Guidelines for Setting-Up and Operation of Signalised Intersections with Red Light Cameras

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Biography

Kelly Imberger has a Bachelor of Science degree with honours in psychology and a Graduate Diploma in Road Safety. In February this year Kelly joined ARRB Transport Research and has been working on projects involving motorcycle licensing, a road safety school education checklist and red light cameras. Prior to joining ARRB, Kelly was employed by VicRoads for seven years and enjoyed work in both the Road Safety and Registration and Licensing Departments. Kelly worked on a variety of projects in the areas of motorcycle safety and training, crash data and young drivers. Kelly also managed the Redevelopment of the Car Driver Knowledge Test.

Abstract

The literature has produced mixed results on the effectiveness of red light cameras on crashes. Various Australian studies have shown crash reductions varying from 7% to 46%. Different studies also report different results in the crash types that decrease or increase following the installation of cameras. The mixed results reflect methodological problems in the studies and are likely to be associated with a variety of different factors pertaining to the camera and traffic environment. The results also indicate that signals and red light cameras combine to produce an interactive system, which needs to be set up professionally as a whole if it is to perform optimally in terms of safety and efficiency. Thus ARRB Transport Research was commissioned by Austroads to develop 'Guidelines for Setting-up and Operation of Signalised Intersections with Red Light Cameras'. A review of literature from Australia and overseas to summarise current knowledge on the safety impact of red light cameras at traffic signals was undertaken. This was followed by an examination of the red light camera programs throughout Australasia and a comparison of the pattern of crash types at red light camera sites with those for a group of non-camera sites in three jurisdictions. Guidelines for the setting-up and operation of red light cameras were developed from this work. The aim of the Guidelines is for future and existing red light camera programs to operate at a high level of effectiveness in terms of crash reductions and to decrease red light running and crashes resulting from this behaviour. The Guidelines will also be useful for those jurisdictions seeking funding for new red light camera programs.

1. BACKGROUND

Studies from Australia and overseas have shown that crashes at signalised intersections present a considerable road safety problem. Many of these crashes are the result of red light running, in the Sydney metropolitan area approximately 18% of casualty crashes at signalised intersections involve drivers running a red light (South et al, 1988; Hillier et al, 1993). Red light running crashes tend to be more severe than other types of crashes and have a high cost to the community (Radalj, 2001). Red light cameras have therefore been developed and installed in Australia and overseas as an enforcement measure against drivers who run red lights. One author concluded that these cameras are cost effective with a benefit/cost ratio of around two (Zaal, 1994).

Red light cameras are devices that automatically photograph vehicles that go through a red light at a signalised intersection. They are triggered by a wire induction loop embedded beyond the intersection stop line so that photographs are taken of vehicles that enter the intersection after the traffic signal has changed to red. The photographs allow the vehicle

registration number to be read and to ensure exposure a flash is operated automatically. The photographs record details such as date, time of day and time elapsed since the onset of the red signal (South et al, 1988). The camera hardware is visible to road users, and intersections with the devices are usually sign posted to also warn drivers of their presence. Drivers who run red lights at camera intersections are fined a substantial amount, thus deterring them from running red lights.

The literature has produced mixed results on the effectiveness of red light cameras on crashes. Various Australian studies have shown crash reductions varying from seven to 46%. Various studies also report different results in the crash types that decrease or increase following the installation of cameras. The mixed results reflect methodological problems in the studies and are likely to be associated with a variety of different factors pertaining to the camera and traffic environment (Status Report, 2002). These factors include:

- Signal timings – the lengths of the green, amber and red phase and the length of the all-red phase (where both approaches to the traffic signals are displaying the red phase).
- Provision of right/left turn arrows on the intersection approach with a red light camera.
- Speeds of vehicles and the possible effect of camera location knowledge on these speeds.
- Traffic flow at the intersection.
- Traffic signal hardware set-up, for example lack of lantern conspicuity.
- Delay time between detection of red light running and driver punishment.
- Use of red light camera warning signs.
- The approaches the cameras are installed, in terms of numbers and direction.

The results also indicate that signals and red light cameras combine to produce an interactive system, which needs to be set up professionally as a whole if it is to perform optimally in terms of safety and efficiency. Thus, optimal safety and efficiency outcomes for red light cameras requires careful consideration of the above factors in the design of programs and selection of sites. Guidelines for the setting-up and operation of red light camera programs would be of significant benefit to police and other road safety practitioners.

2. SCOPE OF PROJECT

The development of 'Guidelines for Setting-up and Operation of Signalised Intersections with Red Light Cameras', consisted of three components:

1. A review of literature from Australia and overseas to summarise current knowledge on the safety impact of red light cameras at traffic signals.
2. The results of consultation undertaken with key individuals in the jurisdictions of Australasia regarding the nature of their red light camera programs.
3. An analysis of the pattern of crash types at red light camera sites with those for a group of non-camera sites in three jurisdictions – Queensland, Victoria and New Zealand (Christchurch).

'Guidelines for Setting-up and Operation of Signalised Intersections with Red Light Cameras' were developed from the results obtained from the three components. The overall aim of the Guidelines is to enable future and existing red light camera programs to operate at a high level of effectiveness in terms of crash reductions and to decrease red light running and crashes resulting from this behaviour. The Guidelines will also be useful for those jurisdictions seeking funding for new red light camera programs.

3. METHOD

3.1 Literature review

The Australian Transport Index, TRIS (Transportation Research Information Service, produced by the US Transportation Research Board), ITRD (International Transport Research Documentation, produced by the OECD) databases and the Internet were searched for material on red light cameras.

3.2 Red light camera programs in Australasia

Information was obtained on red light camera programs in each jurisdiction in Australasia. This involved:

1. Contacting each jurisdiction's road authority, police department and council (where applicable) for the relevant staff whom could supply information on the jurisdiction's red light camera program.
2. Development of a survey to gather the required information on red light camera programs.
3. Sending the survey (via email) and telephone discussion with stakeholders to gather the information. The surveys were returned (via email).
4. Face to face interviews with the jurisdictions of Victoria, South Australia, Western Australia, New South Wales and New Zealand to gather further information.

3.3 Crash analysis

An analysis of the pattern of crash types at red light camera sites with those for a group of non-camera sites in Queensland, Victoria and New Zealand (Christchurch) was undertaken. It is not intended that the comparison of crashes at red light sites to non-camera sites be a statistically matched comparison nor a before/after study with statistically identified control and treatment groups, as this was not in the scope of the project. The analysis aims to provide a simple picture of the nature of crashes at red light camera sites compared to non-camera sites, and to determine if there are any differences in crash patterns associated with the camera sites. Due to the nature of the analysis, it is not expected that differences in camera and non-camera site crashes will be found. Also, sites without cameras are usually treated with engineering countermeasures to decrease crashes if a camera is not installed. Thus jurisdictions place cameras at intersections where required or alternatively use engineering treatments for non-camera sites to achieve crash reductions.

Five years of crash data were analysed for each jurisdiction. The analysis involved:

1. A review of crashes at signalised intersections that did not have red light cameras. These crashes were selected to match the location (statistical division name [a variable in the data]) and/or speed limit (a variable in the data) of red light camera crashes.
2. A review of crashes at red light camera sites (signalised intersections).
3. A review of crashes on the camera approaches at red light camera sites (signalised intersections). The directions of initial vehicle movements (of the vehicles involved in the first crash event) were matched to the direction the camera faced.

4. FINDINGS

4.1 Literature review

The literature provided mixed results as to the effectiveness of red light cameras in terms of crash reductions. However, there have been a greater number of studies that showed crash reductions as opposed to increases. A greater amount of studies showed a decrease in right angle, right against and all crashes (compared to increases). However, a greater amount of

studies showed an increase in rear end crashes (compared to a decrease). Thus red light cameras may have merit if the decreases in right angle and right against outweigh the potential increases in rear end crashes (taking severity into account – rear end crashes are the least severe type of crash).

A grouped analysis of eight different red light camera crash studies by Retting, Ferguson and Hakkert (2003) to better estimate the effect of red light cameras on crashes also found promising results. The grouped analysis aimed to account for regression to the mean and spill-over effects. Studies were placed into three groups. The results for the first group of studies (studies that did not account for regression to the mean and spill-over effects) showed a statistically significant 39% reduction in injury crashes compared to the control sites. For the second group (studies that did partially address regression to the mean but not spill-over effects), a nonsignificant 10% reduction in injury crashes compared to control sites was found. This group of studies failed to account for the spill-over effect, thus increasing the likelihood that crash reductions were underestimated. Finally, a statistically significant 29% reduction in injury crashes compared with control sites was shown for the third group (studies that did account for regression to the mean and spill-over effects). This estimate falls between the first two groups, as expected from the methodological problems. The authors concluded that red light cameras are highly effective in reducing injury crashes, with a best estimate of 25 to 30% (Retting et al, 2003).

4.2 Red light camera programs in Australasia

The consultation phase of the project provided a large amount of information on each jurisdiction's red light camera program ranging from date of program introduction, trial periods, program continuation, the number of red light camera sites, nature of camera rotation, set-up and functionality to positive and negative aspects of the program.

Some of the positive aspects of the programs and their deficiencies are discussed here, as they are most relevant to development of the Guidelines. The positive aspects included:

- Some jurisdictions believe the red light camera program is a proven enforcement technique and that the number and severity of crashes can be decreased. This means that crash costs borne by the community are also reduced.
- The use of wet film has been relatively simple and reliable for some jurisdictions.
- Having a program in place allows the danger of red light running to be promoted.
- The program is well accepted by both drivers and the community.
- The combined speed/red light program is a very good deterrent to speeding.

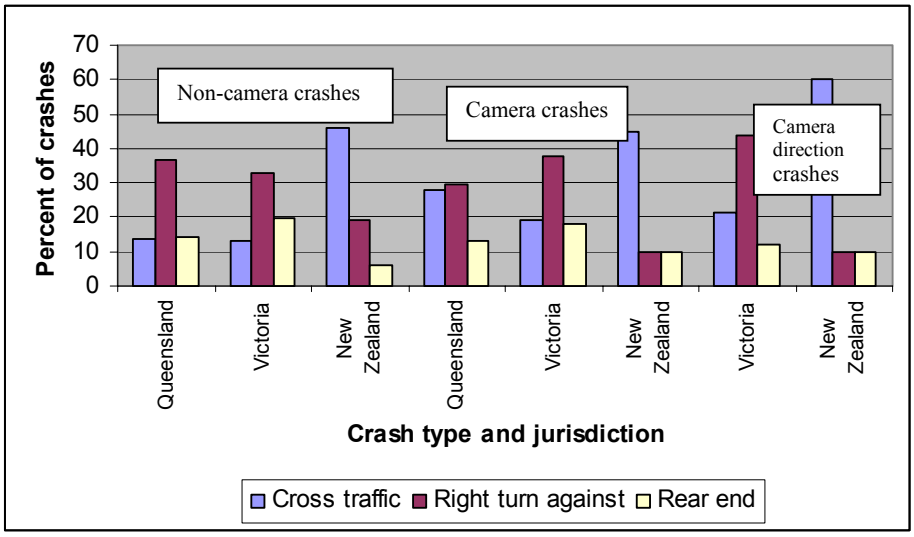
Program deficiencies were identified in the following areas:

- Insufficient site maintenance.
- The flash only triggers if a camera is present at the site. Therefore the deterrent value of sites decrease when the camera is absent for extended periods. Often there are few cameras for a large amount of hardware boxes and cameras do not get rotated frequently enough.
- Camera and film issues, for example film can jam from time to time
- A lack of appropriate publicity.
- The method of site selection should be more scientific.
- Signage design may be more appropriate if a symbol is used.
- Some signalised intersections, which meet the criterion for red light cameras, should preferably be upgraded (engineering treatment) rather than equipped with cameras, for example right turn arrows installed.
- There have been numerous upgrades to intersection equipment, for example changes to signals and intersection layouts. This means evaluating the effect of the camera is difficult.

4.3 Crash Analysis

The crash analysis concentrated on the year, severity, crash nature and DCAs/crash movements for each jurisdiction for both non-camera, camera and camera approach (Victoria and Christchurch only). As expected differences in crash patterns at camera and non-camera sites were not noticeably different. Of most interest, were the DCAs (Queensland or Victoria) or Crash Movement Classification codes (New Zealand) compared across jurisdictions. Figure 1 compares the percentage of crashes for each DCA/Movement group by jurisdiction (note there are no camera-direction crashes for Queensland). For non-camera crashes, both Queensland and Victoria had the largest amount of crashes in the right turn against category (36.7% for Queensland and 32.8% for Victoria), however New Zealand had its largest amount of crashes in the cross traffic category (45.7%). For all-camera crashes Queensland and Victoria again had the highest amount of crashes in the right turn against category (29.5% and 38% respectively), whilst New Zealand again had the highest amount of crashes in the cross traffic category (45%). For camera-direction crashes, Victoria remained highest in the right turn against category (43.7%) and New Zealand in the cross traffic category (60%). The difference in the DCAs/Movement codes for the Australian jurisdictions compared to New Zealand may be related to intersection set-up (the number of fully controlled right turns, signal settings and phasings, intersection design and so on), which may operate differently in the two countries.

Figure 1 – Jurisdiction comparison of crash percentages on common dcas/movements (5 years of data)



5. CONCLUSION

The objective of this project was to provide a set of step-by-step instructions for a successful red light camera program. A summary of the Guidelines is outlined below.

Pre-installation phase – are red light cameras the most appropriate solution:

- Planning and stakeholder involvement.
- Red light camera site crash history.
- Site observation studies of red light running and speeding.
- Site intersection changes over time.

- Engineering audit of crash problem sites (changes to signal visibility, site distance, signal timing and cycles and overall intersection design or an alternative treatment options must be ruled out before consideration of red light cameras).
- Complaints from the public.
- Other items for consideration such as high pedestrian presence and higher traffic volumes.

Installation phase – planning, site selection, enforcement, signal characteristics, publicity and so on:

- Choosing appropriate camera system technology.
- The need for legislative changes.
- The need for publicity.
- Installation of system hardware, set-up and operation.
- Warning signs.
- Camera rotation plan.
- Infringement issue plan.
- Potential problems and how to overcome them.

Monitoring phase – monitoring camera sites, updating sites as required and maximising the success of the program. This is of high importance especially if program effectiveness must be demonstrated for on-going funding.

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Keywords

Crash reductions, Guidelines, red light cameras, red light running and right angle crashes.