1
6	N			\$0–\$25,000	Site preparation, Installation	Weigh station mainline	4
26	Y	DOT	Very satisfied	\$0–\$25,000	Site preparation, Installation, Maintenance	Weigh station mainline	1
11	Y	Technology vendor	Somewhat satisfied		Site preparation, Installation, Maintenance, Enhancements, Warranty	Weigh station mainline	1
17	Y	Technology vendor	Very satisfied			Weigh station mainline	3
10	N			\$0–\$25,000	Site preparation, Installation, Maintenance, Warranty	Weigh station mainline	2
1	Y	Technology vendor	Somewhat satisfied	\$0–\$25,000	Site preparation, Installation, Maintenance, Enhancements	Weigh station mainline	2
6	Y	Technology vendor	Very satisfied	\$0–\$25,000	Site preparation, Installation, Maintenance, Enhancements	Weigh station mainline	1
1	Y	Technology vendor	Neither satisfied or dissatisfied	\$0–\$25,000	Maintenance, Enhancements	Weigh station entrance ramp	2

Systems Deployed	Assess Accuracy?	Who Assesses Accuracy?	Satisfaction with Accuracy	Cost	Items Included in Cost	Most Common Installation Site	# of Vendors
25	Y	Technology vendor	Very satisfied	\$75,001–\$100,000	Site preparation, Installation, Maintenance, Enhancements, Additional equipment, Warranty	Weigh station mainline	2
5						Weigh station entrance ramp	3
9	Y	Technology vendor	Somewhat satisfied	\$0–\$25,000	Site preparation, Installation, Maintenance, Enhancements, Additional equipment	Weigh station mainline	2
9	N			\$0–\$25,000			

4.3.1.2 Drivewyze

Table 4.2 summarizes data on Drivewyze. Twelve jurisdictions use the system, with nine evaluating its accuracy on a regular basis. On average, jurisdictions reported having 12.3 systems deployed. Most systems cost less than \$25,000. What was included in the cost varied significantly, ranging from just installation and maintenance to a full spectrum of equipment and services — that is, everything from site preparation through warranty. The most common installation site is the weigh station mainline.

Table 4.2 Drivewyze Usage Summary

Systems Deployed	Assess Accuracy?	Who Assesses Accuracy?	Satisfaction with Accuracy Rate	Cost	Items Included in Cost	Most Common Installation Site	# of Vendors
14	Y	MCSAP agency	Very satisfied	\$0–\$25,000	Site preparation, Installation, Maintenance, Enhancements, Additional equipment, Warranty	Weigh station mainline	1
6	N			\$75,001–\$100,00	Installation, Maintenance	Weigh station entrance ramp	4
21	Y	DOT	Somewhat satisfied	\$0–\$25,000	Installation, Maintenance	Weigh station mainline	1
18	Y	Technology vendor		\$0–\$25,000	Site preparation, Maintenance	Weigh station mainline	1
2	Y	Technology vendor	Somewhat satisfied	\$0–\$25,000	Installation, Maintenance, Enhancements	Weigh station mainline	2
21	Y	Third-party vendor	Somewhat satisfied	\$75,001–\$100,00	Installation, Maintenance, Enhancements	Mainline before weigh station	1
6	Y	Technology vendor	Very satisfied	\$0–\$25,000	Site preparation, Installation, Maintenance, Enhancements	Weigh station mainline	1
1	Y	Technology vendor	Neither satisfied or dissatisfied	\$0–\$25,000	Maintenance, Enhancements	Weigh station entrance ramp	2
37	Y	Technology vendor	Very satisfied	\$100,001+	Site preparation, Installation, Maintenance, Enhancements, Additional equipment, Warranty	Weigh station mainline	2

Systems Deployed	Assess Accuracy?	Who Assesses Accuracy?	Satisfaction with Accuracy Rate	Cost	Items Included in Cost	Most Common Installation Site	# of Vendors
5						Weigh station entrance ramp	3
8	Y	Technology vendor	Somewhat satisfied	\$0–\$25,000	Site preparation, Installation, Maintenance, Enhancements, Additional equipment	Weigh station mainline	2
9	N			\$0–\$25,000			
14	Y	MCSAP agency	Very satisfied	\$0–\$25,000	Site preparation, Installation, Maintenance, Enhancements, Additional equipment, Warranty	Weigh station mainline	1

4.3.2 Weights and Measures

4.3.2.1 WIM Scales

Table 4.3 summarizes data on WIM scale utilization. Eighteen jurisdictions use WIM scales; 13 respondents indicated their agencies evaluate scale accuracy. Technology vendors typically do evaluations. Most jurisdictions are at least somewhat satisfied with the levels of accuracy. WIM scales often top out at over \$100,000, a figure which typically includes site preparation and installation; less often, a warranty is included. The most common installation site is weigh station entrance ramps.

Table 4.3 WIM Scale Usage Summary

Systems Deployed	Assess Accuracy?	Who Assesses Accuracy?	Satisfaction with Accuracy Rate	Cost	Items Included in Cost	Most Common Installation Site	# of Vendors
14	Y	Technology vendor	Very satisfied	\$0–\$25,000	Site preparation, Installation, Maintenance, Enhancements, Additional equipment, Warranty	Weigh station mainline	2
8	Y	Technology vendor	Very satisfied	\$100,001+	Site preparation, Installation, Maintenance, Warranty	Weigh station mainline	3
24	Y	DOT	Very satisfied	\$75,001–\$100,000	Site preparation, Installation, Maintenance, Warranty	All three locations	1
11	Y	Technology vendor	Neither satisfied or dissatisfied	\$100,001+	Site preparation, Installation, Maintenance, Enhancements, Warranty	Weigh station mainline	1
17	Y	Technology vendor	Very satisfied		Site preparation, Installation, Maintenance	Weigh station entrance ramp	0
37	Y	MCSAP agency	Somewhat satisfied	\$75,001–\$100,000	Site preparation, Installation, Maintenance	Weigh station mainline	3
6	Y	Technology vendor	Very satisfied	\$100,001+	Site preparation, Installation, Maintenance, Additional equipment, Warranty	Weigh station entrance ramp	1
7	Y	Technology vendor	Very satisfied	\$25,001–\$50,000	Site preparation, Installation, Maintenance, Enhancements	Weigh station entrance ramp	4
20	Y	O&M Contractor	Very satisfied	\$100,001+	Site preparation, Installation, Maintenance, Additional equipment, Warranty	Virtual weigh station	1

Systems Deployed	Assess Accuracy?	Who Assesses Accuracy?	Satisfaction with Accuracy Rate	Cost	Items Included in Cost	Most Common Installation Site	# of Vendors
6	Y	MCSAP agency	Somewhat satisfied	\$100,001+	Site preparation, Installation, Maintenance	Weigh station mainline	2
4	Y	Technology vendor	Somewhat satisfied	\$100,001+	Installation, maintenance, enhancements, warranty	Weigh station mainline	1
27	Y	Technology vendor	Very satisfied	\$100,001+	Site preparation, Installation, Maintenance, Enhancements, Additional equipment, Warranty	Virtual weigh station	
5						Weigh station mainline	
2	Y	Third-party vendor	Somewhat satisfied	\$0–\$25,000	Site preparation, Installation, Maintenance, Enhancements	Weigh station mainline	2
22	Y	Technology vendor	Somewhat satisfied	\$100,001+			
5							
8	Y	Technology vendor	Very satisfied	\$100,001+	Site preparation, Installation, Maintenance	Weigh station mainline	1

4.3.2.2 Static Scales

Table 4.4 summarizes data on static scale use. Eighteen jurisdictions use these scales. All jurisdictions evaluate their accuracy, a task most often completed by technology vendors. Fifteen respondents said their agencies are very satisfied with the level of accuracy. Static scales often cost over \$100,000. This price generally included site preparation and installation; 10 jurisdictions reported warranties being included in the cost. The most common installation site is weigh station entrance ramps.

Table 4.4 Static Scale Usage Summary

Systems Deployed	Assess Accuracy?	Who Assesses Accuracy?	Satisfaction with Accuracy Rate	Cost	Items Included in Cost	Most Common Installation Site	# of Vendors
14	Y	MCSAP agency	Very satisfied	\$100,001+	Site preparation, Installation, Maintenance, Additional equipment, Warranty	Weigh station mainline	3
8	Y	Third-party vendor	Very satisfied	\$100,001+	Installation, Maintenance, Warranty	Weigh station entrance ramp	2
28	Y	ISP and DOT	Very satisfied	\$100,001+	Site preparation, Installation, Maintenance, Additional equipment, Warranty	Weigh station entrance ramp	1
40	Y	MCSAP agency	Very satisfied	\$100,001+	Site preparation, Installation, Maintenance, Warranty	Weigh station entrance ramp	1
13	Y	DOT	Very satisfied		Site preparation, Installation, Maintenance	Weigh station	
31	Y	State Dept.	Very satisfied	\$100,001+	Site preparation, Installation, Maintenance, Warranty	Weigh station ramp	1
16	Y	Technology vendor	Very satisfied	\$100,001+	Site preparation, Installation, Maintenance, Additional equipment, Warranty	Weigh station and mobile	1
7	Y	Technology vendor	Very satisfied	\$100,001+	Site preparation, Installation, Maintenance, Enhancements	Weigh station entrance ramp	1
13	Y	Contractor	Very satisfied	\$100,001+	Site preparation, Installation, Maintenance, Warranty	Weigh station mainline	4

Systems Deployed	Assess Accuracy?	Who Assesses Accuracy?	Satisfaction with Accuracy Rate	Cost	Items Included in Cost	Most Common Installation Site	# of Vendors
12	Y	MCSAP agency	Very satisfied	\$100,001+	Site preparation, Installation, Warranty	Weigh station entrance ramp	2
1	Y	Technology vendor	Very satisfied	\$100,001+	Installation, Maintenance	Other (please specify)	1
24	Y	Technology vendor	Very satisfied	\$100,001+	Site preparation, Installation, Maintenance, Enhancements, Additional equipment, Warranty	Weigh station entrance ramp	2
5	Y	State Dept.	Very satisfied	\$100,001+		Weigh station entrance ramp	2
10	Y	Third-party vendor	Somewhat satisfied	\$100,001+	Site preparation, Installation, Maintenance, Enhancements, Additional equipment, Warranty	Weigh station entrance ramp	2
9	Y	Dept. of Ag.	Somewhat satisfied	\$100,001+			
10	Y	Technology vendor	Very satisfied				
5	Y						
6	Y	Technology vendor	Very satisfied	\$75,001–\$100,000	Site preparation, Installation, Maintenance	Weigh station mainline	1

4.3.2.3 3D Truck Screening

Table 4.5 displays responses from the one jurisdiction that uses 3D truck screening for CMV enforcement activities.

Table 4.5 3D Truck Screening Usage Summary

Systems Deployed	Assess Accuracy?	Who Assesses Accuracy?	Satisfaction with Accuracy Rate	Cost	Items Included in Cost	Most Common Installation Site	# of Vendors
1	Y	DOT	Neither satisfied or dissatisfied	\$75,001–\$100,000	Site preparation, Installation, Maintenance	Weigh station entrance ramp	1

4.3.2.4 Truck Height & Width Detection

Table 4.6 summarizes data on height and width detection systems, which eight jurisdictions have adopted. Jurisdictions average 8.75 system deployments. All but one jurisdiction does accuracy assessments, a task most often handled by a MCSAP agency. Levels of satisfaction varied. Prices varied as well, but generally included site preparation, installation, and maintenance. Weigh station entrance ramps are the most common installation sites.

Table 4.6 Truck Height & Width Detection System Usage Summary

Systems Deployed	Assess Accuracy?	Who Assesses Accuracy?	Satisfaction with Accuracy Rate	Cost	Items Included in Cost	Most Common Installation Site	# of Vendors
3	Y	MCSAP agency	Very satisfied	\$25,001–\$50,000	Site preparation, Installation, Additional equipment, Warranty	Weigh station mainline	2
10	Y	MCSAP agency	Somewhat satisfied	\$75,001–\$100,000	Site preparation, Installation, Maintenance, Warranty	Weigh station entrance ramp	1
11	Y	MCSAP agency	Somewhat satisfied	\$0-\$25,000	Site preparation, Installation, Maintenance, Warranty	Weigh station entrance ramp	1
15	Y	Officer verification	Very satisfied	\$0-\$25,000	Site preparation, Installation, Maintenance, Warranty	Weigh station entrance ramp	1
4	Y	Technology vendor	Very satisfied	\$100,001+	Site preparation, Installation, Maintenance, Warranty	Weigh station entrance ramp	1
7	N			\$0-\$25,000	Site preparation, Installation, Maintenance, Enhancements	Weigh station entrance ramp	1
18	Y	O&M Contractor	Very satisfied	\$100,001+	Site preparation, Installation, Maintenance, Additional equipment, Warranty	Virtual weigh station	5+
2	Y	MCSAP agency	Somewhat satisfied	\$25,001–\$50,000	Comment: 20 years old	Weigh station entrance ramp	0

4.3.3 Detection Technologies

4.3.3.1 Tire Anomaly/Tire Pressure Screening

Table 4.7 summarizes data on tire anomaly/tire pressure screening systems, which are being used by 11 jurisdictions. Jurisdictions average 5.45 system deployments. Ten jurisdictions evaluate system accuracy, which is done most often by vendors. Most systems cost over \$75,000, a price that included site preparation, installation, maintenance, and a warranty. Weigh station entrance ramps are the most common installation points.

Table 4.7 Tire Anomaly/Tire Pressure Screening System Usage Summary

Systems Deployed	Assess Accuracy?	Who Assesses Accuracy?	Satisfaction with Accuracy Rate	Cost	Items Included in Cost	Most Common Installation Site	# of Vendors
3	Y	Technology vendor	Somewhat satisfied	\$100,001+	Site preparation, Installation, Maintenance, Warranty	Weigh station entrance ramp	1
4	Y	Technology vendor	Very satisfied	\$75,001–\$100,00	Installation, Maintenance, Warranty	Weigh station mainline	2
19	Y	MCSAP agency	Very satisfied	\$75,001–\$100,000	Site preparation, Installation, Maintenance, Warranty	Weigh station entrance ramp	2
5	Y	Technology vendor	Very satisfied	\$100,001+	Site preparation, Installation, Maintenance, Enhancements, Warranty	Weigh station mainline	1
5	Y	Technology vendor	Very satisfied			Weigh station mainline	
4	N			\$100,001+	Site preparation, Installation, Maintenance, Warranty	Weigh station entrance ramp	1
2	Y	MCSAP agency	Very satisfied	\$50,001–\$75,000	Site preparation, Installation, Maintenance, Enhancements	Weigh station entrance ramp	1
6	Y	Technology vendor	Very satisfied	\$100,001+	Site preparation, Installation, Maintenance, Additional equipment, Warranty	Weigh station mainline	1
2	Y	Technology vendor	Very satisfied	\$100,001+	Site preparation, Installation, Maintenance, Enhancements, Additional equipment, Warranty	Weigh station entrance ramp	2
8	Y	Technology vendor	Very satisfied	\$0–\$25,000	Site preparation, Installation, Maintenance, Enhancements, Additional equipment, Warranty	Weigh station entrance ramp	1

Systems Deployed	Assess Accuracy?	Who Assesses Accuracy?	Satisfaction with Accuracy Rate	Cost	Items Included in Cost	Most Common Installation Site	# of Vendors
2	Y	Technology vendor	Somewhat satisfied	\$100,001+			

4.3.3.2 Radiation Panels

Table 4.8 summarizes the use of radiation panels in two jurisdictions. Both jurisdictions paid \$50,001 – \$75,000, but the prices included different equipment and services. One jurisdiction evaluates system accuracy, which is done by the vendor. Each system is placed near weigh stations, but in different locations.

Table 4.8 Radiation Panel Usage Summary

Systems Deployed	Assess Accuracy?	Who Assesses Accuracy?	Satisfaction with Accuracy Rate	Cost	Items Included in Cost	Most Common Installation Site	# of Vendors
14	Y	Third-party vendor	Very satisfied	\$50,001–\$75,000	Warranty	Weigh station mainline	1
2	N			\$50,001–\$75,000	Site preparation, Installation, Maintenance, Enhancements, Additional equipment, Warranty	Weigh station entrance ramp	1

4.3.4 Readers/Cameras

4.3.4.1 Hazardous Materials

One jurisdiction uses hazardous materials identification screening technologies. Table 4.9 offers details.

Table 4.9 Hazardous Materials Screening System Usage Summary

Systems Deployed	Assess Accuracy?	Who Assesses Accuracy?	Satisfaction with Accuracy Rate	Cost	Items Included in Cost	Most Common Installation Site	# of Vendors
2	Y	DOT	Very satisfied	\$75,001–\$100,000	Site preparation, Installation, Maintenance, Enhancements, Warranty	Weigh station entrance ramp	2

4.3.4.2 Driver-Focused Cameras

Table 4.10 offers details on the three jurisdictions using driver-focused cameras. Two jurisdictions evaluate system accuracy and report being very satisfied. Price points varied as did equipment and services included in the costs. Two of the three systems are installed on weigh station entrance ramps.

Table 4.10 Driver-Focused Cameras Usage Summary

Systems Deployed	Assess Accuracy?	Who Assesses Accuracy?	Satisfaction with Accuracy Rate	Cost	Items Included in Cost	Most Common Installation Site	# of Vendors
3	N			\$50,001–\$75,000	Site preparation, Installation, Maintenance, Warranty	Weigh station entrance ramp	1
4	Y	Technology vendor	Very satisfied	\$0–\$25,000	Unknown	Weigh station entrance ramp	1
2	Y	MCSAP agency	Very satisfied	\$100,001+	Site preparation, Installation, Maintenance, Enhancements, Additional equipment, Warranty	Mobile trailers	1

4.3.4.3 Infrared Brake Cameras

Table 4.11 reviews information from the seven jurisdictions that use infrared brake cameras. Five jurisdictions have either a MCSAP agency or vendor evaluate system accuracy. Most systems cost more than \$75,000, a price tag that typically included installation, maintenance, and a warranty. Weigh station entry ramps are the most popular choice for installation.

Table 4.11 Infrared Brake Cameras Usage Summary

Systems Deployed	Assess Accuracy?	Who Assesses Accuracy?	Satisfaction with Accuracy Rate	Cost	Items Included in Cost	Most Common Installation Site	# of Vendors
4	Y	Technology vendor	Somewhat satisfied	\$100,001+	Installation, Maintenance, Enhancements, Warranty	Weigh station entrance ramp	2
1	Y	MCSAP agency	Somewhat satisfied	\$50,001–\$75,000	Site preparation, Installation, Maintenance, Warranty	Static scale area	2
4	N			\$25,001–\$50,000	Site preparation, Installation, Maintenance, Warranty	Weigh station entrance ramp	1
7	Y	MCSAP agency	Very satisfied	\$100,001+	Site preparation, Installation, Maintenance, Enhancements	Weigh station entrance ramp	1
1	Y	Technology vendor	Very satisfied	\$75,001–\$100,000	Installation, Maintenance, Enhancements, Warranty	Mobile van	1
2						Weigh station entrance ramp	

Systems Deployed	Assess Accuracy?	Who Assesses Accuracy?	Satisfaction with Accuracy Rate	Cost	Items Included in Cost	Most Common Installation Site	# of Vendors
1	Y	Technology vendor	Somewhat satisfied	\$100,001+			

4.3.5 Traffic Counters

4.3.5.1 Traffic Counter Systems

Table 4.12 summarizes data on traffic counter systems from the nine jurisdictions in which they are used. System deployments, prices, and satisfaction with accuracy varied. Weigh station mainlines are the most common locations for installation.

Table 4.12 Traffic Counter System Usage Summary

Systems Deployed	Assess Accuracy?	Who Assesses Accuracy?	Satisfaction with Accuracy Rate	Cost	Items Included in Cost	Most Common Installation Site	# of Vendors
14	N			\$0–\$25,000	Unknown		
3	Y	DOT	Neither satisfied or dissatisfied	\$50,001–\$75,000	Site preparation, Installation, Maintenance	Virtual weigh station	1
11	Y	Technology vendor	Neither satisfied or dissatisfied		Site preparation, Installation, Maintenance, Enhancements, Warranty	Weigh station mainline	1
13	Y	Technology vendor	Very satisfied			Weigh station mainline	
6	Y	Technology vendor	Very satisfied	\$100,001+	Site preparation, Installation, Maintenance	Roadside	3
4	N			\$50,001–\$75,000	Maintenance, Warranty	Weigh station mainline	1
10	N			\$0–\$25,000	Site preparation, Installation, Maintenance	Weigh station entrance ramp	
200	Y	DOT	Somewhat satisfied				
82							

4.3.5.2 Traffic Vehicle Classification System

Table 4.13 reviews data on traffic vehicle classification systems, which five jurisdictions employ. The average number of system deployments is 12. All jurisdictions do accuracy assessments, a task most often outsourced to by vendors. System costs exceeded \$100,000 and usually included site preparation, installation, and maintenance. Three jurisdictions are very satisfied with system accuracy. Most jurisdictions locate systems on weigh station mainlines.

Table 4.13 Traffic Vehicle Classification System Usage Summary

Systems Deployed	Assess Accuracy?	Who Assesses Accuracy?	Satisfaction with Accuracy Rate	Cost	Items Included in Cost	Most Common Installation Site	# of Vendors
11	Y	Technology vendor	Neither satisfied or dissatisfied		Site preparation, Installation, Maintenance, Enhancements, Warranty	Weigh station mainline	1
17	Y	Technology vendor	Very satisfied		Site preparation, Installation, Maintenance	Weigh station mainline	
6	Y	Technology vendor	Very satisfied	\$100,001+	Unknown	Roadside	2
20	Y	O&M Contractor	Very satisfied	\$100,001+	Site preparation, Installation, Maintenance, Additional equipment, Warranty	Virtual weigh station	5+
6	Y	Technology vendor	Somewhat satisfied	\$100,001+	Site preparation, Installation, Maintenance	Weigh station mainline	1

4.3.6 Screening Inspection

4.3.6.1 Wireless Roadside Inspection/Level VIII Technology

One jurisdiction uses wireless roadside inspection technologies (Table 4.14). Notably, FMCSA evaluates the accuracy of the 27 installations.

Table 4.14 Wireless Roadside Inspection System Usage Summary

Systems Deployed	Assess Accuracy	Who Assesses Accuracy?	Satisfaction with Accuracy Rate	Cost	Items Included in Cost	Most Common Installation Site	# of Vendors
27	Y	FMCSA	Very satisfied	\$100,001+	Enhancements, Additional equipment	Weigh station mainline	1

4.3.7 Novel Technologies

Two respondents said their jurisdictions employ new or novel technologies — (1) the use of uncrewed aerial systems (UAS) for license plate screening and (2) cameras/sensors to identify bridge strike offenders. Both jurisdictions were willing to host demonstrations for Kentucky representatives, however, resource limitations prevented us from visiting. But one jurisdiction presented at the annual Strategic Planning Meeting for the Kentucky ITD team on using UAS to identify CMVs that attempt to bypass inspections.

Chapter 5 Conclusions

5.1 Summary of Findings

Most North America jurisdictions use at least one kind of ITS-CVO technology to assist with CMV enforcement activities. The most common of these are LPRs, USDOT# readers, WIM scales and static scales, and preclearance systems. LPR and USDOT# reader adoption is not as widespread as some other technologies, perhaps due to their high costs. Scales and preclearance systems are the most ubiquitous. Table 5.1 lists modal price ranges (i.e., prices which appeared most often in survey responses) for 15 technologies. Prices cover labor, site preparation, installation, maintenance, and a warranty.

Table 5.1 Modal Prices of Technologies Used by North American Jurisdictions for CMV Enforcement Activities

Technology	Modal Price
LPR/DOT# Readers	\$500,000+
PrePass	\$0–\$25,000
Drivewyze	\$0–\$25,000
WIM Scales	\$100,001+
Static Scales	\$100,001+
3D Truck Screening	\$75,001–\$100,000
Truck Height & Width Detection	\$0–\$25,000
Tire Anomaly/Tire Pressure Screening	\$100,001+
Radiation Panels	\$50,001–\$75,000
Hazard Materials ID	\$75,001–\$100,000
Driver-Focused Cameras	*
Infrared Brake Cameras	\$100,001+
Traffic Counters	\$50,001–\$75,000
Traffic Vehicle Classification System	\$100,001+
Wireless Roadside Inspection	\$100,001+

*No mode. Each price (\$0–\$25k, \$50,001–\$75,000, \$100,001+) listed once.

Most jurisdictions evaluate the accuracy of data generated by ITS-CVO technologies. Often, technology vendors are responsible for every aspect of system implementation, from installation and maintenance to accuracy assessments. Jurisdictions are generally satisfied with system performance and levels of accuracy. Most systems are installed near weigh stations, either on weigh station entrance ramps or along adjacent mainlines.

5.2 Significance

By identifying gaps in technology adoption, data accuracy, and vendor oversight, the research will help KYTC make data-driven decisions about future investments. Our findings also highlight opportunities for improved coordination between state partners and vendors, which is essential for ensuring CMV screening technologies are efficient, accurate, safe, and cost-effective.

5.3 Limitations

This study has several limitations. First, it was completed over the course of five years. The extended research timeline was due to COVID-19 and other logistical hurdles. While our methodologies stayed consistent, data collected in 2021 are probably less relevant now. Second, the law enforcement survey covered a wide range of ITS-CVO technologies, which limited the number of questions we could reasonably ask. As such, we could not explore some areas of

interest without overburdening respondents. Third, we had not expected many of the technologies to cost more than \$100,000, reducing our ability to more narrowly assess pricing. And lastly, survey response rates were low, ranging from 0% to 37%. Thus, while the data provide insights into ITS-CVO technology use, we lack a comprehensive picture of industry and agency practices. Without vendor input, we could not validate information provided by survey respondents.

5.4 Recommendations for Future Research

Further study is needed to develop standardized approaches for establishing the benefits and costs of ITS-CVO technology investments. This will help states prioritize technologies that offer the highest returns on investment in terms of safety and operations. Research on cross-agency system integration could reveal opportunities to improve communication between enforcement, registration, and credentialing platforms, while analysis of vendor oversight models may identify best practices for strengthening contractual arrangements and improving accountability. Future studies should evaluate emerging tools such as AI-based OCR, predictive analytics, and mobile screening solutions to assess their scalability and effectiveness. Surveying enforcement officers, motor carriers, and other stakeholders will offer more comprehensive knowledge of how ITS-CVO technologies impact safety and compliance outcomes.

Future research should also explore opportunities to improve collaboration between jurisdictions, federal agencies, and private vendors to promote more transparent data-sharing practices. Establishing standardized reporting protocols and clear expectations for performance evaluation can help ensure technology outcomes are measured consistently across jurisdictions. Additionally, investigating the long-term operational and maintenance costs of ITS-CVO technologies would provide insights into long-term performance and returns on investment. Comparative analyses of states that have implemented innovative contracting or performance-based vendor agreements will reveal best practices for managing complex technology partnerships.

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