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Virtual Commercial Vehicle Control Stations for California: A Review of Legal and Institutional Issues

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Task Order 5105

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Abstract

In the past five years, commercial vehicle travel has increased 60 percent on California's highways, without a corresponding increase in compliance inspection station capacity or enforcement officers. Commercial vehicles that do not comply with regulations impose significant public costs including, for example, pavement and structure damage to roads and catastrophic crashes. In response to these problems, the California Department of Transportation is investigating the potential application of detection and communication technology in virtual compliance stations (VCS) to cost-effectively improve enforcement of commercial vehicle regulations. This study begins with a description of the fledgling VCS research programs in the U.S. as well more advanced international VCS programs. Next, the results of expert interview with key officials involved in the early deployment stages of VCS programs in Kentucky, Florida, Indiana, and Saskatchewan are reported. This is followed by an analysis of institutional barriers to VCS screening and automated enforcement based on the relatively extensive body of literature on the commercial vehicle electronic pre-screening programs and red-light and speeding automated enforcement programs. The paper concludes with some key recommendations to address legal and institutional barriers to VCS deployment in the U.S.

Key Words: Commercial vehicle compliance, ITS, institutional issues

INTRODUCTION

In the past five years, commercial vehicle travel has increased 60 percent on California's highways (*1*) without a corresponding increase in compliance inspection station capacity or enforcement officers. If the number of trucks requiring inspection exceeds station capacity, then queues form, which waste drivers' time and fuel, worsens air pollution, and creates roadway safety hazards. As a result, compliance inspection station operators must routinely allow trucks to bypass overcrowded stations and non-compliant vehicles escape inspection. In addition, scofflaw commercial vehicle operators (CVO) strategically choose routes to avoid inspection stations. CVOs that do not comply with regulations impose significant costs on the public. For example, for every ten percent by which a truck exceeds its weight limit, there is approximately a 40 percent increase in pavement and structural damage (*2*), which significantly increases roadway reconstruction and resurfacing costs. And while truckers are among the safest category of drivers, crashes involving trucks are often catastrophic and many result from non-compliance.

In response to these problems, the California Department of Transportation (Caltrans) is investigating the potential application of detection and communication technology to virtual compliance stations (VCSs) to cost-effectively improve enforcement with CVO regulations. Successful implementation of any technology, however, depends not only on its merits but also on a favorable institutional environment (*3,4*). For example, case studies of CVO pre-screening programs document histories of delay and compromises due to institutional barriers (*5*). Similarly, a long list of automated enforcement programs have been discontinued because of non-technical reasons (*6, 7, 8*).

An early understanding of potential barriers specific to VCS implementation may enable the development of an effective program strategy. This study begins with a description of CVO electronic screening programs and fledgling VCS programs in the U.S., as well more advanced VCS programs outside of the U.S. Next, the results of expert interview with key officials involved in the early deployment stages of VCS programs in Kentucky, Florida, Indiana, and Saskatchewan are reported. This is followed by an analysis of institutional barriers to VCS screening enforcement and automated enforcement based on the relatively extensive body of literature on the CVO electronic pre-screening programs and red-light and speeding automated enforcement programs. The paper concludes with a discussion of major findings.

BACKGROUND

In the U.S., there are currently two major national CVO electronic screening programs in operation, the North American Pre-clearance and Safety System (NORPASS) and the PrePass™ program, as well as one statewide program in Oregon, Operation GreenLight. PrePass™ is the largest of these programs, operating in 25 states across the country from California to Virginia. Carriers that participate in PrePass™ are pre-certified; their safety records and credentials are routinely verified by state and federal agencies and updated in the PrePass™ database. At designated weigh stations, ports of entry, and agricultural interdiction facilities, weigh-in-motion (WIM) scales are imbedded in the mainline highway, and roadside dedicated short range communications (DSRC) antennas are installed. The DSRC antennas communicate with trucks' transponders, which identify trucks in the pre-screening database. If credentials and weight limits

are in order, then truckers are given a green light on the transponder to proceed. If not, the transponder beeps and flashes red, signaling truckers into static weigh stations for inspection. The criteria for station bypass are established individually by each state.

Oregon established Operation GreenLight in 1995, as an enhanced electronic pre-clearance program. Operating its own program, rather than using the regional electronic pre-clearance programs, allows Oregon more extensive use of data collected by the program. In particular, Oregon's pre-clearance system facilitates their unique weight-mile tax program. The program now has 21 mainline systems, featuring WIM and DSRC automatic vehicle identification (AVI), at ports-of-entry and major weigh stations (*9*).

While the pre-clearance programs are very popular among established carriers and drivers, such systems could be used more fully. By design, these programs keep the safest and most compliant carriers out of weight and inspection stations, saving time, money, and fuel for carriers and freeing up enforcement agents to focus on those most likely to be noncompliant. These programs are voluntary and tend to be used most frequently by larger trucking firms that practice qualifying fleet maintenance and safety procedures. Small independent truckers typically do not join these pre-clearance programs because participation costs are perceived to be greater than program benefits. A large number of trucks must still pass through facilities to be weighed and visually screened by law enforcement personnel, and scofflaws routinely circumvent these stations.

The VCS concept is most fully deployed outside of North America. For example, in New South Wales, Australia, 100 cameras located on freight routes, weigh stations, and mobile inspection units record speed, fatigue, and weight inspection offences as part of the TruckScan program. WIM detectors are installed at weight inspection locations on the mainline. If the Roads and Traffic Authority (RTA) confirms a detected offence, then RTA issues a citation to the driver or operator and records the offence against the driver's license and the vehicle's registration. If four offences are issued within a three-year period, then the RTA will suspend the driver's license.

North American programs in Kentucky, Indiana, Florida (U.S.) and Saskatchewan (Canada) have recently begun research and development of VCS applications (*10*). These programs differ with respect to levels of deployment and enforcement automation, but all use image capturing and sensing technologies to increase compliance enforcement. There is limited documentation of these programs (i.e., presentation materials and agency websites), thus we conducted expert interviews with officials from these programs to gain a better understanding of their programs.

EXPERT INTERVIEWS

Researchers conducted interviews over the telephone with experts involved in virtual compliance station research programs in Kentucky (*11*), Florida (*12*), Indiana (*13*), as well as Saskatchewan (*14*) during the months of February and March 2005. Following are the key findings from each interview.

Kentucky's Remote Monitoring & Virtual Weigh Stations

The Kentucky program is designed to address inadequate enforcement of weight restrictions on secondary roads. Truckers use these roads to bypass nearby fixed inspection stations by strategically entering and exiting the freeways. Tradition roving patrols (or mobile enforcement) cannot effectively address this problem because they are too visible; truckers know within five minutes of setup to avoid a patrolled stretch. The key objective of the program was to identify effective alternatives to static inspection stations.

The first field test used cameras only to capture multiple images of trucks on a route frequently used to avoid a nearby inspection station (US 25). The images were sent to a monitor at the inspection station where the operator viewed the images on a monitor and then could manually look up a truck's Department of Transportation (DOT) number information in a centralized database. The second field test (US 25 in Southern Kentucky) included WIM and camera technology to screen for overweight trucks. In both field tests, if a problem was detected, then an officer was dispatched to bring the truck in for inspection at a static station.

Two key challenges were reported; first, there was insufficient staff to check the monitor and manually look up the DOT number information and, second, there was difficulty obtaining a readable image of DOT number because of non-standard DOT numbers (i.e., placement and size) and limited camera shutter speed to capture clear images at highway speeds. It was noted that license plate numbers are easier to read with available technology, but that these numbers are also not standard across states, linked to needed information, and/or information can be very time consuming to look up. Some early advantages of the programs were noted. Some police used the monitors regularly to focus enforcement efforts and have become "minor champions" of the program. In addition, the low cost and simplicity of the applied technology in the first test worked well.

The technology evaluation of the second field test is the next step, which will focus on the percent of usable DOT number photos triggered by the WIM. Longer-term plans may include VCS stations that are independent of fixed inspection stations. There are only four other locations in Kentucky in which the technology can be located on bypass routes near fixed stations. The feasibility of incorporating license plate reader technologies may also be examined.

Florida's Remotely Operated Compliance Stations

The Florida DOT has worked on its Remotely Operated Compliance Station program for the past three and one half years. It is designed to catch non-compliant trucks, which bypass static inspection stations, and is focused on technology testing, especially in delivering power supply to remote areas and transmitting information from the video to the enforcement team. There are two sites, both rural, two hours outside of the city of Orlando, which are currently able to detect speed and height, and, in the near future, WIM technology will be incorporated. Video monitors are always on, but do not record or alert the remote console unless the height sensors are triggered. Police use the pictures taken of the truck for visual identification only; they do not record or process license plate or DOT numbers.

Institutional issues have not been a concern up to this point. It is interesting to note that the CVO enforcement in Florida is housed in the Office of Motor Carrier Compliance, which is part of the Department of Transportation. The state police do not enforce weight and compliance. This may lead to decreased friction and increased coordination.

The relatively "low tech" approach of their program has been successful from their perspective for two reasons. First, it avoids CVO privacy concerns because it does not capture DOT or license plate numbers. Second, the low-cost of the simple off-the-shelf technology used in the field test works well to identify trucks that are bypassing inspection stations. In the future, they hope to apply a wider range of sensors to the program (i.e., not just WIM sensors).

Indiana's Virtual Weigh Stations

The program in Indiana is designed to catch overweight trucks that bypass eight static weigh stations and impose significant damage on and repair costs to the state's roadways. They cite a study of pavement data from northern Indiana showing that roads had to be repaved ten years earlier than planned because of overweight truck damage. They also cite a study that indicates only 14 trucks with weight violations, in excess of 85,000 pounds, were cited at the eight stations during a two-month period. In contrast, another study of one WIM site on I-80/94 outside of Chicago documents 37 trucks per day in excess of 90,000 pounds and seven per day over 100,000 pounds. Concern was expressed that other weigh station functions, such as credentialing may be equally inefficient. Moreover, it was also noted that improved truck technology has made it more difficult for officers to eyeball overweight trucks with decent accuracy. The primary objective of the program is to increase trucker's uncertainty about enforcement locations to more effectively deter CVO non-compliance, increase the efficiency of catching non-compliant CVOs, and reduce pavement damage.

The first field test was on State Route (SR) 24 at Fort Wayne, and two subsequent field tests were implemented on I-65 in the northwest and SR 1 near Cincinnati, Ohio. The field tests involved a WIM with a wireless transmitter and camera that sent real-time data to a patrol car. When the WIM identified an overweight vehicle, the patrol car was dispatched to bring the truck to a pull-off location where it could be weighed with a certified portable scale. Such a weighing process can be dangerous if it is done on the shoulder; however, there may be a number of ways to design or configure the pull-off location (e.g., rest areas or specially designed spots) that would be less costly than building a new static weigh stations. The use of cameras in the field tests has helped to get the patrol car out of the line of sight and increase truckers "uncertainty" about enforcement locations and reduce the number of hours required to detect a CVO weight violation.

Canada's Remote Controlled Weigh Stations

The Canadian program is designed to modernize while saving money. The weigh scales at existing inspection stations are in good condition, but the facilities themselves do not meet current building codes. If the system can work unmanned, then funds can be saved not only on labor but also on facility up-grades. Additionally, the problem with overweight trucks in the

northern portion of the province is seasonal. However, it is inefficient to build new, traditional stations that are in operation for only a few months a year.
One field test within the Saskatoon City limits is a virtual weigh station with a WIM sensor, frontal license plate reader, a side capture camera, and a transponder reader. Officials hope to conduct traditional weight and dimension checking along with semi-automated credential checking at satellite locations. Cameras are combined with height and weight classification sensors, and drivers will scan identification information at a remote weigh station, while an operator at a centralized location then looks up the driver's credentials. If there is a problem, the driver will then be instructed to report to a manned weigh station. These are screening program only; information is provided to officers who then bring overweight vehicles to weigh station. Two key program challenges include data integration and CVO sensitivity to increased costs and paperwork.

EVALUATION OF INSTITUTIONAL BARRIERS

In this section, the analysis of institutional barriers to VCS is drawn from two bodies of evaluative literature, the CVO electronic pre-screening programs and red light and speeding automated enforcement programs. Two major categories of institutional constraints are identified: lack of stakeholder support and legal constraints. In general, the discussion of stakeholder support for VCS encompasses both screening enforcement and automated enforcement. However, the discussion of legal constraints largely applies to VCS with automated enforcement features.

Lack of Stakeholder Support

Lack of stakeholder support by the CVOs subject to VCS programs and by administrative agencies charged with implementing programs has been identified as a key barrier to implementation, particularly in the evaluation of CVO pre-screening programs, such as NORPASS and PrePass^{TM}. Research suggests that understanding stakeholder concerns and addressing those concerns may be essential to an effective implementation strategy.

Commercial Vehicle Operators

The literature suggests that CVOs may have several important concerns surrounding the implementation of a VCS program, including: business confidentiality, operational costs, and privacy and government intrusion. This section discusses each concern and then outlines a number of steps to help address these concerns.

Confidentiality CVOs, as corporations, do not have the same privacy rights as individuals (*6*). However, they do have an interest in the privacy of the information that is collected about them by pre-clearance, screening, or enforcement systems. Gellman (*6*) uses the term confidentiality, rather than privacy, to refer to the interest of a business in the secrecy of information. He notes that businesses historically protect their own information through contracts. The evaluative literature on electronic pre-screening programs commonly documents CVOs' concern that information collected through pre-screening not be disclosed to competitors (*9, 15, 16, 17*). The voluntary electronic screening programs (NORPASS, PrePass™, and Operation Greenlight)

address this concern through third-party data management contracts. A non-voluntary VCS program that uses license plate readers, for example, may eliminate this form of protection, and new confidentiality assurances may need to be worked out.

Operating Costs The history of voluntary CVO screening in the U.S. indicates significant sensitivity to any program that might increase operating costs. More specifically, concern has been expressed that such programs may be a stepping stone to increased governmental regulation and enforcement as well as a weight-distance tax (*15*). A U.S. DOT survey indicates that CVOs are more likely to accept technology applications that improve their bottom line rather than increase regulation enforcement (*18*).

Steps to Address CVO Concerns In general, the literature on CVO electronic pre-screening programs largely recommends involving CVOs early on in the process; for example, by giving CVOs leadership positions on committees or public/private working groups that allow them to help shape the direction, strategies, goals, and implementation of the programs (*5,9,15,17,18*). This recommendation is complicated, however, by the fact that the industry is far from monolithic (*18*). For example, an analysis of one survey of truck drivers finds significant differences in acceptance of electronic screening along these lines: union vs. non-union, company drivers vs. independent owner operators, younger vs. older drivers, and inexperienced vs. experienced drivers (*18*). Thus, efforts to involve CVO interests in the implementation process should reflect the diversity of the industry. Educational outreach programs may also be used to inform CVOs about the technology application as well as it benefits, such as reduced truck wait times and fuel costs (*5, 9, 15, 17, 18*). Evaluations of U.S. voluntary electronic screening programs document average time savings per weigh station bypass from 1.17 to 4.86 minutes and average fuel savings from 0.06 to 0.18 gallons (*16*). To address concerns related to business confidentiality, many sources recommend early clarification on the limits of data use and, when possible, use of a third party to manage data (*5, 9, 15, 17, 18*).

Administrative Agencies

The literature suggests that administrative agencies may have several important concerns surrounding the implementation of a VCS program, including: implementation and enforcement costs, adoption by law enforcement personnel, and technical interoperability.

Implementation and Enforcement Costs Screening and enforcement technologies can improve the efficiency of enforcement efforts; however, such programs are not without significant capital, operation, and maintenance costs to public administrative agencies. A review of CVO screening programs found "high anticipated… public implementation costs" and "lack of technical expertise among current personnel" amongst administrative officials to be significant barriers to implementation (*15*, p. 14).

Concerns of Law Enforcement Personnel One evaluation of the Pre-Pass™ program notes that one barrier to implementation was that "law enforcement personnel still don't trust the technology and fear missing unsafe trucks, a process now done by eyeballing the vehicles at the weigh stations" (*15,* p. 7). In the context of automated enforcement, Blackburn and Gilbert (*8*) cite a study conducted in 1984 for the National Highway Traffic Safety Administration

(NHTSA) of three state law enforcement agencies who had tested automated enforcement technology in the field. The involved personnel generally thought the concept was excellent and were in favor of implementing the program. However, the Institute of Transportation Engineers (*7*) notes that other studies document a number of concerns about automated enforcement among law enforcement personnel:

- Could reduce felony arrests;
- May perpetuate a negative image of officers as "sneaky;"
- Deprives motorists of officer discretion; and
- Is opposed by unions because of "image and job security" concerns. (*7,* p. 32)

Interoperability Non-technical interoperability refers to differences in business models and data sharing agreements that exist between one pre-clearance program and another. This has emerged as a critical issue in some pre-screening programs (*9*). The Oregon GreenLight program encountered significant interoperability problems with the existing regional pre-screening program (*9*). California now has 33 PrePass™ bypass and WIM points in operation. A new VCS program may need to address interoperability issues with existing electronic pre-screening programs.

Steps to Address Administrative Agency Concerns The CVO electronic pre-screening literature suggests that many barriers related to implementation and enforcement costs can be addressed by developing an incremental implementation strategy that starts with relatively modest technologies, training programs, and staff requirements (*5*). Administrative barriers may be overcome by involving top leadership in the programs in outreach efforts and by documenting early program benefits (*5*). Agency coordination for the program may be facilitated by creating an inter-agency working group, clearly delineating agency roles, and identifying the lead agency (*5*). More specific concerns of law enforcement personnel may be addressed by soliciting their involvement early in the process and by outreach campaigns to inform personnel about the program, effects, and benefits (*7*). Past experience also indicates that interoperability issues can be resolved by "investing in new equipment and software, cooperation in systems development and implementation, and by encouraging the development of standards" (*5,* p. 16).

Legal Constraints

Legal constraints, including the constitutionality of a program and lack of enabling legislation, may inhibit the implementation of an effective automated enforcement VCS program. Many of these constraints are documented in reviews and case studies of automated enforcement programs in the U.S.

Constitutionality

Automated enforcement programs have raised concerns about the violation of an individual's right to privacy, as inscribed in the First and Fourth Amendments of the Constitution. In CVO applications where data are collected, the desire to protect trade secrets has intensified this concern (*6*). However, no court case has yet established an individual vehicle driver's right to privacy under the First Amendment. Blackburn and Gilbert (*8*) note that the Supreme Court

protects the right to privacy under the First Amendment only in matters concerning marriage, family, and sex, and that the act of driving is not included. Legal scholars also assert that automated enforcement does not violate Fourth Amendment protections against unreasonable searches, based on several cases that find that vehicle drivers and occupants have a diminished legal expectation of privacy. In Cardwell v. Lewis (417 U.S. 583, 590, 1974), the courts noted that vehicles travel public roads and occupants are in plain view (*19*, p. D-5). The case of U.S. v. Knotts (460 U.S., 1983) took the legal expectation of privacy one step further by carving out legal space for electronic surveillance of vehicles traveling public roads (*7*). Commercial vehicle drivers have even less claim to privacy; courts have ruled that the use of public highways for commercial purposes is different than other uses, and states have greater leeway in the treatment of truck drivers than for drivers of passenger cars (*20*).

In addition to privacy concerns, automated law enforcement may raise several other constitutional issues around the right of free association (First Amendment), the right of equal protection (Fourth Amendment), right to present a defense (Sixth Amendment) and the right to due process (Tenth Amendment).

Alcee et al. (*21*) note that cases claiming the right of free association have been successful only against government regulation when targeting the actions of particular groups who gathered to exercise their First Amendment rights. Automated enforcement targets only those drivers who violate the law. Because such drivers do not constitute an organized association and their actions do not constitute acts of free speech, these cases do not apply to automated enforcement. Alcee et al. (*21*) note that photo enforcement does not interfere with freedom of intimate association, since successful claims in that realm only involve statutes that directly interfere with marital and family relations.

Alleged violators must also have the opportunity to come in and state their case before the court (*7, 8, 21, 22, 23*). Concerns related to the Sixth Amendment right to present a defense have been raised when there is a time lag between the alleged violation and the receipt of citation because defendants may forget important details needed to defend their case, especially when they are unaware that they have been caught (*7*). While it is in the interest of the issuing agency to be as fair and speedy as possible, from a public acceptance standpoint, the courts have ruled that a delay of up to one year in issuing citations does not violate due process rights as long as it is not deliberate (*7*).

Thus, while automated enforcement has withstood claims against its constitutionality, automated enforcement programs must be consistent with any existing state laws. This point is illustrated by notable cases. For example, automated enforcement programs were found to be constitutionally sound, although they violated the provisions of their enabling legislation or state law in Denver, Colorado (Denver v. Pirosko, County Court of Denver, Case No. S003143859) and San Diego, California (The People of the State of California v. John Allen, et al.; Case No. 57927SD). Both programs were reactivated after brief suspensions for program modifications.

Enabling legislation

The implementation of automated enforcement programs usually requires special amendments to state law. According to the Insurance Institute for Highway Safety (*24*), 19 states and Washington, DC currently have some form of local or statewide enabling legislation for automated enforcement. However, long-standing programs in Arizona operate without a specific statute (*25*). Such enabling legislation is typically necessary to establish a number of important legal conditions necessary for the effective operation of automated enforcement.

The California case illustrates the need for enabling legislation to implement a cost-effective automated enforcement program. Currently, California law authorizes the use of camera technology in red-light and grade-crossing violations automated enforcement programs and photo-radar for automated speeding enforcement is specifically prohibited (California Vehicle Code §§ 210, 21455.5, 21455.6, 40518-40521). As a result, there is no legal authority to issue direct citations from automated enforcement programs other than red light or grade crossing. Instead, notices of violation can be issued to the registered vehicle owners, which then can begin the process of legal service for an eventual court citation. The owner is given the option of signing and returning the notice or making an appointment to view the photograph. Until the owner signs the notice of violation, the county does not have jurisdiction over the alleged violator to issue a citation. If the alleged violator ignores the notice, staff of the implementing agency must make a positive license photo match and submit a formal request to the court to have a citation issued. Photographs that do not match the ones on file or are blurry must be thrown out. This procedure is labor intensive, costly, and reduces the number of tickets that can be issued successfully. Eight of the nine defunct automated speed enforcement programs in California noted this as a major contributing factor in their demise (*8, 26*).

The specific elements of the enabling legislation are usually determined in cooperation with the courts, enforcement agencies, state transportation department, motor vehicle departments, and any other agency whose operations may be affected by the program (*7*). According to the ITE (*7*), the basic framework is one that typically establishes: (1) liability, (2) defense procedures, (3) infraction type, (4) legal service, (5) delegates authority to a civilian contractor for some enforcement duties, (6) penalty and fine provisions, and (7) admissibility of evidence.

On the other hand, voluntary CVO electronic screening programs do not necessarily require enabling legislation because their rules and procedures are established through voluntary contracts among agencies, vendors, and the carriers (*6*). However, non-voluntary screening VCS applications may require legislation that addresses issues related to business confidentiality and trade secrets, depending on the type of data collected by the program.

PROGRAM DESIGN ELEMENTS

The literature suggests that successful automated enforcement programs have carefully calibrated decisions on these key design elements to their institutional context: (1) owner or driver liability, (2) manned or unmanned and mobile or fixed operation, (3) location selection, (4) enforcement thresholds, and (5) program management. These elements may have positive or negative effects on a program's ability to meet its objectives. The discussion in this section is largely drawn from

the automated enforcement literature and thus would apply to a VCS program with automated enforcement capabilities.

Owner or Driver Liability

The history of automated red-light and speed enforcement in the U.S. indicates that the decision to assign liability to the owner or driver of a vehicle may influence the effectiveness and public acceptance of a program. From a deterrence standpoint, registered-owner liability is preferred (*27*) because the rate of tickets issued per violation recorded is generally higher as a high quality image is not required to positively match a driver's face to their license photo. This may be especially critical in a highway environment, where vehicle speed affects the quality of a photograph (*28*). On the other hand, when identification is positively established, the violation can be treated more like a moving violation, which is a criminal infraction, allowing the program to impose stiffer penalties including demerit points and possible license suspension. Moreover, the driver liability may defuse public opposition when it is significantly based on the belief that it is unfair to hold owners responsible for actions committed by others in their vehicle. Most, but not all, automated enforcement programs assign liability to the registered owner as a civil infraction, similar to a parking ticket. Out of the 18 states, plus Washington, DC, where cities operate photo radar, fourteen have programs that assign responsibility to the owner. Registered-owner liability is the legal principle behind parking tickets, and the penalty is only a civil fine. Unlike parking tickets, however, many automated enforcement programs will dismiss a citation if the vehicle owners can provide proof that they were not driving at the time of the infraction. This provision is frequently put in place where there are questions about the fairness of registered-owner liability and require that a photograph be taken of the driver, in addition to the license plate. For example, owners who were not driving at the time of a photo-radar violation in Portland, Oregon can sign and return a "certificate of innocence," along with a photocopy of their drivers' license to have the citation dismissed (*29*).

Automated enforcement programs in Colorado, Washington State, and California assign responsibility only to the driver. In California, the issuing agency must manually establish a positive match between the driver in the automated enforcement photo and the driver's license photo on record. Only 25 percent of red-light camera violations in San Francisco result in a citation (*30*). Although an alleged violator's license cannot be suspended as a consequence of photo enforcement in California, failure to respond can result in having a hold placed on the license and registration. In San Francisco, the current fine for a red-light violation is about $361, plus demerit points.

The ability to establish owner and/or driver liability may be more complicated for CVOs compared to personal vehicle users because of industry leasing and contracting arrangements. However, VCS programs may entirely avoid the issue of liability by using information to initiate an immediate investigation of the CVO at the nearest fixed inspection facility or mobile facility, to issues warnings to CVO, and/or to launch an in-depth audit of the CVO after repeated warnings. Programs in Australia and the U.S. have experimented with these types of program designs.

Manned or Unmanned and Mobile or Fixed Operation

Another key program design issue is whether the equipment will operate with or without an officer present. Under the silent witness theory, photographs obtained when a violation is detected can stand as evidence as long as the equipment is certified to be regularly calibrated and properly maintained (*8*). Most courts, including those in California, admit photographic evidence under the silent witness theory.

In the U.S., all red-light camera programs operate unmanned at fixed locations, and most photo-radar programs are operated out of a stationary police car or a van that moves among predetermined locations. In some locations, such as Portland, Oregon, the law requires the van driver or camera attendant to be a sworn police officer (*31*). In other places, like Scottsdale, Arizona, the vendor is authorized to set up the equipment (*32*). Both Scottsdale and Washington, DC operate fixed, unmanned speed cameras, along with mobile cameras.

Mobile units appear to be more popular in the U.S. for two key reasons. First, their mobility allows cities to expand the reach of photo radar by rotating their cameras frequently among a large number of locations. For example, San Jose, California rotates its three camera vans among 170 streets. Scottsdale deploys its mobile units around its residential streets but uses its fixed cameras at the city's most crash-prone intersections. There is also a sense that mobile, manned cameras are somehow "fairer" because they require the presence of an officer or technician; state laws in Nevada and Utah allows photo-radar enforcement only if it is accompanied by an officer (*33*).

However, fixed cameras that are in force 24 hours a day appear to be more effective than mobile cameras that are operated for shorter time periods (*34*). A study conducted for the U.K. Department for Transport found that "on average, killed and serious casualties fell by 65 percent at fixed and 28 percent at mobile sites" (*35*). However, mobile cameras still yield significant results in terms of crash and speed reduction (*34, 35, 36*). In addition, because of their smaller footprint, fixed cameras can be used in locations where a van may not. Fixed cameras are also less expensive to operate because they require less equipment and personnel time. Scottsdale pays a monthly fee of $2,672.80 for each of its nine cameras and $6,682 a month for each of its four speed vans (*32*).

Current VCS programs in North America, as noted previously, avoid the issue of admissibility of photographic evidence because they provide the image of an alleged violator to an enforcement official who can then bring in the vehicle to a fixed inspection station or a certified mobile inspection unit to verify the violation.

Location Selection Criteria

In the case of automated red-light and speed enforcement, location selection criteria are typically based on the program goals. The San Jose program focuses on reducing speeding on residential streets, and photo-radar locations go through a multi-step process that requires extensive resident input and feedback. First, a resident must nominate the location. Then, police verify that the location meets their criteria for speeding, and a petition is circulated among residents whose

homes face the affected street. If 51 percent of the residents agree, the location is included in the list of streets on which the cameras are authorized for use (*37*). Scottsdale, which aims to reduce crashes overall, places their cameras at locations that have a large, but unspecified, number of crashes. Residents may request mobile enforcement vans on residential streets, but those locations also must meet speed and crash criteria (*32*). The ITE cautions agencies to clearly define and follow the criteria by which locations are selected to avoid charges that the programs are being operated unfairly (*7*).

In the context of CVOs, automated enforcement technology can be most effectively applied in locations with a significant violation problem and limited routes that can be used to avoid the VCS (e.g., outside of ports).

Enforcement Thresholds

Some have suggested that one of the reasons automatic enforcement of CVOs has been so controversial is that people have a sense that the technology may not accurately measure the violation. Studies of automated CVO weight screening and enforcement programs in France, however, found that the technology was reasonably accurate and increased citation rates as compared to before program implementation**:** "93 percent of the pre-selected and statistically weighed vehicles were really overloaded and that 70 percent of the stopped vehicles were charged" (*38*, p. 257). Similar findings were obtained for programs in China and Korea (*38*). To avoid this charge, programs can establish a threshold below which they do not issue tickets.

Program management

Most automated red-light and speed enforcement agencies in the U.S. choose not only to rent the photo enforcement equipment from a vendor but also to contract a bundle of system equipment and services necessary to operate the program. It is far less common for cities to own their own equipment and operate it fully themselves, although Campbell, California did just that when its vendor went out of business (39). Larger cities, such as New York, have assigned a full-time manager to over see operations, manage the vendor contract, and respond to public concerns. However, in a number of cities, the programs are just one of many responsibilities of a commanding officer. Automated CVO enforcement programs have and would also likely require vendor equipment and services to operate their programs.

Lack of vendor oversight has and can result in significant legal challenges to an automated enforcement programs. For example, in 2001, a State Superior Court judge found that evidence from San Diego's red-light enforcement program was inadmissible because the city had given the vendor too much control over the program (Case No. 57927SD). The judge was alarmed that the contractor was able to move the system's roadway loop detectors without the city's knowledge. Further, the ruling found that the payment terms, in which the vendor received a portion of each successful ticket, constituted an illegal contingency payment that voided the contract. This case prompted the California legislature to pass legislation in 2003 (California Assembly Bill 1022) specifically prohibiting contractors from being paid by the ticket, selecting the locations, changing the signal timing, or reviewing or approving tickets. Until this rule, it was customary for automated enforcement contracts in California to be structured so that the vendor

received a payment for each successful ticket, and those contracts remain valid until their expiration date. Many automated enforcement programs outside of California still compensate their contractors this way. Charlotte, North Carolina expressed a preference for this system because it creates a greater incentive for vendors to maintain and improve their system (*40*).

In 2002, the California State Auditor released a comprehensive audit of the implementation procedures and effectiveness of red-light camera programs in seven California jurisdictions (*41*). The report found that all had weaknesses that made them vulnerable to legal challenges similar to those faced by San Diego. It also recommended more rigorous supervision of vendors including the establishment and enforcement of basic "business rules," such as rules for screening violations, how long records will be kept, and how often maintenance will be performed. In addition, the report recommends periodic site visits to the vendor's operations to ensure that the vendor's procedures comply with state law and the contract terms.

CONCLUSIONS

This review of institutional barriers included an analysis of the relatively extensive body of literature on the CVO electronic pre-screening programs and red-light and speed automated enforcement programs, including: national and international reviews, case studies, reports, and news articles. Additional insights into barriers to VCS implementation were obtained from expert interviews with key officials in the early deployment stages of VCS programs in Kentucky, Indiana, Florida, and Saskatchewan. In sum, this research suggests the following key steps to address stakeholder barriers to implementation for screening enforcement and automated enforcement VCS:

1. Start with smaller, less costly, and less controversial programs;
2. Establish multi-agency working groups early on in the process, which should include all CVO related agencies;
3. Include the judiciary in working groups, if automated enforcement is being considered;
4. Involve the CVO industry early on in the planning and implementation process through advisory groups;
5. Conduct targeted educational outreach efforts for agencies and the CVO industry; and
6. Document and communicate the costs and benefits of the program.

In general, the research suggests that automated enforcement VCS programs would be constitutional. However, cost-effective implementation may require enabling legislation that specifies liability, defense procedures, infraction type, legal service, delegate authority to civilian contractor for some enforcement duties, penalty and fine provisions, admissibility of evidence (*7*), and confidentiality. In addition, program design and implementation must take care to ensure that they do not violate any provisions of their enabling legislation or state law.

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