Title

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A Review of Legal and Institutional Issues

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In the past 5 years, commercial vehicle travel has increased 60% 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 costs on the public (e.g., costs due to pavement and structural 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 improve enforcement of commercial vehicle regulations cost-effectively. This study begins with a description of the fledgling VCS research programs in North America as well more advanced international programs. Next, the results of expert interviews with key officials involved in the North American VCS programs in Kentucky, Florida, and Indiana in the United States and in Saskatchewan, Canada, are reported. This is followed by an analysis of institutional barriers to VCS implementation based on the evaluation literature on commercial vehicle electronic prescreening 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 United States.

In the past 5 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, queues form; these waste time and fuel, worsen air pollution, and create roadway safety hazards. As a result, compliance inspection station operators must routinely allow trucks to bypass overcrowded stations, and noncompliant 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 10% by which a truck exceeds its weight limit, there is approximately a 40% 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 noncompliance.

In response to these problems, the California Department of Transportation (Caltrans) is investigating the potential application of detection and communication technology in virtual compliance stations (VCSs) to improve enforcement with CVO regulations cost effectively. Successful implementation of any technology, however, depends not only on its merits but also on a favorable institutional environment (*3, 4*). Case studies of CVO prescreening programs document histories of delay and compromises due to institutional barriers (*5*). Similarly, a long list of automated enforcement programs have been discontinued for nontechnical 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, fledgling VCS programs in North America, and more advanced international VCS programs. Next, the results of expert interviews with key officials involved in the early deployment stages of VCS programs in Kentucky, Florida, and Indiana, as well as Saskatchewan, Canada, are reported. This is followed by an analysis of institutional barriers to VCS based on the evaluation literature on CVO electronic prescreening and red-light and speeding automated enforcement programs. The paper concludes with a discussion of major findings.

BACKGROUND

In the United States, there are currently two major national CVO electronic screening programs in operation—the North American Preclearance and Safety System (NORPASS) and the PrePass program—as well as one statewide program in Oregon—Operation Green Light. PrePass is the largest of these programs, operating in 25 states across the country from California to Virginia. Carriers that participate in PrePass are precertified; 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 prescreening 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, which is the signal for truckers to enter static weigh stations for inspection. The criteria for station bypass are established individually by each state. Oregon initiated Operation Green Light in 1995 as an enhanced electronic preclearance program. Operating its own program, rather than using the regional electronic preclearance programs, allows Oregon more extensive use of data collected by the program. In particular, Oregon's preclearance system facilitates their unique weight-mile tax program. The program now has 21 mainline systems, featuring WIM and DSRC

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automatic vehicle identification, at ports-of-entry and major weigh stations (*9*).

While the preclearance programs are 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 weigh and inspection stations, saving them time, money, and fuel and free enforcement agents to focus on those most likely to be noncompliant. The 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 preclearance 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 offenses as part of the TruckScan program. WIM detectors are installed at weight inspection locations on the mainline. If an offense is detected, a citation is issued and the offense is recorded against the driver's license and the vehicle's registration. If four offenses are issued within a 3-year period, a driver's license can be suspended.

North American programs in Kentucky, Indiana, Florida, (United States) and Saskatchewan 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; thus for this study interviews were conducted with officials to better understand program objectives, successes, and challenges.

EXPERT INTERVIEWS

Researchers conducted telephone interviews with experts involved in virtual compliance station research programs in Kentucky, Florida, Indiana, and Saskatchewan during February and March 2005 (*11*). The key findings from these interviews are given in the next sections.

Kentucky's Remote Monitoring and Virtual Weigh Stations

The Kentucky program was designed to address inadequate enforcement of weight restrictions on secondary roads. CVOs use these roads to bypass nearby fixed inspection stations by strategically entering and exiting the freeways. Traditional roving patrols cannot effectively address this problem because they are too visible; truckers know within 5 min 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 they could be viewed by an operator who could manually locate the 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, an officer was dispatched to bring the truck in for inspection at a static station.

Two key challenges were reported: (*a*) insufficient staff to check the monitor and manually find the DOT number information and (*b*) difficulty obtaining a readable image of the DOT number because of nonstandard DOT numbers (i.e., placement and size) and limited camera shutter speed to capture clear images at highway speeds. License plate numbers are easier to read with available technology, but that these numbers are not standard across states, linked to needed information, and even if linked, the information can be time-consuming to locate.

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 where 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 3½ years. It is designed to catch noncompliant trucks that bypass static inspection stations and is focused on technology testing, especially in delivering power supply to remote areas and transmitting information from video to the enforcement team. There are two sites, both rural and 2 hours outside of the city of Orlando, that are currently able to detect speed and height; 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 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 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 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.

Indiana's Virtual Weigh Stations

The program in Indiana was designed to catch overweight trucks that bypass eight static weigh stations and impose significant damage on and repair costs to the state's roadways. Studies were cited that documented frequent, undetected weight violation and significant roadway pavement damage in the state. Improved truck technology has made it more difficult for officers to eyeball overweight trucks with acceptable accuracy.

The first field test was on 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 several 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 station. The use of cameras in the field tests helped to remove 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 was designed to modernize while saving money. The weigh scales at existing inspection stations were in good condition, but the facilities themselves did not meet current building codes. An unmanned system could save funds not only on labor but also on facility upgrades. Also, the problem with overweight trucks in the northern portion of the province is seasonal, and it would be inefficient to build new, traditional stations that operate 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 semiautomated 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 programs 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 evaluation literature, the CVO electronic prescreening programs as well as red light and speeding automated enforcement programs. Two major categories of institutional barriers 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 from the CVOs subject to VCS programs and by administrative agencies charged with implementing them has been identified as a key barrier to implementation in the evaluation of CVO prescreening programs. Research suggests that understanding and addressing stakeholder 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 or government intrusion. This section discusses each concern and then outlines several 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 information that is collected about them by preclearance, 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 literature on electronic prescreening programs commonly documents CVO concern that information collected through prescreening not be disclosed to competitors (*9, 12–14*). Voluntary electronic screening programs in the U.S. address this concern through third-party data management contracts. A nonvoluntary 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 prescreening programs in the U.S. indicates significant sensitivity among CVOs to increased 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 (*12*). Not surprisingly, a U.S. DOT survey indicates that CVOs are more likely to accept technology applications that improve their bottom line than those that increase regulation enforcement (*15*).

Steps to Address CVO Concerns In general, the literature on CVO electronic prescreening programs largely recommends involving CVOs early 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, 12, 14, 15*). This recommendation is complicated, however, by the fact that the industry is far from monolithic (*15*). For example, an analysis of one survey of truck drivers finds significant differences in acceptance of electronic screening along these lines: union versus nonunion, company drivers versus independent owner–operators, younger versus older drivers, and inexperienced versus experienced drivers (*15*). 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 savings (*5, 9, 12, 14, 15*). Evaluations of U.S. voluntary electronic screening programs document average time savings per weigh station bypass from 1.17 to 4.86 min and average fuel savings from 0.06 to 0.18 gal. (*13*). 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, 12, 14, 15*).

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 cur-

rent personnel" to be significant barriers to implementation among administrative officials (*12*).

Concerns of Law Enforcement Personnel An evaluation of the PrePass 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" (*12*). In the context of automated enforcement, Blackburn and Gilbert (*8*) cite a study conducted in 1984 for 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, ITE (*7*) notes that other studies document several 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*).

Interoperability Interoperability refers to differences in business models and data sharing agreements that exist between one preclearance program and another. This has emerged as a critical issue in some prescreening programs (*9*). The Oregon Green Light program encountered significant interoperability problems with the existing regional prescreening 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 prescreening programs.

Steps to Address Administrative Agency Concerns The CVO electronic prescreening 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 with involvement of top leadership in the programs in outreach efforts and with documentation of early program benefits (*5*). Agency coordination for the program may be facilitated by creation of an interagency working group, clear delineation of agency roles, and identification of a lead agency (*5*). More specific concerns of law enforcement personnel may be addressed by solicitation of their involvement early in the process and by outreach campaigns to inform personnel about the program, effects, and benefits (*7*). 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*).

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 United States.

Constitutionality

Automated enforcement programs in the United States have the potential to be challenged on grounds that they may violate important constitutional rights and protections, including the First Amendment rights to privacy and association, the Fourth Amendment protection against illegal search and seizure, and the Fifth and Fourteenth Amendments' right to due process. Legal scholars, however, agree that the wider body of established case law, not specific to automated enforcement, provides ample precedents for the use of these systems (*16–19*).

Many legal scholars assert that claims against automated enforcement based on an individual's right to privacy are without legal merit (*8, 16–19*). The Supreme Court has ruled that the First Amendment protects an individual's right to privacy only in matters concerning fundamental rights, such as those "relating to marriage, procreation, contraception, family relationships, child rearing and education" (*18*). Because the zone of privacy under constitutional protection is narrow, no court case has yet established an individual vehicle driver's right to privacy under the First Amendment (*8, 18*). In fact, because driving is an activity that is rightly subject to a great deal of state regulation, a driver's expectation of privacy is quite limited. The decision in Cardwell versus Lewis (417 U.S. 583, 590, 1974) held that vehicles travel public roads and occupants are in plain view and have no reasonable expectation of privacy (*16*). The decision in Griswold versus Connecticut held that marriage fell under a distinct sanctity of privacy; however, driving in plain view on public highways does not provide such protection (*8*). 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 that states have greater leeway in the treatment of truck drivers than for drivers of passenger cars (*20*).

Another claim based on provisions of the First Amendment is that automated enforcement restricts freedom of association; however, legal scholars argue that such a claim "misconstrues the scope of associational rights" (*18*). Cases claiming freedom of association have been successful only against government regulations targeting the actions of particular groups who were gathered to exercise their first amendment right of free speech (*18*). Laird versus Tatum specified that there would be no freedom of association claim where the First Amendment right to free speech was not affected (*16*).

Claims against automated enforcement based on fourth amendment protections against illegal search and seizure are also not considered valid by legal scholars. A warrant with probable cause is only required where a person exhibits a reasonable expectation of privacy (*8*). In U.S. versus Knotts (460 U.S., 1983) the placement of an electronic tracking device by police on a suspect's car without a warrant was upheld (*16*). In Kratz versus U.S. a defendant who had been apprehended in a telephone booth claimed his fourth amendment protection from "search and seizure" was violated because of his expectation of privacy. However, the Supreme Court held that the fourth amendment protects individuals, not places, and what a person knowingly exposes in public, even in his own home or office, is not subject to protection (*8*).

Other claims based on the Fifth and Fourteenth Amendments' protection of the right to due process have also been made against automatic speed enforcement programs. The differences between officer-issued citations and mailed automated speed enforcement citations (level of notification, officer discretion, establishment of jurisdiction, and notification lag) are not by themselves violations of due process (*8, 16–19*). However, care must be taken in establishing automated speed enforcement ticketing procedures, as in any enforcement process, to provide for reasonable notice, declaration of innocence, and review of evidence (*8*).

Enabling Legislation

The implementation of automated enforcement programs usually requires special amendments to state law. According to the Insurance Institute for Highway Safety (*21*), 19 states and Washington, D.C.,

currently have some form of local or statewide enabling legislation for automated enforcement. However, long-standing programs in Arizona operate without a specific statute (*22*). Such enabling legislation is typically necessary to establish 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 rail-crossing violations automated enforcement programs. Photo-radar for automated speeding enforcement lacks specific enabling legislation (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 rail 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 and identify the driver. 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 photograph 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. In eight of the nine defunct automated speed enforcement programs in California this was noted as a major contributing factor in their demise (*8, 23*).

Specific elements of the enabling legislation are usually determined in cooperation with the courts, enforcement agencies, state transportation department, motor vehicle department, and any other agency whose operations may be affected by the program (*7*). According to ITE (*7*), the basic framework is one that typically establishes (*a*) liability, (*b*) defense procedures, (*c*) infraction type, (*d*) legal service, (*e*) delegation of some enforcement authority to a civilian contractor, (*f*) penalty and fine provisions, and (*g*) admissibility of evidence.

In contrast, 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, nonvoluntary 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: owner or driver liability, manned or unmanned and mobile or fixed operation, location selection, enforcement thresholds, and 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 may be preferred (*24*): the rate of tickets issued per violation recorded is generally higher because a high quality image is not required to match a driver's face positively to their license photograph. This may be especially critical in a highway environment, where vehicle speed affects the quality of a photograph (*18*). In contrast, when driver liability is positively established, the violation can be treated as a moving violation, which is a criminal infraction, and allow the program to impose stiffer penalties including demerits and possible license suspension. Driver liability may also defuse public concern about the fairness of holding 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. Of the 18 states, plus Washington, D.C., where cities operate photo-radar, 14 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 requires that a photograph be taken of the driver, in addition to the license plate. For example, an owner who was 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 driver's license to have the citation dismissed (*25*).

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 photograph and the driver's license photograph on record. Only 25 percent of red light camera violations in San Francisco result in a citation (*26*). Although an alleged violator's license cannot be suspended as a consequence of photographic enforcement in California, failure to respond can result in a hold placed on the license and registration. In San Francisco, the current fine for a red light violation is approximately $361, plus demerit points.

The ability to establish owner or driver liability may be more complicated for CVOs than for 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 CVOs, and to launch an in-depth audit of the CVO after repeated warnings. Programs in Australia and the United States have experimented with these types of program designs.

Manned or Unmanned and Mobile or Fixed Operation

Another key program design issue is whether automated enforcement 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 at fixed and unmanned locations, and most photo-radar programs operate out of a stationary police car or a van that moves among predetermined locations. However, both Scottsdale, Arizona, and Washington, D.C., operate fixed and unmanned as well as mobile and manned speed cameras.

An important advantage of mobile units is that their range is relatively high because they can be rotated among many locations. For example, San Jose, California, rotates its three camera vans on 170 streets; Scottsdale deploys its mobile units around its residential streets but uses its fixed cameras at the city's most crash-prone intersections. In addition, there is also a sense that mobile, manned cameras are somehow fair because they require the presence of an officer or technician (*27*).

In contrast, mobile cameras, because they must be manned, are operated less than the 24 hours per day. Fixed cameras, which can operate 24 hours per say, may be more effective than mobile cameras (*28*). A study conducted for the UK Department for Transport found that "on average, killed and serious casualties fell by 65 percent at fixed and 28 percent at mobile sites" (*29*). However, mobile cameras still yield significant results in terms of crash and speed reduction (*28–30*). 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 (*23*).

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 speed enforcement program focuses on reducing speeding on residential streets, and photo-radar locations go through a multistep 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% of the residents agree, the location is included in the list of streets on which the cameras are authorized for use (*23*). Scottsdale, which aims to reduce crashes overall, places 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 (*23*). ITE cautions agencies to define clearly 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.

Enforcement Thresholds

Some have suggested that one of the reasons automated enforcement of CVOs has been so controversial is that people believe 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 over those 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" (*31*). Similar findings were obtained for programs in China and Korea (*31*). 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 United States choose to lease not only the photographic enforcement equipment from a vendor but also 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, although Campbell, California, did just that when its vendor went out of business (*23*). Larger cities, such as New York, have assigned a full-time manager to oversee operations, manage the vendor contract, and respond to public concerns. However, in several 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 program. 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 (*23*).

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 (*32*). 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 literature on the CVO electronic prescreening 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 multiagency working groups early 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 in the planning and implementation process through advisory groups.
5. Conduct targeted educational outreach efforts for agencies and the CVO industry.
6. Document and communicate the costs and benefits of the program.

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

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