Investigation of Automated Photo Enforcement for Red Light Running

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Executive Summary

Deliberate running of red lights at intersections is a significant factor contributing to nearly one million motor vehicle crashes at traffic signals each year.¹ In Florida alone, red light running caused more than 11,600 crashes, 121 deaths and 16,000 injuries in 1996.² Employing traditional engineering and enforcement methods such as ensuring proper signal timing, removing unwarranted signals and police enforcement can reduce red light running. However, financial constraints and logistical problems make it difficult and dangerous to enforce the law at the hundreds of intersections in urban areas.

Automated photo enforcement, using red light cameras, provides an innovative approach for compliance with traffic control devices. Red light cameras connected to the traffic signal system and the loop detectors buried in the pavement continuously monitor the intersection and produce photographic evidence of vehicles whose drivers run red lights. Red light cameras generally take two pictures of each violation, one just as the vehicle enters the intersection and the second when the vehicle is in the middle of the intersection.

Across the U.S., and in Florida, new state laws and subsequent amendments to local ordinances are required to implement automated photo enforcement projects. These legal issues are complex and need to address liability aspects, citation fines, and equitable distribution of revenues to various agencies involved. People may also have concerns over a loss in privacy, especially if frontal photography is needed.

Significant investments are necessary to implement this technology. They include acquiring cameras, installation of new loops, and public awareness campaigns. A well planned and focussed public awareness and information campaign is essential for the success of photo enforcement projects. Involvement of various community, traffic safety, and automobile agencies such as Community Traffic Safety Teams, Senior Citizen Groups, and AAA would help in convincing the community. Additionally, these projects can be cost neutral as the fines can pay for the program.

Interest on red light camera systems is growing rapidly among state agencies and local governments. A number of automated photo enforcement projects are being implemented in various states/cities including Arizona, Virginia, Maryland, North Carolina, New York, Los Angeles, and San Francisco. The results from various evaluation studies are promising, indicating significant reductions in red light violation rates as well as considerably improved awareness of the problem, after the implementation of photo enforcement programs.

¹ Richard Retting et al., Evaluation of red light camera enforcement in Oxnard, California, Insurance Institute for Highway Safety.
² Tallahassee Democrat, 01/07/98.
Investigation of Automated Photo Enforcement for Red Light Running

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May 1998
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1.0 Introduction

Running red lights is one of the leading causes of accidents in urban areas. Nationwide, 22 percent of all collisions in 1996 were due to the driver's disregard for the traffic control devices. In Florida alone, red light running caused more than 11,600 accidents, 121 deaths, and 16,000 injuries in 1996. This problem goes largely unchecked due to the inability of law enforcement to adequately patrol hundreds or even thousands of intersections in an urban area. A new method, the use of red light photo enforcement cameras, is being implemented to enforce traffic laws by automatically photographing vehicles whose drivers run red lights.

The objective of this study is to examine various issues concerning the usage of red light photo enforcement cameras and their use in several cities in the U.S. and to examine their potential use in Florida. This study explores various legislative issues concerned with automated photo enforcement; technical details of red light cameras; advantages; disadvantages, and issues of the use of this technology; and different application methods.

1.1 Red Light Running and its Impact

Throughout the U.S., red light running has been increasingly recognized as a serious safety concern. The Insurance Institute for Highway Safety reports that running traffic control devices like red lights is one of the most frequent causes of crashes in urban areas. Generally, red light offense occurs when a motorist illegally enters an intersection after the light has turned red (there are exceptions, such as turning right, see Section 1.3). However, motorists inadvertently caught in the intersection when waiting to turn are not red light runners. It is the responsibility of motorists to adjust their driving behavior to suit the weather and road conditions. As stated earlier, 121 fatalities in Florida resulted from drivers running red lights in 1996, and drivers running red lights in Tallahassee caused two deaths and 246 injuries in 1997. It was estimated

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3 Gerald Ensley, Tallahassee Democrat, 1/7/98; and Personal communication with George Ferris, Former Chief-Polk County Community Traffic Safety Team.
4 Gerald Ensley, Tallahassee Democrat, 1/7/98.
that the annual number of red light violations on the streets of San Francisco was approximately 3.5 million.\textsuperscript{6} A study conducted at a busy intersection in Arlington County, Virginia, found that a motorist ran a red light every 12 minutes.\textsuperscript{7} The situation was found to be even worse during peak commuting hours. It has been estimated that the accidents due to red light running cost about $7 billion a year in the U.S.\textsuperscript{8}

1.2 Counter Measures for Reducing Red Light Running

Various countermeasures are available to solve the red light running problem. Some can be categorized as engineering measures that provide operational solutions, such as ensuring proper signal timing or removing an unwarranted signal, and as enforcement techniques that are aimed at changing the behavior of the drivers such as traditional police enforcement. This section describes some of the countermeasures that could be used to curb red light running.

1.2.1 Adjusting the Signal Timing

Substantial portions of motor vehicle crashes in the U.S. occur at intersections controlled by traffic signals. This phenomenon has been found to be more prevalent in urban areas, as the National Highway Traffic Safety Administration showed that 39 percent of fatal crashes at urban intersections occurred at traffic signals in 1991.\textsuperscript{9} The length of the change interval or clearance interval at the intersections has been found to be one of the factors influencing red light violations.

The change interval consists of a steady yellow signal indicating an imminent change in the signal, and this may be followed by an all-red phase during which the traffic approaching the intersection in all directions is required to stop. Past research has found that indecision of the drivers in predicting the phasing of the yellow interval and their inability to come to full stop

\textsuperscript{6} Bond M. Yee and Jack L. Fleck, San Francisco Red Light Camera Enforcement Program.
\textsuperscript{7} Insurance Institute for Highway Safety.
\textsuperscript{8} The Orlando Sentinel, 12/28/97.
when the signal changes to red, results in crashes. Generally, the type and duration of change intervals is selected by following standards specified by The Manual on Uniform Control Devices (MUTCD), which indicates that a yellow interval in the range of 3 to 6 seconds is sufficient for normal speeds. In a study conducted by the Insurance Institute for Highway Safety, researchers concluded that increasing yellow signal length may decrease late exits and reduce potential vehicle conflicts and, hence, might reduce motor vehicle crash rates.

1.2.2 Removal of Unwarranted Traffic Signals

The researchers at the Insurance Institute for Highway Safety found that red light running and intersection crashes might occur due to the traffic signals maintained at intersections with very low volumes. A study done on low volume intersections by Kay et al. in 1980 reports reductions in crashes and injuries after conversion from signal controls to stop sign control. Another crash analysis (Persaud et al.) done in 1996 reported an overall crash reduction of 24 percent at low volume intersections after the removal of signals.

1.2.3 Traditional Enforcement

Enforcing various traffic laws, such as signal violation, in accordance with the respective laws can also reduce red light violations. Traditional enforcement requires a law enforcement officer to observe a red light violation and then chase, stop, and cite the violator. This process can be very difficult, because the police officer must see the same signal phase that the violator sees in order to cite the violator. It can also endanger motorists, pedestrians, and officers, because the officers would also have to run the red light to catch the violators. Apart from safety issues, the financial and manpower resources required to enforce traffic laws at multiple intersections by traditional methods are enormous.

Safety consequences and the large volume of signalized intersection red light violations mean police may not be able to enforce the law; therefore, the automation of this enforcement activity may prove particularly attractive to many cities. Red light camera enforcement is being used in several sites in the United States, and it can change driver behavior towards red light running if
conducted in conjunction with a widespread public awareness campaign, as reported in several studies.\textsuperscript{10}

1.3 Legal Issues Associated with Red Light Running and Red Light Cameras

Running red lights is against the law and can be extremely dangerous. In Florida, this offense is treated as a moving violation, and offenders are issued traffic citations accordingly. Florida Statutes 316.075(3) and 316.076(1), and the Florida Driver’s Handbook specifically outline the requirements of drivers as they encounter a red light situation. Some of the enabling state legislation aspects will be discussed in the later part of this section. However, special laws are necessary to allow the use of cameras to catch red light runners. Several states have amended their laws accordingly, and, as of today, Florida does not allow the use of cameras.

1.3.1 Florida Statutes 316.075 (3)

This statute stipulates the required obedience by vehicular traffic whenever a steady red light is used in a traffic sign or signal

\textit{Steady red indication}

(a) Vehicular traffic facing a steady red signal shall stop before entering the crosswalk on the near side of the intersection or, if none, then before entering the intersection and shall remain standing until a green indication is shown; however:

1. The driver of a vehicle which is stopped at a clearly marked stop line, but if none, before entering the crosswalk on the near side of the intersection, or, if none then at the point nearest the intersecting roadway where the driver has a view of approaching traffic on the intersecting roadway before entering the intersection in obedience to a steady red signal may make a right turn, but shall yield the right-of-way to pedestrians and other traffic proceeding as directed by the signal at the intersection, except that municipal and county authorities may prohibit any such right turn against a steady red signal at any

\textsuperscript{10} Retting et al., "Evaluation of Red Light Camera Enforcement in Oxnard, California" and "Follow-up Surveys done on Tempe & Mesa residents", Summit Group.
intersection, which prohibition shall be effective when a sign giving notice thereof is erected in a location visible to traffic approaching the intersection.

2. The driver of a vehicle on a one-way street that intersects another one-way street on which traffic moves to the left shall stop in obedience to a steady red signal, but may then make a left turn into the one-way street, but shall yield the right-of-way to pedestrians and other traffic proceeding as directed by the signal at the intersection, except that municipal and county authorities may prohibit any such left turn as described, which prohibition shall be effective when a sign giving notice thereof is attached to the traffic control signal device at the intersection.

(b) Unless otherwise directed by a pedestrian control signal as provided in s. 316.0755, pedestrians facing a steady red signal shall not enter the roadway.

1.3.2 Florida Statutes 316.076 (1)

This statute stipulates the required obedience by vehicular traffic whenever an illuminated flashing red or yellow light is used in a traffic sign or signal

FLASHING RED (STOP SIGNAL). --When a red lens is illuminated with rapid intermittent flashes, drivers of vehicles shall stop at a clearly marked stop line, but if none, before entering the crosswalk on the near side of the intersection, or if none, then at the point nearest the intersecting roadway where the driver has a view of approaching traffic on the intersecting roadway before entering the intersection, and the right to proceed shall be subject to the rules applicable after making a stop at a stop sign.

Chapter 4 (Signals, Signs, and Pavement Markings) in Florida Driver's Handbook says drivers must

Come to a complete stop at the marked stop line or before moving into the crosswalk or intersection. After stopping, you may turn right on red at most intersections if the way is clear. Some intersections display a NO TURN ON RED sign, which you must obey. Left turns on red from a one-way street into a one-way street are also allowed.
Currently, drivers committing red light violations are issued citations for the offense of Florida statute 316.074(1). This offense is treated as a moving violation, and the State has assessed a fine of $60 for each of these moving violations. Furthermore, counties may also include some administrative fees. For example, Hillsborough County imposes an administrative fine of $30, bringing the total fine to $90. Additionally, the State assesses three points to the license status of every driver convicted of a moving violation.

The traditional method of police enforcement of traffic laws in urban areas has not been entirely effective, as evidenced by the increasing magnitude of problem. Large amounts of resources are necessary to deploy patrolling officers at all the intersections. Apart from funding problems, enforcement of red light running may also create some safety problems. These violations may also require chasing a red light runner through a red light, thereby endangering the lives of officers, motorists, and the pedestrians.

Technology now exists to automatically identify red light runners. Special high speed and high-resolution cameras receive vehicle location information from loops embedded in the pavement and the signal timing box. When a vehicle passes over the loops and into the intersection after the light has turned red, pictures (usually two) are taken of the vehicle and its license plate. The time of day, length of the time after the light has turned red, and the vehicle speed are all imprinted on the photographs. Based on these photographs, citations can be mailed to the motorists.

Several cities and states in U.S. have been involved in implementation of red light camera programs. New York and Los Angeles were the first two cities to implement red light programs. As the knowledge and awareness on the technology grow, several states such as California, Virginia, Maryland, Arizona, and North Carolina, are in the process of implementing such

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11 Florida Statute 316.074 (1) Obedience to and required traffic control devices: The driver of any vehicle shall obey the instructions of any official traffic control device applicable thereto, placed in accordance with the provisions of this chapter, unless otherwise directed by a police officer, subject to the exceptions granted the driver of an authorized emergency vehicle in this chapter.

12 Conversations with Hillsborough County Sheriff's Office and the University of South Florida Police.
programs. A few other places like Ft. Meade in Florida and Arlington in Virginia carried out experiments with the concept by issuing warning letters to violators.

Existing Florida laws\textsuperscript{13} do not permit the use of red light enforcement cameras, and new laws would be required to allow the local authorities to use red light cameras for law enforcement purposes. The laws are necessary to cite the red light runners by mail and to issue a ticket without a law enforcement officer witnessing the infraction. The legislation would make the registered owner/operator of the vehicle responsible for the violation, establishing a presumption that the owner is the vehicle driver at the time of offense. The legislation should also provide a procedure under which the registered owner/operator of a vehicle may establish that the vehicle was under the control of another person at the time of offense, and this other person would be fined.

In this direction, Florida Legislature will be discussing a bill (hb1479 c1) introduced in March 1997 by State Rep. John Cosgrove, during the 1998 legislative session. This bill, if passed, would allow police officers to ticket red light runners through the mail based on the evidence produced by automated enforcement. It also authorizes county or municipality to enact an ordinance that provides for use of detector to enforce steady red light traffic signal and requires public notice prior to use of said detector.

Depending upon the respective state laws, red light running violations photographed by cameras can be handled in one of the three ways described below:

1. The registered owner is charged with a traffic violation, but he/she can contest the citation by filing an affidavit swearing that he/she was not driving at the time of violation.

2. The registered owner is issued a parking citation and is responsible for the violation without regard to who is driving at the time offense.

3. The \textit{driver} is charged with a moving violation, if sufficiently identified. Drivers are identified by obtaining clear photographs of both the driver and license plate. If the vehicle's driver cannot be identified, then the registered owner is charged, and his/her

\textsuperscript{13} Some states amended their old laws in order to permit the use of red light cameras.
failure to pay the fine or identify the driver (if the registered owner was not the
driving the vehicle at the time of violation) will hold up registration of the vehicle.
(This method is used in California and Arizona).

In the first and second cases, the need for frontal photography (to identify the drivers) would not
be necessary, removing the potential concern over driver’s right to privacy. Virginia, Maryland,
and North Carolina do not require frontal photography as the citations are issued to the registered
owners and the owners have the right to challenge citations. In New York City, red light
violations are treated like parking violations in which the registered owner is responsible for the
violation without any regard to who is driving the vehicle at the time of violation, and, hence,
frontal photography is not needed.

California and Arizona passed legislation requiring that photo enforcement of red light violations
fully identify the driver of the car. These laws mandated that the automated photo enforcement
system must obtain clear photograph of the vehicle’s license plate as well as the driver. In such a
case, frontal photography becomes essential, making automated photo enforcement more
complex.

1.4 North Carolina’s State Law on Red Light Cameras

The General Assembly of North Carolina passed an act (S.L.1997-216 and Senate Bill 741) in its
1997 session to authorize local governments to use photographic evidence images as prima facie
evidence of a traffic violation. It defined a traffic control photographic system as an electronic
system consisting of a photographic, video, or electronic camera and a vehicle sensor installed to
work in conjunction with an official traffic control device to automatically produce photographs,
video, or digital images of each vehicle violating a standard traffic control statute or ordinance.

This act also made the owner of the vehicle responsible for a violation unless the owner can
furnish evidence the vehicle was, at the time of the violation, in the care, custody, or control of
another person. This statute states that a violation detected by a traffic control photographic
system shall be deemed as a non-criminal violation for which a civil penalty of $50 shall be
assessed. Subsequently, an ordinance has been made amending the Charlotte City Code allowing the use of cameras at the intersections to catch red light runners. (See Appendix B for a complete text of the legislation.)

1.5 California’s State Law on Red Light Cameras

Following the success of photo enforcement at railroad crossings in Los Angeles County, California enacted a law in 1996 authorizing red light photo enforcement. This law stipulated that a clear photograph of the driver and license plate are needed to issue a violation. Once the camera captures the driver’s image, and if the driver of the vehicle is sufficiently identified, drivers are charged with the violation. Otherwise, a citation is sent to the registered vehicle owner under the presumption that the driver is generally the owner. Failure to pay the fine or identify the driver (if the registered owner was not the driving the vehicle at the time of violation) will hold up registration of the vehicle. During the initial study period, the violators were penalized with a standard fine of $104 and, subsequently, the state assembly increased the fine for motorists who run red lights to $270 and allocated half of the increase to city or county where the violation occurs. (See Appendix B for a complete text of the legislation.)

2.0 Red Light Camera Technology

This section describes red light camera technology, including its components, functionality, outputs, manufacturers, installation and maintenance issues; reliability and accuracy aspects, and costs associated with the cameras. Red light cameras (see Figures 1 & 2) generally take two pictures of each violation, one just as the vehicle enters the intersection and another when the vehicle is in the middle of the intersection. On both photographs, violation data such as date, time, seconds into the red phase, lane number, and the location of the violation are imprinted. These cameras are capable of operating on a 24-hour basis and under adverse weather conditions without any interruption. A light flash (of about 150-200W) allows the cameras to operate at night without blinding drivers with a flash.
Figure 1. Red Light Camera (Picture 1).

Figure 2. Red Light Camera (Picture 2)

Figure 2 shows the red light camera at two different positions on the supporting pole or bar. These systems are equipped with mechanical gears or bearings so the cameras can be lowered or raised to different locations on the bar. This arrangement is useful for maintenance and repair.
purposes. As the loading and unloading of the film has to done manually, this saves a lot of time and also resources. Figure 3 shows some more examples of pole mounted cameras.

Figure 3. Examples of Pole Applications with Red Light Cameras.

Cameras often are installed at multiple locations at each intersection, as shown in Figure 4, to photograph the violating vehicles and, if required by the state laws, the vehicle drivers (as in the
case of California and Arizona). Red light cameras installed and connected to traffic signal systems (loops and signal boxes) monitor the traffic in each lane approaching the intersection. Often, the cameras will not have any power except during the red phase for the direction being monitored. Red light cameras generally take two pictures (Photo 'A' and Photo 'B'- see Figures 4 & 5) of each violation. The camera is triggered and first photograph (Photo 'A') will be taken when any vehicle passes over the sensors at a specified elapsed time and at a certain speed after the signal has turned red. Another photograph (Photo 'B') shows the vehicle in the middle of the intersection.

Figure 4. Location of Red Light Cameras at an Intersection.
Upon the review of the photographic evidence and depending upon the state law requirements, citations (see Figure 6) are issued by mail to either vehicle owners or to drivers at the time of the offense. (Note: Pictures of red light cameras presented in this section have been based or sourced from the web pages/brochures of American Traffic Systems, USPTI and MultaStar.)

Various manufacturers are involved in the development of red light camera technology. They include American Traffic Systems based in Arizona, U.S. Public Technologies from California, Digital Red Light Camera System from Israel, REDFLEX Traffic Systems based in California, and AVIAR Inc from Texas.

The majority of these systems use conventional wet film photography, although there is one experimental site (Howard County, Maryland) using digital images. Wet film technology has been the preferred method since any tampering with the film is easily detected and these cameras offer higher resolution. However, using digital cameras are improving in resolution and vendors are developing methods to ensure there is no opportunity to tamper with the digital image. (See Appendix A for brochures from different vendors.)
Figure 6. An Example of Citation Issued using Automated Photo Enforcement.
3.0 Red Light Camera Usage in the U.S.

Red light cameras are being proposed or are now used for law enforcement purposes at several places in the United States, including New York City; Los Angeles, San Francisco, Oxnard, Poway, El Cajon, and Beverly Hills, California; Scottsdale, Tuscon, and Mesa, Arizona; Charlotte, North Carolina; and Fairfax, Virginia. Several other communities, including Arlington, Virginia; Jackson, Michigan; City of North Miami, Florida; and Polk County, Florida, are experimenting with the cameras to issue warning notices to vehicle owners. This section briefly describes the San Francisco red light enforcement project and Polk County’s red light photo enforcement pilot project.

3.1 San Francisco’s Red Light Camera Enforcement Program

3.1.1 Legal Aspects

Following a tragic and a highly publicized accident caused by someone running a red light at an intersection close to San Francisco State University in October 1994, City officials in San Francisco initialized a pilot project to study the use of red light cameras. In June 1995, the County Transportation Authority approved funding for a pilot project using three vendors to install cameras at two intersections each.

As the pilot project began, the State Legislature amended the California Vehicle Code in 1996 (SB833) to allow the use of red light cameras to identify red light runners. The State law requires full identification of the driver of the car. Once the camera captures a red light violator’s image, the vendor mails the citations (carrying a fine of $104 and one point against the driver’s license) signed by the police department to the registered owners under the presumption that the registered owners are typically the drivers. If the accused desires to contest the ticket, they can schedule a court hearing. The accused also can view the photographs by scheduling a time with the Municipal Court.

14 This project did not go beyond the concept stage.
15 This pilot project ended in 1996.
3.1.2 Financial Aspects

The San Francisco Transportation Authority appropriated $250,000 from sales tax collections to cover start-up costs (installation of loops, conduits, etc.), project management and oversight, and interim studies throughout the project. Each vendor was provided with $30,000 per intersection to cover the installation of cameras. For each $104 fine levied, San Francisco County receives $46.50. From these funds, the vendors receive $17.50 per paid citation to cover the cost of cameras, film developing and citation processing costs, statistical and data analysis, and follow-up court liaison and support as necessary. However, the Pilot Program has found that the $17.50 is inadequate to fund a full-scale program. In October 1997, the Governor signed into law AB 1191, which increased the fine for red light violation to $270. Table 1 shows the distribution of fine and assessment amounts mandated by AB 1191.

Table 1. Distribution of Fine and Assessment Amounts Mandated by AB 1191

<table>
<thead>
<tr>
<th>Violations in incorporated areas</th>
<th>Distribution of Fine</th>
<th>Amount ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>State Trial Court Implementation Fund</td>
<td>5.40</td>
</tr>
<tr>
<td></td>
<td>City general fund</td>
<td>79.38</td>
</tr>
<tr>
<td></td>
<td>State penalty assessment</td>
<td>68.60</td>
</tr>
<tr>
<td></td>
<td>County penalty assessment</td>
<td>48.02</td>
</tr>
<tr>
<td></td>
<td>City and County shares</td>
<td>68.60</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>270.00</strong></td>
</tr>
<tr>
<td>Violations in unincorporated areas</td>
<td>State Trial Court Implementation Fund</td>
<td>5.40</td>
</tr>
<tr>
<td></td>
<td>City general fund</td>
<td>79.38</td>
</tr>
<tr>
<td></td>
<td>State Penalty assessment</td>
<td>68.60</td>
</tr>
<tr>
<td></td>
<td>County penalty assessment</td>
<td>48.02</td>
</tr>
<tr>
<td></td>
<td>County share of base fine</td>
<td>68.60</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>270.00</strong></td>
</tr>
</tbody>
</table>

The City of San Francisco recently awarded a new, expanded red light photo enforcement project to US Public Technologies Inc (USPTI). This project will include 34 intersections outfitted with all the hardware and will integrate portable equipment units to be rotated from one intersection to another. The details of this agreement are still under negotiation, but the vendor will be paid a
flat monthly fee plus a per citation fee. The violator's fines are now such that they will fully fund this project.

3.1.3 Vendor Aspects

In June 1995, the County Transportation Authority selected three vendors to install cameras at two intersections each. Two vendors Electronic Data Systems (EDS) and USPTI installed cameras at four intersections. A third vendor, also assigned two locations, dropped out of the program. Eventually, EDS also pulled out of the project, and USPTI completed the installation of cameras at all the four intersections in January 1997. The following section describes the USPTI technology used in the pilot project.

3.1.4 Technological Aspects

The red light camera system\textsuperscript{16} (see Figure 7) consists of two parts. Its core is the integrated portable enforcement unit that can be moved from one intersection to another. This unit consists of a computer, a high-speed camera, a flash, a digital loop signal processor, and an optional memory card system. The fixed part of the system, dedicated to a single intersection, has wiring and detection loops installed in the roadway and a bullet-resistant cabinet mounted on a hinged pole. Approximately 80 percent of the system's cost is in the portable enforcement unit, which can be effectively rotated among as many as 10 traffic intersections.

These cameras are activated only when a vehicle is detected entering the intersection after the traffic signal has turned red. Cameras are capable of taking two photographs: first when the vehicle enters the intersection, and again approximately 1.5 seconds later. These pictures show the vehicle's illegal progression through the intersection. Each photograph includes a data box containing the date and location of the violation, the speed of the vehicle, the length of the yellow phase of the signal preceding the violation, and the precise number of seconds the signal was red prior to the vehicle entering the intersection. The driver's face, the vehicle and the license plate, and other visible environmental conditions are shown in each photograph.

\textsuperscript{16} The information on USPTI Red Light Cameras discussed in this report is based on the brochures provided by USPTI and conversations with USPTI personnel.
3.1.5 Political and Public Support/Awareness Aspects

The key political decision-makers associated with the pilot project, such as the Mayor and the Board of Supervisors, were very supportive and provided coordinated efforts to make the project successful. The project received widespread community support from groups such as the Senior Action Network and the San Francisco Pedestrian Safety Coalition who have worked with Department of Parking and Traffic in support of automated photograph enforcement. The media also played a major role in disseminating the information on new technologies to the public.

Though it is too early to determine the effectiveness of the red light camera technology in terms of a reduction in the number of accidents, the red light enforcement program statistics (see Table 2) provided by the City of San Francisco show that red light running was reduced by more than 40 percent at the four intersections in the first six months of the automated photo enforcement program (November 1996 to April 1997). According to a recently released press release from the City of San Francisco on collision data, collisions resulting from infractions related to traffic control devices dropped by about 10 percent in 1997, the year after the installation of red light
This encouraged the City to expand the project to another 34 intersections. However, no information is available on the attitudinal survey that was supposed to be conducted to ascertain the public perceptions towards the pilot project.

Table 2. Red Light Enforcement Program Statistics

<table>
<thead>
<tr>
<th>Month</th>
<th>Vehicles counted</th>
<th>Violations photographed</th>
<th>Ratio of violations to total vehicles detected (%)</th>
</tr>
</thead>
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<tr>
<td>Nov '96</td>
<td>2,698,241</td>
<td>2,986</td>
<td>0.11</td>
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<tr>
<td>Dec '96</td>
<td>3,214,898</td>
<td>3,087</td>
<td>0.10</td>
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<tr>
<td>Jan '97</td>
<td>3,842,595</td>
<td>3,493</td>
<td>0.09</td>
</tr>
<tr>
<td>Feb '97</td>
<td>3,662,034</td>
<td>2,669</td>
<td>0.07</td>
</tr>
<tr>
<td>Mar '97</td>
<td>3,748,881</td>
<td>2,535</td>
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</tr>
<tr>
<td>Apr '97</td>
<td>2,111,905</td>
<td>1,362</td>
<td>0.06</td>
</tr>
</tbody>
</table>

Source: Red light cameras fact sheet, Department of Parking & Traffic, Traffic Engineering Division, City and County of San Francisco.

3.2 Polk County's Red Light Pilot Project

Polk County, Fl, conducted one of the first demonstration projects showcasing automated photo enforcement technology. The project consisted of installation of red light cameras at an intersection in Lakeland, Haines City, Fort Meade, and Bartow. Apart from the installation of these four red light cameras, the project also included continuous video monitoring of some intersections. Conceived in the year 1993, and implemented in September 1994, this pilot project was one of the earliest experiments conducted on red light cameras in the United States. The main goals of the project were to test the various camera technologies developed by vendors, and to ascertain the impacts of automated photo enforcement on red light running, if any. The following sub-sections describe some issues associated with this project.

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17 Conversation with Bridget Smith, Red Light Photo Enforcement Project Manager, City of San Francisco.
18 The section on Fort Meade's pilot project is based mostly on the information provided by George Ferris, who was the project leader and also the Chief of Polk County Community Traffic Safety Team.
3.2.1 Legal Aspects

In the absence of any state law allowing the use of cameras to cite red light violators in Florida, no citations were issued, but warning letters were sent. This did not evoke much interest or response from the community as there are no provisions for fines. However, some commercial corporations responded, saying that they appreciated the information and that their drivers would be reprimanded.

3.2.2 Financial Aspects

The pilot project was federally funded, with more than $150,000 of support from the Federal Highway Administration (FHWA). The County rented the camera equipment from different vendors (see section 4.2.3) and also paid them to install the cameras. However, one vendor (Aviar Inc.) installed equipment at its own expense.

The Polk County Community Traffic Safety Team (CTST) was the lead agency the project. CTSTs involve a comprehensive, multi-disciplinary, and multi-jurisdictional approach to solving safety problems within a community such as a county, a portion of a county, multiple counties, or any other jurisdictional arrangement. Formed with representatives from the disciplines of engineering, enforcement, education, emergency services, these community traffic safety teams perform various activities concerned enforcement and public education. These teams are developed to solve local problems by involving the public, with assistance from the state.

3.2.3 Technological and Vendor Aspects

Since one of the goals of the demonstration project was to test various red light camera technologies available, cameras developed by different vendors were used. Three vendors USPTI, American Traffic Systems Inc., and Aviar Inc., were involved in the project. Two intersections in Lakeland and Bartow were equipped with cameras from two different vendors, while two intersections in Haines City and Fort Meade were given to a single vendor, and the same camera was used on a rotation basis. Some intersections were monitored on a continuous basis by using video cameras. These cameras, controlled and viewed from nearby police stations, recorded several traffic crashes.
3.2.4 Public Awareness/Community Support Aspects

A public awareness campaign was conducted by posting signs at each of the intersections to increase awareness among the people on various aspects of red light running. However, it was determined that other special public awareness measures are needed to inform the vast number of visitors who rarely drive through these intersections.

3.2.5 Results and the Effectiveness of the Project

The following were the results from the pilot project:

- The reduction in red light violations and accidents is unknown because the duration of the project was short and cameras were used only periodically, not on a continuous basis. Also, most data that were collected have not yet been analyzed.
- A total of 15 violations/day were observed in Haines City and Lakeland, and 10 violations/day were observed in Fort Meade.
- The cameras worked very accurately during both day and night.
- No problems were faced in getting photographs of license plates, except with tractor-trailers with front license plates on power units.
- Two key issues in gaining public support were identified. One issue relates to the reluctance of the people to disclose the names and addresses of their friends to whom they loan their cars. The other is the delay in receiving a citation.

4.0 Project Costs

The cost of the photo enforcement projects varies depending upon the magnitude of the program, that is, the number of intersections to be equipped with red light cameras. The project costs include start up items such as cameras, housing (it protects equipment from environmental conditions and eliminates the problems of vandalism) and infrastructure such as installation of new loops and signal boxes at intersections. According to information provided by vendors, the cameras cost approximately $50,000 each, housing costs around $6,000; and installation of new loops requires another $10,000.
However, it is to be noted that the costs described here do not represent the costs on a whole project basis, but these are individual component costs.

5.0 Evaluation of the Red Light Camera Enforcement Projects

During the initial use of automated photo enforcement, it is important to evaluate the project and determine the device’s effectiveness in reducing red light accidents caused by running red lights. These projects can be evaluated to determine reductions in actual red light violations after the installation of cameras; increased driver compliance to traffic control devices; and community, media, and political support to the use of technology. A number of such studies were done in California, Arizona, and New York. The Insurance Institute for Highway Safety evaluated red light camera enforcement project in Oxnard, while the Summit Group conducted an attitude and opinion survey concerning red light photo safety in Mesa and Tempe. This section summarizes results from these studies.

In a study conducted on police-reported crashes, the Insurance Institute for Highway Safety concluded that the likelihood of vehicle occupants sustaining injuries is increased in red light running crashes (45%) than the other types of crashes (30%). However, it may be too soon to conclude that accidents due to red light running will drop, as many of the photo enforcement projects in U.S are in their initial stages of development and implementation.

The City of San Francisco reported a 10 percent drop in collisions related to traffic control infractions after the implementation of automated photo enforcement. An Australian study reported a 32 percent drop in right-angle collisions at the intersection with red light cameras in Victoria. Some earlier studies done in the U.S. reported a decline in the number of tickets/violations issued after the installation of red light cameras.

19 Personal communication, San Francisco Department of Parking and Traffic.
Figure 8 shows the percentage reduction in red light violations after the implementation of automated photo enforcement. Results from San Francisco show that the rate of vehicles running red lights has dropped from approximately 5 violations per 5,000 vehicles to 3 vehicles per 5,000 vehicles. The City reported more than a 40 percent drop in red light running at four test intersections in the first six months of the program.

New York City reported that New Yorkers have altered their driving habits significantly after the installation of red light cameras, and the city experienced a 62 percent decrease in the average number of violations photographed per location since the program inception. Los Angeles, the first city in the United States to issue tickets based on automated photo enforcement, also showed promising results. The four-month pilot project on Compton Boulevard produced a 92 percent reduction in the number of violations; the three-month project at Alondra Boulevard reduced violations by 60 percent.

A study conducted by Insurance Institute for Highway Safety in the City of Oxnard, California, found a large and highly significant reduction in red light violations after the implementation of
photo enforcement program. It has been observed that the violation rates at the test sites reduced by about 42 percent. This study also found that the amount of citation fines would significantly influence the long-term effects of red light camera enforcement in Oxnard. The study believes that the implications in Oxnard will be influenced by the substantial increase (from $104 to $270) in red light violation fines in California.

The Summit Group conducted surveys two surveys for two cities in Arizona (Mesa in 1996 and 1997; Tempe in 1997 and 1998) to ascertain the attitudes and opinions concerning the use of photo radar and red light photo safety. The results from these surveys and other studies have been shown in Figure 9.

**Figure 9. Percentage In Favor of Automated Photo Enforcement**

<table>
<thead>
<tr>
<th>% In Favor of Red Light Cameras (RLC)</th>
<th>82%</th>
<th>89%</th>
<th>61%</th>
<th>61%</th>
<th>80%</th>
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<tr>
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<td></td>
<td></td>
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<tr>
<td>Tempe 2</td>
<td></td>
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<td></td>
<td></td>
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<td>Nationwide 3</td>
<td></td>
<td></td>
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<tr>
<td>Large Cities 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oxnard 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

Notes: 1. Follow-up survey of attitudes and opinions of Mesa residents concerning photo radar and red light photo safety.
2. Follow-up survey of attitudes and opinions of Tempe residents concerning photo radar and red light photo safety.
3. Insurance Institute for Highway Safety.
4. Retting et al., Statement before the Maryland House of delegates-Aggressive driving conference.

The Summit Group conducted first survey immediately after the implementation of the red light camera projects, while the second survey was conducted one year after the implementation. Several questions were added to the second survey to see who might have received citations and its impact on their behavior towards the programs. The results from these surveys indicated significant improvement in public awareness of the enforcement projects (72 percent in 1997 from 28 percent in 1996 for Mesa; 61 percent in 1998 from 34 percent in 1997 for Tempe).
Survey results also show that the respondents continue to strongly support the safety programs (82 percent in 1997 and 76 percent in 1996 for Mesa). However, the biggest block of opposition came from the respondents who admitted they had been ticketed in the past for red light running. In a nationwide survey conducted by the Insurance Institute for Highway Safety in 1995, 61 percent of about 1,000 people surveyed favored the use of automated photo enforcement. According to another national survey sponsored by the Insurance Research Council, 61 percent of the respondents favored the use of cameras and it was also found that greatest support came from large cities.  

**Issues, Advantages, and Disadvantages of Automated Photo Enforcement**

As the use of red light photo enforcement grows, a number of key issues, advantages, and disadvantages of these systems are being discovered and documented. Automated photo enforcement faces several challenges prior to implementation including legislative, legal, financial, technical, and awareness issues. This section describes some issues, advantages, and disadvantages associated with automated photo enforcement.

**6.1 Legislative Issues**

In most jurisdictions, it is necessary for an officer of the law to witness a traffic infraction before a ticket can be issued. Therefore, to implement photo enforcement projects, laws allowing governments to make use of cameras to identify red light runners are necessary. As discussed earlier, several states, including California, Maryland, and North Carolina, have amended their existing enforcement laws, while some local governments like Arlington, Virginia, Polk County, Florida; and Jackson, Michigan have been encouraging testing the technology by holding pilot projects.

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However, passing the required legislative measures has, in some states, been difficult, with stiff resistance coming from several associations and politicians. Some of the issues that the required legislation should include are:

- How should a red light violation be handled--as a moving violation or as a violation similar to parking violation? This provides the answer to the question as of who will be liable for the violation--either the driver of the vehicle or the registered owner of the vehicle.
- Is it necessary to identify the drivers? Or should the tickets be issued to the owner/operator of vehicles. A procedure should be provided to establish if the vehicle was under the care of somebody else.
- Can images produced by red light cameras be used as a prima facie evidence to issue citations and also to convince the judiciary?
- What is the appropriate amount of citation fees and their distribution to vendors/operators and various other departments involved? This proved to be a difficult task in California. The State Assembly of California increased the citation fees from $104 to $270 because it was found that the fines and their distribution in the pilot project were inadequate to fund a full scale program.

6.2 Technical Issues

Today, various manufacturers are developing red light camera systems in the U.S. They not only supply and install the equipment, but they are also involved in the operation and maintenance of entire projects. By and large, the technological aspects of the cameras developed by different manufacturers are the same; however, differences might exist in their service standards. This section describes some of the technical aspects that should be considered in developing a red light camera project.

- Is the project is a pilot project or a full-scale project? Conducting a pilot project (similar to the one in Polk County) along with an appropriate publicity campaign may help convince the legislature and gain the public and community support on the usefulness of red light cameras in reducing traffic accidents. This might eventually lead to a full-scale project if the results from pilot project prove to be positive.
• How do existing loops and signal system work with the new technology? This is an important concern because the installation of new loops and traffic signal equipment involves considerable costs. However, it has been found that most of these technologies work very well with the existing traffic signal equipment, but they do require the installation of new loops, and this costs approximately $10,000 per intersection.  

• What sort of cameras should be used—wet film or digital? As discussed earlier, most of the existing photo enforcement systems use wet film cameras because they provide greater resolution photographs. However, they involve more maintenance work since periodic loading and unloading of the film is required. Though digital cameras offer a high level of flexibility in storing and transmitting the photographs, it is possible to tamper the evidence using computer technologies.

• Should photos showing the violations be printed on the citations? The results from San Francisco project found that appeals to the courts that dispute the citations could be reduced by as much as 80 percent if the photographs are printed on the citations. This technique is useful in avoiding court battles, and thereby collecting the fines more rapidly. However, this would increase the cost of preparing the citation.

• Should police officers be trained, thus eliminating the need for vendor representatives in courts in case of disputes, and thus reducing costs?

• How should missing license plates and environmental factors like glare and obscurity be handled? These are found to reduce approximately 25 percent of the readable license plates.

6.3 Administrative/Inter-Departmental Issues

Implementation of red light camera projects requires coordinated and cohesive efforts among various governmental departments in the study area. These projects demand coordination among various agencies such as county/city transportation authorities, law enforcement agencies including police, judicial councils, and municipal courts; and elected officials. Another vital administrative issue regards the organizing agency that would be in charge of maintenance,

21 Conversation with Lauri S. Keller, Regional Marketing Manager, USPTI.
gathering and developing film, issuing citations, and providing expertise and evidence in the courts. Often these responsibilities are part of the vendor contract.

6.4 Public Awareness/Community Support Issues

The success of red light camera projects depends upon the understanding of the public on the use of the technology and the public support for the project. As automated photo enforcement is relatively a new and emerging technology, an aggressive public information and awareness campaign is essential to ensure driver compliance to traffic rules and fines imposed by new statutes. The target audience consists of many communities, including political decision makers, automobile associations, senior citizen groups (particularly for states like Florida), Traffic Safety Coalitions and Community Traffic Safety Teams, and various media including print, TV, and radio. Some of the issues associated with public awareness campaign include:

- developing partnerships and building coalitions with various agencies
- enlisting the support of law enforcement agencies
- gathering pre-campaign crash data related to red light running and explaining the advantage of using cameras to reduce those crashes, with proven results from other projects
- conducting media campaigns and developing customized media materials
- conducting and analyzing post-campaign surveys
- fully explaining the technology

6.5 Financial/Funding Issues

The financial aspect is one of the key issues in the implementation of red light camera projects. Because of the severe financial constraints, and in the absence of any proven record on the success of these projects, funding from local governments for these projects has been limited. City and County authorities are implementing automated photo enforcement projects with assistance from various state and federal agencies; however, most of the funding for pilot projects has come from vendors developing these technologies. These vendors have supplied, installed, operated, and maintained the technology; issued the citations; and collected revenues.
In turn, governments pay the vendors either a fee per paid citation or a fixed monthly/yearly fee. Some important financial issues associated with automated photo enforcement are:

- Identifying the funding source. This includes examining and evaluating various funding sources available such as federal/state/local/governments, and the vendors who may be willing to bear some of the expenses.
- Determining citation fees, and their distribution among various departments and agencies to ensure a justifiable compensation. This task has to be done by considering overall objectives and goals of the project. For example, if the vendors are paid a fee per paid citation, then there is a disadvantage of appearing to encourage a profit motive into vendors to issue more citations and hence more revenue. Conversely, if vendors are paid based on a flat monthly rate, the governing agencies should be willing to take some risks due to losses. It requires a reasonable estimation of the number of violations expected and the amount of revenue that would be generated; otherwise, the local agencies might incur losses.

6.6 Privacy Issues

The privacy issue has often been used as an argument against the use of red light cameras. Proponents of this argument claim that photographing vehicles whose drivers run red lights violates their privacy rights. The use of frontal photography (as used in states like California and Arizona) to identify drivers and take their photographs has been a major concern for this group of people. In this aspect, the use of cameras to record only the license plates in the rear of the vehicles, but not the vehicle occupants, will greatly reduce the problem. Furthermore, a well-planned public awareness campaign that explains the advantages of cameras to the community in containing the violations, could also help in solving the privacy issue.

6.7 Advantages

Automated photo enforcement using red light cameras helps to:

- reduce the problem of limited enforcement resources and logistical difficulties of conducting traditional methods of traffic signal violation enforcement.
- reduce red light running, and hence the number of crashes
• modify driver behavior, particularly if used in conjunction with public awareness campaign
• provide evidence that can be used in the court both for red light violations and accidents
• captures more violators, and increased revenue can be used for various developmental purposes or to expand the violation program to additional intersections
• reduce insurance rates and health care costs for drivers
• increase the safety of drivers and law enforcement officers

6.8 Disadvantages

Automated photo enforcement may also result in some disadvantages, including:
• dealing with legislative issues, which can be very time consuming and may take many years and much effort before adoption
• selecting intersections and vendors can be complex and time consuming once the legislation is in place for the development of a photo enforcement program
• dealing with the large time lag between when an infraction occurs and when the violator receives a ticket. This is confusing and requires violators to try to remember if they were the driver and the circumstances surrounding the infraction. Using traditional methods, the violator is identified almost immediately and can prepare a possible defense of their actions.
• dealing with the vehicle owners who were not driving the vehicle at the time of the infraction it puts the owner of the vehicle in an awkward situation. The owner might have to confront the driver and get that person (likely a friend or a relative) to get to court and pay the fine.
• high start up and infrastructure costs involved with the project
• the potential loss of privacy
• public perceptions--If the goal of the governments and vendors is to increase revenue by fixing high citation/ticket fee, it may result in public opposition. The program should be oriented to improve the quality of life by reducing safety concerns.
7.0 Conclusions

Based on interviews with red light photo enforcement vendors and project managers, literature, and personal site visits, the following conclusions can be drawn:

Traffic infractions due to red light running pose severe and growing concerns, and the safety consequences are enormous. Red light running can be reduced by using various engineering measures like adjusting signal timing and removing unwarranted signals, and also by traditional enforcement. However, limited enforcement resources and logistical problems make it difficult to adequately enforce the law at hundreds (even thousands) of intersections in urban areas.

Automated photo enforcement provides an approach for better compliance with traffic control devices and improves safety at the intersections, and, in some cases, it will have a greater impact on violators as the cameras provide undeniable photographic proof of the violation.

Interest in red light camera systems is growing rapidly among state agencies and local governments. The results from various evaluation studies are promising, which indicate significant reductions in red light violation rates as well as considerably improved awareness, after the implementation of photo enforcement programs. In San Francisco, red light running was reduced by more than 40 percent at four intersections in the first six months of the program, and this encouraged the City to expand the project. The New York City experienced a 62 percent decrease in the average number of violations photographed per location, and it has been observed that the violation rates at the test sites reduced by about 42 percent in the City of Oxnard.

A state law and subsequent amendments to the local ordinances are essential to implement automated photo enforcement projects. These legal issues are complex and need to address several issues, including liability aspects, citation fines, and equitable distribution of fines to various agencies involved. Adopting the required legislation to allow photo enforcement and developing liability standards are time consuming and require support from several communities.
People may also have concerns over a loss in privacy, especially if frontal photography is needed.

A well planned and focused public awareness and information campaign is essential for the success of photo enforcement projects. Involvement of various community, traffic safety, and automobile agencies such as Community Traffic Safety Teams, Senior Citizen Groups, and AAA would help in convincing the community. Law enforcement officers need to be trained to effectively deal with the new technology.

Though significant initial investments are necessary to acquire camera technology, install new loops and for conducting public awareness campaigns, automated photo enforcement projects can be cost neutral because the fines can pay for the program. However, a number of vendors are showing keen interest in participating in photo enforcement pilot projects at their own expense, by associating with various state and local agencies. Such pilot projects can be converted into long-term and meaningful safety projects by offering incentives such as, a fixed monthly/annual fee or a fee per paid citation, to vendors.

Finally, automated photo enforcement is important and holds promise to the future of law enforcement by reducing red light crashes and enhancing safety at intersections.
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Roger, Ray. "Cameras may catch red light runners," The Orlando Sentinel, 1/31/96.

Yee, Bond and Fleck, Jack. "San Francisco Red Light Camera Enforcement Program."
Appendix

Appendix A: Information from Red light Camera Vendors

Appendix B: Legislation from North Carolina and California

Appendix C: Contacts
Appendix A

Information from Red Light Camera Vendors
Appendix B

Legislation from North Carolina and California
Appendix C

Contacts
# Contacts

<table>
<thead>
<tr>
<th>Name</th>
<th>Contact Information</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>George Ferris</td>
<td>708-503-8892</td>
<td>• Former chief of Polk County Community Traffic Safety Team and project lead for the red light camera pilot project in Polk County in Florida</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Provided information on Polk County project</td>
</tr>
<tr>
<td>Amy L. Gambill</td>
<td>704-336-4125</td>
<td>• Public Service Officer with the Charlotte DOT, Charlotte, NC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Source for information on proposed red light project in Charlotte</td>
</tr>
<tr>
<td>Dana King, Zev Fogel,</td>
<td>619-558-8778</td>
<td>• Contacts at U.S. Public Technologies Inc.,</td>
</tr>
<tr>
<td>James Maguire, Lauri S. Keller</td>
<td></td>
<td>• Provided information brochures and catalogues on various technologies</td>
</tr>
<tr>
<td>James Kelly</td>
<td>512-295-5285</td>
<td>• President, Aviar Inc.,</td>
</tr>
<tr>
<td>Adam E. Tuton</td>
<td>602-922-2100</td>
<td>• Source from the American Traffic Systems Inc.,</td>
</tr>
<tr>
<td>Richard A. Retting²²</td>
<td>703-247-1500</td>
<td>• Researcher with the Insurance Institute for Highway Safety</td>
</tr>
<tr>
<td>Bridget Smith, Jack Fleck</td>
<td>415-554-2346</td>
<td>• With the City and County of San Francisco</td>
</tr>
<tr>
<td></td>
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<td>• Provided information on red light cameras in San Francisco</td>
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<tr>
<td>Elizabeth Sheetz</td>
<td></td>
<td>• With the Central Florida Regional Planning Council, Bartow, FL</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• In charge of compiling the final report for Polk County project</td>
</tr>
<tr>
<td>Hiep Huynh</td>
<td>305-948-2903</td>
<td>• City Traffic Engineer, City of North Miami Beach, Fl</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Provided information on the proposed red light camera project in the city</td>
</tr>
</tbody>
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### Internet Sites with Red Light Photo Enforcement Information

- U.S. Public Technologies Inc., [www.uspti.com](http://www.uspti.com)
- Driver Safety Systems, [www.dss.co.il](http://www.dss.co.il)
- Insurance Institute for Highway Safety, [www.highwaysafety.org](http://www.highwaysafety.org)
- Tempe Traffic Safety, [www.tempe.trafficsafety.com](http://www.tempe.trafficsafety.com)
- Mesa Traffic Safety, [www.mesa.trafficsafety.com](http://www.mesa.trafficsafety.com)
- Winnipeg Police Force, [www.winnipeg.freenet.mb.ca](http://www.winnipeg.freenet.mb.ca)

²² The authors are grateful for the information provided by Mr. Retting and the Insurance Institute for Highway Safety.

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Victoria Traffic Camera Office, Australia
Online Sunshine, the official guide to the state of Florida Legislature

www.home.vicnet.net.au
www.leg.state.fl.us