So You're Considering a Red Light Camera Program ?

Lessons and Insights from Over a Decade of Camera Operation in South and Central Ontario

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Abstract
Red light cameras are a form of automated enforcement that has been used world-wide. Six municipalities in the province of Ontario have had a program in place since November of 2000. These municipalities, in co-operation with the Ministries of the Attorney General and Transportation and the office of the Information and Privacy Commissioner, have jointly developed and operated a highly successful red light camera program. The Regional Municipality of York joined the program during 2013 increasing the number of red light camera sites in operation to over 190 sites. The main objective of this paper is to provide suggestions to municipalities considering initiating a red light camera program. The suggestions are based on lessons learned in the Province of Ontario during thirteen years of operations. As is common in the world today, technological innovation has created options for red light camera operation and the paper looks at several of the key options and provides suggestions about the relative merits of current and emerging technologies. The paper considers the influence and impacts of governing legislation on technological choice. The organizational structure behind a red light camera program can be the key to public and court credibility and public acceptance. This paper discusses the regulatory and joint municipal structure in place in Ontario and comments on its advantages. The paper also discusses the common elements required to staff a program and initiate the various legal and management processes required to support a program. Site selection for a red light camera program is the primary decision affecting the success for a red light cameras program. This paper provides insights into the choice of sites for a red light camera program and how to develop a business case for a municipality which is contemplating deployment of red light cameras. Along with the internal project development, a jurisdiction will also need to consider parallel safety, signage and specific user outreach programs to maximize the likelihood of success and minimize negative input. The paper provides suggestions on how the revenue obtained by red light camera programs might be streamed toward safety programs in participating municipalities. Overall, the discussions in this paper are aimed at assisting municipalities who might be considering a red light camera process in structuring the discussion and organizing the decision-making and implementation processes.

Introduction

Road operating agencies worldwide are beginning to recognise more and more need to focus on road safety. Prestigious organisations such as the United Nations (1) and Transport Canada (2) have initiated formal programs aimed at reducing the human and financial loss associated with motor vehicle collisions. Similarly, provincial and local municipal agencies in Canada have begun developing or expanding on formal (strategic road safety) or informal road safety programs. While many of these programs contain innovative approaches to the problem of motor vehicle safety, the core is still the traditional three “E”s: engineering, enforcement and education. Enforcement plays an important role in road safety for two reasons. First, the response to an improper behaviour is immediate correction; second, the response is specifically directed to the road user responsible for the unsafe behaviour (as versus engineering or education which are broad-based in their targets).

However, increasing demand for road safety enforcement conflicts with ever increasing pressures on police services for other, competing programs. This has led to a search for alternative methodologies which include automating the enforcement process. Automated enforcement of traffic violations, particularly speed and red lights, has become common in Canada, North America and across the world. This paper will discuss some of the insights and lessons learned from the operation of a major red light camera (RLC) enforcement program in the province of Ontario, Canada.

Why use automated enforcement?

The value of enforcement is in its ability to alter human behaviour. The deterrent effect is dependent on the intensity or level of enforcement. Once it is known to be present, automated enforcement has the advantage of being active 24/7 and therefore has a much greater deterrent effect than the occasional presence of a police officer and vehicle. In addition, it is often possible to deploy automated enforcement at locations for which it would be impossible or dangerous to conduct manned enforcement. The downside to automated enforcement is that the penalty often does not include driver’s licence demerit points (it does not in Ontario) and a manned officer is often able to identify other serious violations such as driving with a suspended license or alcohol involvement.

Why use red light cameras?

Right angle collisions at signalised intersections are among the most severe and most commonplace of collisions in urbanised areas. The Federal Highway Administration in the United States estimates that red light running is a factor in an average of 916 fatalities and 165,000 injuries annually in the U.S. (3) Unless there is a signal malfunction, the only way such a collision can occur is if one of the drivers failed to observe or ignored the traffic signal indications. The Federal Highway Administration Road Safety Toolbox (4) estimates that red

light cameras can reduce right-angle vehicle collisions at signalised intersections by 25%. However, there is a caveat, in that the FHWA also estimates that, initially, rear end collisions increase by 15%. The Toolbox values were arrived at by examining and comparing the best available research reports.

Figure 1. Typical Red Light Camera and Flash Unit Installation

The reason that red light cameras do not appear to be more effective is that the collision reduction statistics quoted are for an entire intersection while the cameras are typically placed on only one approach to the intersection. In addition, not all violations are intentional – a proportion of red light running is unintentional and therefore is not susceptible to the behaviour modification that a red light camera violation ticket would achieve.

However, there are several positives to be considered. First, right-angle collisions tend to be much more severe than rear end collisions. Therefore, the installation of red light camera changes the balance of the type of collision to one which is less severe. As well, there is some evidence from the City of Toronto (5) to show that the increase in rear end collisions may diminish with time, thereby increasing the overall value and effect of the red light cameras. Also, there is a great deal of variability in the outcomes. A City of Toronto report (6) showed that while rear-end collisions increased slightly after RLCs were initially installed, the increases were notably less at RLC sites than at other City of Toronto locations for the same time period. It would appear that the rear-end collision increases are sensitive to site selection. Finally, the biggest benefit comes in the “spillover” effect which suggests, according to some studies, that the implementation of red light cameras at a select number of sites can influence behaviour at all signalised intersections across a jurisdiction. This is where the biggest “bang for the buck” occurs and is where the true value of a red light camera program is shown. A recent study in Alberta (7) showed a 10.7% reduction in overall collisions and a 22.7% reduction in severe collisions at non-RLC intersections that could be attributed to the “spillover effect”.

History of the red light camera program in Ontario

The history of the red light camera program in the Province of Ontario is one of cooperative involvement of the participating municipalities. Red light cameras are only deployed on local roadways, not on the provincial highway system, at present. The program was initiated when a group of municipalities teamed up to make a presentation to the province of Ontario, and subsequently, six of those municipalities (Cities of Toronto, Ottawa and Hamilton and Regional Municipalities of Peel, Waterloo and Halton) began formal operation of the red light camera systems in November, 2000. Following a trial, or demonstration period, which included a major study of the effects of the RLC program (8), the program received permanent provincial endorsement in 2004 (with some requirements, such as regular reporting and mandatory signing) and has operated in a stable production environment since. At present, the program has over 170 operating red light camera sites and the seventh municipality, the Region of York, has recently joined the program with another 20 camera sites. In addition, at least three more Ontario municipalities, through their respective City or Regional councils, have expressed interest in joining the program in the near future.

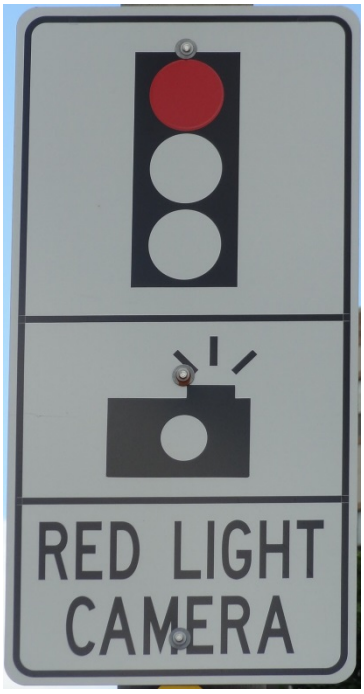

Figure 2. Ontario Red Light Camera Signing Used on All Legs of All Red Light Camera Monitored Intersections

Lessons learned

The Ontario program has been around long enough, is large enough and is successful enough to provide some insights into what is required to initiate and maintain a competent, smoothly-operating red light camera program. In addition, investigations (9) into the impacts of starting a

new program in a municipality, conducted on behalf of the City of Kingston, have provided useful insights into both structure choices and business case outcomes. Following are some of the lessons learned from the Ontario program.

A. Check all the engineering alternatives first; red light cameras are the last resort

The object of any safety program such as a red light camera program is to reduce collisions and injuries. Red light cameras are a way of changing driver behaviour, but only when there is no other alternative to fix the problem. The first step should be to review the intersection operations to determine if there are simple engineering solutions which might be implemented to reduce red light running. Engineering solutions are much more immediate and may be simpler and easier to implement than red light cameras. The engineering reviews fall into several areas. First, vehicle clearance intervals should be checked. These should be consistent with the timing used throughout the jurisdiction and should be consistent with documented and accepted practice. If the clearance intervals are appropriate, the site should then be checked for operational constraints. Are the signal heads visible? Are there vertical or horizontal geometrics which impede the driver's view of the traffic signals? Is there a severe downgrade which might suggest that the clearance interval is should be as per the formulae rather than as per the tables? Are there background distractions which make the traffic signal heads less visible? Only when an intersection has been checked and cleared of other contributing issues, should red light cameras be considered to resolve a right angle vehicle collision problem.

Figure 3. Use of Auxiliary Traffic Signal on Sharp Horizontal to Improve Signal Conspicuity and Driver Compliance

B. Doing the project as a group is better

The Ontario program operates as a single unified entity. Decisions are made jointly. There is a common vendor engaged via a common request for proposals process. Processing for all seven jurisdictions is done at one site. Maintaining a high degree of consistency has contributed to the high degree of success of the program. While there is an additional layer of bureaucracy required to coordinate the activities of all the members, this is a small price to pay for an improved product. The advantages are several. First there are more overall resources which allow the workload, which is particularly onerous at the outset, to be divided up, thereby shortening the start-up duration. The provincial ministries whose cooperation and action is required for the various legislative and legal processes, are more than happy to deal with a single entity rather than a number of individual jurisdictions. The consistency that results from a single red light camera system and single style of processing and prosecutions, leads to clarity within the court system and simplified public consultation and reaction. There are financial economies of scale which result from a single joint processing centre and from joint procurement.

In order to get the Ontario red light camera program off the ground initially, working groups were established in all of the key areas. The key areas included evaluation, field operations, processing, public awareness, court services, prosecutions and judicial introduction. Clearly, this would have been a major task for an individual municipality and the sharing of both the workload and knowledge between the professionals expedited the process and resulted in a better product.

C. Initiating a red light camera program within a municipality requires a big team

Starting a red light camera program from scratch, even within the framework of a well-defined existing program, requires the involvement of a wide range of individuals from the participating municipality. The group may include:

- a project manager who will oversee all of the activities;
- a project administrator to deal with the day-to-day issues of billing, public comment and contract management;
- engineering staff to make decisions about road safety and site selection;
- a solicitor to deal with a number of contracts;
- a purchasing representative to manage procurement and comment on contracts;
- a financial administrator to set up and audit various accounts associated with the program;
- representatives of prosecutions and court services to deal with processing of the violation notices and dealing with court requests;

- a media or communications person to prepare the necessary information to explain to the public what is happening; and
- a police contact to coordinate activities

All of these individuals will need orientation and some training and the group will need to work together recognising timeframes and the interaction of various components of the program. The advantage of a unified structure in Ontario is that the program is already in operation and there are individuals and subcommittees with direct knowledge of the specific issues who can provide resources and explanation. Nonetheless, the staff commitment is significant and time must be allowed for education and team-building. The expected start-up time for a program in Ontario is 18-24 months, from the time of the initial Council approval.

D. A red light camera program is best run as an engineering initiative

The core reason for initiating a red light camera program is to improve road safety. The road safety experts within any municipality are the traffic engineering or roadway engineering groups. Therefore, initial the decision on whether to embark on a red light camera program and the decisions on site selection need to reside with the engineering groups. Similarly, decisions on operating parameters, when to retain or close down sites, etc. are ones that should be made on the basis of road safety and need to be led by the engineering groups. As well, these groups have the data and expertise required to conduct program effectiveness studies and best prepare the various reports required by their municipal councils.

E. Consistency works

One of the key advantages of operating a unified program is consistency. With all agencies operating using the same parameters for camera operation and prosecution, the process is sound, receives far fewer challenges in court and is widely accepted by both the judiciary and the general public. It is extremely important to maintain active communications and retain the support structure in place on all key aspects of the program, even when it seems that no changes are necessary, in case an issue arises.

F. Simple is better

The Ontario red light camera program uses fairly sophisticated technology but is not a technology driven program. The conscious decision has been made to use the minimal level of sophistication in terms of the technology required to get the job done. The end result has been a robust program acceptable to the courts with a very high degree of reliability. The program operates with digital images (since wet film is no longer

available) but uses only still images rather than video. Among other reasons, the practical aspect of having video devices in all courtrooms is a constraint. The measurement of speed for the purposes of identifying a violation and timing the capture of images, is done strictly with inductance loops in the roadway. The program has considered more sophisticated methods of speed measurement which might permit more versatility in terms of choice of location, but to this point has not deviated from the use of inductance loops, as they are deemed to be the most accurate technology. In order to satisfy the legal requirements of “chain of evidence”, the program currently transfers the data from the camera sites to the processing centre through a strictly manual, carefully regulated process. No electronic transfer of data is currently utilised in Ontario. These sorts of decisions have been taken to ensure the maximum reliability of the program and the highest degree of acceptability to the courts. Any complexity that is not value added is generally not advantageous.

G. Separate the vendor from the site choice and prosecution processes

In Ontario, the vendor is responsible for providing, operating, maintaining and decommissioning the red light camera sites. The vendor is also responsible for providing the processing hardware and software. The involved municipalities make all the decisions in terms of site selection and operate the processing centre completely independently from the vendor. This isolates the vendor from any decisions which might affect fine revenue. In turn, this leads to a high degree of respect for the program since there is no obvious conflict of interest.

H. Build in incentives for vendor performance

As part of the joint procurement process in Ontario, the vendor is subjected to a step known as Proof of Performance. This requires the vendor to establish a complete working system, cameras and processing, at the vendor’s expense, prior to the vendor being accepted for full production. This ensures that the vendor starts at an acceptable level of quality. Subsequently, the vendor’s performance is maximized through a system of penalties and bonuses based on the quality of the photographic images provided. The viability of the photographic images in Ontario is established by Provincial Offences Officers, sworn officers of the Crown, who are tasked with determining whether a violation is prosecutable offence. The vendor is responsible for all quality issues which are culpable, that is, can be traced back to responsibilities of the vendor. The vendor would not, for instance, be responsible for a licence plate which was obscured by a trailer hitch. The vendor would, however, be responsible for an out of focus image which could not be used to prosecute a violation. Since the data transfer is done manually and the data is collected approximately twice weekly in Ontario, a benefit is that a representative of the vendor is regularly on site and camera maintenance is typically at the highest level.

I. The business case is usually important

Some municipalities may treat red light camera programs strictly as safety programs without consideration of cost. However, it is more common that jurisdictions which are considering initiating a red light camera program wish to review the business case, especially as the revenue to cost relationship often changes throughout the duration of the program. There are three ways to express the business case for a red light camera. The first is a benefit cost model which considers the benefits solely in terms of collision reduction. This could be either direct costs or the direct and indirect costs, including societal costs. A second model is to simply balance the expected fine revenue against the operational costs of the program. This would seem contrary to the basic premise that a red light camera program is primarily to improve road safety, but would place the least strain on tax-based funding. A third option is a hybrid model in which road safety is maximised, but within the constraint of the minimum financial impact to the operating jurisdiction. This model mixes the safety benefits and fine revenue benefits in a way that provides a sustainable program over the long term with little or no financial input, but with maximised safety. The hybrid model appears to strike the best balance under today's conditions, for most jurisdictions.

J. The business case development and site selection process are intertwined

In order to develop a business case, site-specific information about collisions and violations are required. However this is a circular process, in that the type of business case and the exact balance may require adjustment to the choice of sites. Furthermore, the final site selection can only be confirmed when the red light camera vendor visits the sites to ascertain technical feasibility. From a functional perspective, jurisdictions may wish to choose sites based on factors other than purely motor vehicle collisions or revenues. Geographic dispersion is very important in terms of generating the spillover effect in the long term. That is, spreading the sites around the jurisdiction evenly will have a much greater effect in creating a disincentive to run red lights everywhere. As well this typically satisfies some political concerns at the same time. Thus, the site selection/business case modelling may take a number of iterations.

K. The business case for road safety is best viewed from a long term perspective

Generally, the short-term safety business case for the installation of red light cameras is not positive. A recent example is the study done for the City of Kingston (9), in which not a single site identified, based solely on the safety benefits, could be justified as having a benefit cost ratio exceeding 1.0. However a study conducted in Alberta (7) separated the "spillover" effect and determined that the effect was significant across the entire series of jurisdictions studied. That is, there was a significant safety impact on intersections

without RLCs. This is where the major safety value of a red light camera program can be found. However, the “spillover” effect does not happen immediately, as the connection to the public consciousness through violation notices, signing at the red light camera sites, word-of-mouth and through formal and informal media takes a significant period of time. An estimate from the City of Hamilton (10) is that the spillover effect took 5-6 years of red light camera operation to become measureable. However, once the spillover effect takes hold, the benefit to cost ratios are extremely significant, in the range of 15 – 30 to 1.

L. Critically appraise the literature

A number of papers have been published that supply analyses of the results of studies of red light camera programs and their effects on safety. Many of these studies suffer from methodological issues that may make their results less valid. According to a meta-survey by Decina et al (11), “First, many safety-related factors such as traffic volumes, crash reporting thresholds, approach speeds, cycle lengths for signal timing, weather conditions, and law enforcement practices are uncontrolled and/or confounded during the periods of observation. Second, spillover effects caused by drivers reacting to non-RLC equipped intersections make the selection of comparison sites difficult when designing an evaluation study. Third, sites selected for RLC installations may not really be as randomly selected as intended by the study; and as a result may suffer from a regression-to-the-mean effect. Finally, evaluation studies should but often fail to consider the use of crash severity data to gauge the safety impacts of RLCs.” Thus, when considering the results of studies, one needs to consider very carefully the methodology and assess the results accordingly. One of the most common errors, as noted, is failure to account for regression to the mean. This is the phenomenal where sites are selected based on a high number or rate of collisions which would statistically have reduced whether or not an intervention was made. Regression to the mean can be accounted for through the use of the Empirical Bayesian approach as described by Hauer (12).

M. Measurement and data collection is very important

If a jurisdiction is considering entering into a red light camera program, it should take the time to undertake properly structured data collection prior to installing cameras. As noted above, violation rate studies need to be conducted prior to deciding on sites. These should be done in sufficient numbers to ensure that the revenue predictions are reasonably reliable. As well, it is preferable to build a statistically sound baseline so that possible to evaluate the exact effects of the red light camera program, separated from other background changes. Maintaining accurate collision data for treated sites is required to measure and evaluate the program effectiveness from a collision change perspective.

N. Excess red light camera fines should be retained

If a camera program is successful to the point of having excess revenues when it is launched, those funds should be kept within the program. It is entirely possible that the program may become a money-loser as it matures, as fewer violations are a by-product of a successful program. Having funds in a reserve allows a program to continue without a drain on tax-based funding. If sufficient excess funds continue to be available, they could, and should, be reassigned to road safety programs. In this way, the RLC program is not identified in any way with an initiative to raise funds for the municipality's general revenues, and the profile is raised in terms of improving road safety.

Conclusion

Red light camera programs can be beneficial in terms of safety impacts and acceptable in terms of public opinion. Success depends on a well-constructed and operated program, starting at the foundation stages of program development.

The Ontario experience, which has been very positive and successful, combines the elements of consistency of operating strategy across the sharing jurisdictions; simplicity and transparency of operations; separation of the vendor from the decisions which might affect revenues; and incentives and penalties to ensure the best vendor performance.

Incoming jurisdictions are finding that there is a strong support framework and reference network; that developing a well-founded business case is the best way to gain program approval; that even with support, implementing a new RLC program in a jurisdiction is still a time-consuming effort involving a wide range of staff; that sound methodologies for collecting data are required both for building the business case and future reporting on the outcomes of the program; and that the real benefits in terms of safety improvements are likely to occur only after the program has been in place for a number of years.

In summary, implementing a red light camera program takes significant thought, research and effort, but approached correctly, can result in a positive safety program that will benefit the public at minimal or no cost.

REFERENCES

1. United Nations. *Decade of Action for Road Safety 2011-2020.* http://www.un.org/en/roadsafety/

2. Transport Canada. *Canada's Road Safety Strategy 2015.* http://ccmta.ca/crss-2015/index.php?lang=en_CA

3. FHWA. *Engineering Countermeasures to Reduce Red Light Running*, FHWA-SA-10-005, 2009.

4. U.S. Department of Transportation, Federal Highway Administration. *Crash Modification Factors Clearinghouse.* http://www.cmfclearinghouse.org/results.cfm

5. Toronto Star, October 5, 2011, http://www.thestar.com/news/gta/2011/10/05/red_light_cameras_reduce_rearend_collisions_statistics_show.html

6. City of Toronto. *Works Committee Report 6 to City Council July 21-23, 2004.*

7. AECOM. *Intersection Safety Device Program – Red Light Camera Analysis.* Markham, Ontario, March 2014.

8. Synectics. *Evaluation of the Red Light Camera Enforcement Pilot Project.* St. Catharines, ON, December 2003.

9. CIMA Canada Inc. *City of Kingston Red Light Camera Business Case Study-Final Report.* Burlington, Ontario, February 2014.

10. City of Hamilton Public Works Department. *Report PW11048 to the Public Works Committee*, Hamilton, Ontario, June 2011. http://www.hamilton.ca/NR/rdonlyres/68C78372-9FB7-4472-9BF4-DA86F5C33009/0/Jun20EDRMS_n180036_v1_8_3_PW11048.pdf

11. Lawrence E. Decina; Libby Thomas; Raghavan Srinivasan, Ph.D.; and Loren Staplin, Ph.D. *Automated Enforcement: A Compendium of Worldwide Evaluations of Results,* TransAnalytics, LLC, Kulpsville, PA, September 2007.

12. Hauer, Ezra. *Observational Before-After Studies in Road Safety.* Bingeley, UK, 2008.