Drivers' Attitudes towards Red Light Violations Monitoring System

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Abstract: Traffic accidents pose a major safety risk to all members of society and represent a major concern, posing a threat to human life. Furthermore, they consume material resources and human capabilities, resulting in social and psychological difficulties as well as substantial material losses. Hence, proposals and solutions are needed to curb the continued rise in road accidents shown by local and global statistics. In light of this it is necessary to define the causes of traffic accidents and find solutions to eliminate them. The World Health Organization's (WHO, 2013) statistics show more than 1 million road crash fatalities and 38 million injuries annually, of which 5 million are serious. Several studies emphasize that the primary cause of road crashes is the human element (80%), compared to vehicles and road conditions (20%) (http://www.who.int/violence_injury_prevention/publications/road_traffic/world_report/en/index.html). Crashes resulting from a vehicle running a red light or driving on the wrong side of the road are the most common causes of fatalities and injuries, for both drivers and other road users. Thus, finding a solution to such problems is an urgent, major concern for governments and road safety authorities. Among the suitable methods that have proved successful was the Red Light Camera (RLC) system that accurately monitors violators and provides required documentation like timing, photographs, etc.

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Section One: Introduction

First: Problem of the Study

Traffic safety is a priority for countries, given its benefits to the economy and protection of lives. Thus, departments responsible for traffic flow set up strategies, policies, systems and technologies to reduce the occurrence of accidents and fatalities resulting from road violations in general and traffic signal violation in particular. The majority of road crash fatalities are caused by running a red light. The US Federal Highway Administration (FHWA) estimates that red light violations lead to more than 100,000 crashes and 1,000 fatalities annually, causing the economy to incur losses exceeding $14 billion (Federal Highway Administration FHWA, 2006). These negative results do not only affect vehicle drivers and passengers; one study showed that 50% of the fatalities in road accidents were pedestrians and those crossing the road (Insurance Institute for Highway Safety, 2006).

In Saudi Arabia, the Director of the General Department of Traffic (GDOT) revealed on 20 February 2012 that the number of road accidents reached 544,179 in 2011 (with a daily average of 1,537). He also noted that the number of injuries in the same year exceeded 39,000, while the number of fatalities amounted to 7,153 (with a daily average of 20) (Al-Ajlan, 2012). This is a substantially high rate, compared to 7 fatalities per 100,000 in the United Arab Emirates (UAE) (Al Shaafar, 2012).

As a result of the increased number of crashes and fatalities caused by red light violation, the Ministry of Interior (MOI) in Saudi Arabia contracted with private companies across the Kingdom to install speed monitoring cameras.

As the control of red light violations relies on drivers' awareness of relevant risks, several studies showed that change management should be parallel to system implementation, in order to raise driver awareness of the system's goals and benefits. This will ease resistance towards implementation and further increase success rates. Accordingly, the importance of this study stems from the fact that it focuses on the following objectives:

Second: Objectives of the Study

The study's main objective is to identify the attitudes of drivers towards RLC enforcement through these secondary goals:

1- Determining drivers' attitudes towards GDOT's role in informing them of RLC enforcement
2- Identifying positive and negative aspects of system implementation, from the viewpoint of drivers

Section Two: Theoretical Framework

Developed as well as developing countries seek to improve traffic safety in order to reduce accidents, fatalities, and injuries. Although the UK has one of the best records among EU member countries in terms of road safety (Andrew, Sauerzapf,

& Haynes, 2008), statistics show that it has an average road crash outcome of 3,000 fatalities and 40,000 severe injuries annually (DfT, 2007). The high numbers of fatalities and severe injuries incurred as a result of traffic accidents force governments to adopt policies promoting the protection of drivers and road users. However, they face the challenge of selecting the tools required to lower fatality and injury rates, in addition to high costs (Belin et al., 2010).

Blais and Dupont referred to a number of tools that help reduce fatalities and injuries; these included roadblock tests, automated speed cameras, RLCs and mixed programs. They found that the use of automated technologies significantly increased the likelihood of traffic violators being arrested and enhanced police effectiveness, which had the ensuing effect of reducing the number of traffic offenses, crashes, and injuries. However, the use of automated technology is the most important tool, as it increased traffic violation prevention and control, as well as enhancing police enforcement of the regulations. Studies show that the RLC is an automated tool that helps reduce fatalities, injuries and economic losses, as it lessens the frequency of drivers running red lights (Blais & Dupont, 2005).

Studies pinpointed a number of reasons behind running red lights (the length of signal time, the timer, signal cycle time, signal interval) in addition to vehicle speed, distance from stop line, driver response and their demographic properties (Datta et al., 2000). Retting et al. agreed on some reasons and proposed some methods to aid in promoting compliance with red lights, for example changing the length of the yellow light that warns vehicle drivers against imminent change in road usage right (Ferguson & Farmer, 2008). That study focuses on measuring the effect of yellow light timing, then assessing RLC enforcement.

Meanwhile, Huang and Chin suggested other factors that contribute to increased collisions related to running red lights in Singapore, including young and old vehicle drivers, motorcyclists, as well as peak and late times. All these factors led to a rise accidents at intersections (Huang & Chin, 2009).

Given the importance of red light enforcement in reducing road accidents, governments and technology companies earnestly seek to overcome this problem by inventing and developing a number of automated cameras that monitor violators who will be identified, informed and held accountable. This method increases driver awareness about risks and also documents their violations (Retting et al., 2008). A RLC enforcement system is linked to the traffic signal and a sensor that monitors traffic flow. These cameras document two main scenarios: Crossing an intersection at a speed higher than a predefined limit and crossing the intersection during a red light. Cameras can be used to produce video clips when needed. These cameras also capture the time, date and vehicle speed, which helps traffic safety monitoring bodies to send mail or SMSs to drivers notifying them of incidences of them running a red light, including their plate number, and photographs of the violation (Retting et al., 2008).

The efficiency of RLC enforcement can be measured in two ways: First, reduction in the number of crashes or specific types of crashes (which is done best when cameras are an instrument in handling this occurrence). However, some believe that the outcome cannot be measured in the short run, as analysis of the data is needed for several years after enforcement. The second way to determine the efficiency of RLC enforcement is by assessing the reduction in occurrences of drivers running red lights (Eric et al., 2009).

Based on the positive aspects of RLC enforcement, several countries have adopted this system along with a strategy of ensuring effective and efficient commitment to road user safety as well as punishing those responsible for severe injuries (Wong, Wong & Sze, 2008).

The automated enforcement system was launched in the US to reduce red light violations and other collision-related issues, taking into consideration the effects of public acceptance and operating costs (Smith et al., 2000). In 2006, Hong Kong resorted to the automated camera system following the surge in legal actions related to red light violations from 22,590 in 2003 to 42,916 in 2006.

In order to help countries reap the benefits of RLC enforcement, Smith et al. stressed the importance of cost efficiency and public acceptance, taking into account operations and legislation (Smith et al., 2000).

Another study indicated that public awareness, education, media campaigns, driver's behavior, traffic control, fines, camera failure and privacy impact the efficiency of automated execution of RLC enforcement. The study also highlights the significance of vehicle drivers' perspectives on the success of traffic control strategy in combating negative driving behavior (Wong et al., 2008).

The study also showed a relationship between intersection safety and driver awareness; as Retting et al. confirmed, the more aware drivers become of traffic signals, the higher the intersection safety level achieved (Retting et al., 2008).

It was suggested by Gains et al. that signs should be posted at intersections showing the number of accidents and which had happened in that area and

show their causes. They would be designed to raise drivers' awareness of the negative impacts of speeding and red light violations and should remain in position for several months (Gains, Heydecker, Shrewsbury & Robertson, 2004).

In 2004, Pennsylvania embarked on an experiment installing RLCs in several intersections; this was authorized by the state legislature. In the beginning, rear license plates were photographed for vehicles entering intersections during a red light, while the driver was not photographed. The registered vehicle owner was subject to a $100 fine, but unlike violations resulting from traditional police enforcement, no driver's license penalty points were awarded for camera citations. The legislation required a 120-day warning period during which warning notices, rather than fines, were mailed to registered owners of vehicles running red lights. In addition, conspicuous traffic signs were installed at all camera-equipped locations to warn drivers they were approaching intersections monitored by red light cameras. The warning signs included an image of a traffic signal and the words "Red Light Photo Enforced"—features shown to be well understood by motorists (Retting et al., 2008).

Despite the importance of raising awareness using signs, Wahl et al. emphasized that it is not enough merely to raise awareness and that RLC enforcement in intersections should be linked to information about the huge number of traffic accidents at intersections and their causes (Wahl et al., 2010).

In an effort to activate commitment towards preventing red light violations, some countries issue traffic control manuals based on practical studies, such as The Manual on Uniform Traffic Control Devices that illustrates signal timings. According to the manual, the yellow signal interval should be around 3–6 seconds, and longer intervals should be reserved for approaches with higher traffic speeds. Because drivers generally cannot predict the onset or duration of a yellow signal, the likelihood that a driver will stop on a red signal is related to vehicle speed and distance from the intersection when the signal changes to yellow (US Department of Transportation, 2006).

Driver attitudes towards RLC enforcement are crucial, as substantiated by several studies, such as the one conducted by Ruby and Hobeika about RLCs positive aspects, which showed that drivers can feel some positive economic effects and some positive effects linked to safety (Ruby & Hobeika, 2003).

In summary, the theoretical framework highlights the importance of RLC enforcement, given its huge benefits. However, the high cost of system implementation forces many countries to outsource it to the private sector. In 1999, the UK government agreed to look for ways of using the income generated locally from speed violations to boost camera enhancement activities in a cost-recovery operation (DTLR, 2001).

Legislation was enacted for local tie-ins between security bodies, official highway authorities and the government to recover the money spent on the installation of more speed cameras through proceeds from fines collected through the courts. Accordingly, more cameras were installed across the UK (Jones et al., 2008).

This public–private partnership (PPP) presents an alternative method of providing the public sector with services, goods, expertise and capabilities. PPPs are formed via contract between the public sector and private companies to offer infrastructure or services usually provided by the government. In proper PPPs, the private sector not only seeks profit from successful project execution, but avoids risks from project failure (Urio, 2011).

The awareness aspect is vital to successful PPPs. Jones et al. confirmed that, in order for countries to fulfill the requirements of expected cost recovery from camera installation without encountering strong resistance from drivers they should obligate partners (executors) to place signs at camera installation sites. These signs should stress the dangers of exceeding the speed limit and of red light violations, in addition to stating the number of accidents that resulted in fatalities and injuries over the last 36 months (Jones et al., 2008).

The Kingdom of Saudi Arabia's GDOT documented the system and its objectives on its website (Marketing-campgain.aspx) to offer drivers easy access to key information. This study will focus on benefits from GDOT's website and analysis of what it could provide to enhance traffic safety. GDOT's official website showed that 'SAHER' is a system that aims at regulating and managing traffic flow automatically in major cities across the Kingdom.

Section Three: Methodology of the Study

In this study, the descriptive (surveying) approach was adopted, as it is in line with the study objectives (Saunders, Lewis, & Thornhill, 2009).

First: Defining Research Population

As vehicle drivers constitute the population of the study, samples were taken randomly from 13 cities in 7 regions, namely: Riyadh, Makkah, Eastern Province, Northern Province, Qassim, as well as Jazan and Aseer south of the Kingdom. A total of 2,000 questionnaires were distributed among sample constituents, out of which 950 were returned (representing 47.5%). Upon review, 815 of these questionnaires were found analyzable.

Second: Research Instrument

The questionnaire was used in this research to collect data from motorists in order to determine their views about the implementation of speed monitoring systems. This instrument was proposed by Koh and Wong to determine motorist opinions in order to understand their tendency to violate traffic control systems (Koh & Wong, 2007).

Third: Reliability and Validity

Reliability: Upon finalizing the design of the questionnaire using the theoretical framework, questionnaires were submitted to several academics working at the Institute of Public Administration and King Saud University (KSU), as well as a number of officials, to seek their opinions about the questionnaire's contribution to the study objectives. The questionnaire was revised taking into consideration the remarks of those academics and officials in order to improve the questionnaire.

Validity: After analyzing the initial data of 43 exploratory questionnaires and finding Cronbach Coefficient Alpha, it was found that some sentences had to be deleted or edited. Thus, some sentences were deleted or edited and the questionnaire was re-distributed in its final form.

Cronbach's Coefficient Alpha reached 0.835, which indicates validity of respondents' answers to these questions.

Section Four: Description and Analysis of Red Light Violations Data

First: SAHER's objectives

The table below illustrates the relative distribution of respondents' attitudes towards SAHER's objectives

according to number of occurrences of drivers being fined. "SAHER" is an automated traffic control and management system.

Table (1) SAHER's objectives from drivers' viewpoints according to red light violation fine

Categorizing According to Being Fined / Objective	Not Fined %	Fined %
Collecting violation fines	61.6	71.8
Reduction of accidents	55.1	64.1
Saving lives	36.5	41.0
Controlling traffic flow	18.7	24.4
Other objectives	6.7	5.1

The table results reveal the different attitudes of the sample of drivers towards the objectives of SAHER according to whether they were fined or not. A large percentage of these drivers believe that the main aim of RLC enforcement is to collect violation fines. This opinion was held by 71.8% of those fined and 61.6% of those not fined. Of the drivers who were fined (one or more times), 64% said that RLC enforcement aims to reduce accidents, while 55.1% of those not fined were of the same opinion.

The table also showed that 41% of sample drivers who were fined think that RLC's goal is to save lives, and this opinion was held by 36.5% of those not fined.

The table also showed that 24.4% of sample drivers who were fined and 18.7% of those not fined believe that RLC's objective is to control traffic flow.

Second: Attitudes of Drivers towards GDOT's Efforts to Inform Them of RLC Enforcement

The table below indicates the relative distribution and averages for drivers' attitudes towards the methods followed by GDOT to inform and prepare drivers before and during the implementation of the RLC system.

According to Table 2, 45.9% of respondents believe that GDOT did not properly inform drivers of RLC enforcement. Meanwhile, 17.8% of the sample were neutral and 36.4% were positive. The average for this statement was 2.81, which signals a tendency toward rejecting the statement that GDOT properly prepared drivers for RLC enforcement.

The table also shows that 51.4% of the sample drivers do not agree that GDOT informed drivers using signs that show the number and rates of accidents and fatalities due to red light violations. Neutral opinions reached 19.4%, while those who agreed with the statement represented 19.2%. The average reached 2.69.

Table (2) Respondents' attitudes about driver awareness of RLC enforcement

N	Sentence		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Average	Standard Deviation
1	Drivers were notified via warning signs of RLCs		173	180	137	177	103	2.81	1.366
		%	22.5	23.4	17.8	23.0	13.4		
2	Drivers were informed through signs of the number and rates of accidents and fatalities caused by red light violations.		179	216	149	148	77	2.65	1.297
		%	23.3	28.1	19.4	19.2	10.0		
General Average								2.73	1.185

Third: Attitudes of Drivers towards Positive Aspects of RLC Enforcement

The table below shows sample drivers' opinions of the positive aspects of RLC enforcement determined by reviewing repetition, ratio and standard deviation for drivers' answers to the system.

Table (3)Attitudes of respondents towards positive aspects of RLC enforcement

N	Sentence		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Average	Standard Deviation
1	SAHER monitors red light violations very accurately		71	97	154	219	223	3.56	1.282
		%	9.3	12.7	20.2	28.7	29.2		
2	SAHER helps drivers comply with red lights at camera-monitored intersections.		59	65	88	306	251	3.81	1.198
		%	7.7	8.5	11.4	39.8	32.6		
3	The current level of red light violations fines helps improve driver behavior towards red lights.		81	86	143	277	179	3.51	1.256
		%	10.6	11.2	18.7	36.2	23.4		
4	Doubling amount of red light violations fines upon delay in payment helps improve driver behavior in relation to compliance with red lights.		160	132	165	185	124	2.98	1.378
		%	20.9	17.2	21.5	24.2	16.2		
5	RLC enforcement helps create a social culture of compliance with red lights.		91	114	161	240	154	3.33	1.284
		%	12.0	15.0	21.2	31.6	20.3		
6	RLC enforcement helps families adopt a culture of compliance with traffic lights		90	114	174	236	147	3.31	1.269
		%	11.8	15.0	22.9	31.0	19.3		
7	Selection of intersections in which RLCs were installed was according to their significance (such as large number of accidents).		136	130	189	196	119	3.04	1.322
		%	17.7	16.9	24.5	25.5	15.5		
General Average								3.37	.943

According to the table, different views are held in regard to the positive aspects achieved with RLC enforcement, as averages ranged between 2.98 and 3.81. The table shows that drivers agree on a number of positive aspects of the system, namely those in the statements 1, 2, 3, 5, 6 and 7.

These positive aspects are in line with the theoretical framework that indicate that a RLC enforcement system helps achieve several positive impacts, both at the economic and safety levels (Ruby & Hobeika, 2003).

Statement number 4 shows that respondents believed that doubling the value of red light violations fines upon delays in payment did not help improve driver behavior in relation to compliance with red lights, as the average amounted to 2.98.

Fourth: Attitudes of Drivers towards Negative Aspects of RLC Enforcement

Table (4) Respondents' attitudes towards negative aspects of RLC enforcement

N	Sentence		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Average	Standard Deviation
1	Reducing speed suddenly to avoid red light violations in camera-monitored areas may cause traffic accidents.		42	42	74	240	371	4.11	1.130
		%	5.5	5.5	9.6	31.2	48.2		
2	Shortness of green light phase increases red light violations.		29	42	86	207	390	4.18	1.082
		%	3.8	5.6	11.4	27.5	51.7		
3	Shortness of yellow light phase at some traffic signals increases red light violations.		36	41	74	238	375	4.15	1.099
		%	4.4	5.1	9.1	29.3	46.2		
4	Absence of timer at some traffic signals increases red light violations.		27	43	58	186	454	4.30	1.058
		%	3.5	5.6	7.6	24.2	59.1		
5	RLC enforcement does not take into consideration the presence of non-Arabic speaking drivers in regard to traffic signs.		26	44	165	240	292	3.95	1.063
		%	3.4	5.7	21.5	31.3	38.1		
6	Value of red light violation fines are excessive		81	78	123	140	339	3.76	1.386
		%	10.6	10.2	16.2	18.4	44.5		
7	Red light violation fines have become a financial burden for individuals		70	58	115	151	349	3.88	1.331
		%	9.4	7.8	15.5	20.3	47.0		
General Average								4.07	.843

The table shows an agreement among drivers on the presence of a number of negative aspects for the RLC

enforcement system, as averages ranged between 3.76 and 4.30. These negative aspects are shown in statements 1 through 7.

Section Five: Main Findings and Recommendations

First: Main Findings

The study led to a number of key findings related to RLC enforcement, mainly:

1- RLC objectives

- The study showed that a large percentage of sample drivers believe that the main aim of RLC enforcement is to collect violation fines. Those who held this opinion represented 71.8% of drivers who were fined and 61.6% of those not fined.
- The study also indicated that many believe that accident reduction was the goal of RLC enforcement. This opinion was held by 64% of those fined and 55.1% of those not fined. Meanwhile, 41% of those fined and 36.5% of those not fined were of the opinion that RLC enforcement aims to save lives.

2- Awareness

The study findings showed that drivers believe that GDOT did not exert the required effort to inform

them about RLC enforcement. Nearly half of the study sample was of the opinion that GDOT did not properly inform drivers of RLC enforcement. Similarly, more than 50% of the sample believed that GDOT did not inform drivers using signs that show rates of accidents and fatalities caused by red light violations.

3- Positive Aspects of RLC Enforcement

According to the study findings, there are several positive aspects of RLC enforcement, mainly that it encourages motorists to comply with traffic lights at camera-monitored intersections. In addition, the system monitors red light violations very accurately. The current level of violation fines contributes to the improvement of driver behavior with regard to red light violations. Meanwhile, doubling red light violation fines does not, in the opinion of respondents, contribute to the improvement of driver behavior with regard to compliance to red lights.

4- Negative Aspects of RLC Enforcement

Among the major negative aspects shown by the study are: The importance of the timer at traffic signals; a short green light increases red light violations; a short yellow light in some traffic signals increases red light violations; reducing speed suddenly to avoid red light violations in camera-monitored areas may cause traffic accidents. RLC enforcement does not take into consideration the presence of non-Arabic speaking drivers in regard to traffic signs.

Second: Recommendations

- The GDOT should give more attention to improving drivers' awareness of the importance of compliance with red lights for the safety of road users.
- The GDOT should gain more attention by using different media channels to raise awareness of the goal of the RLCs system and its advantages to the safety of road users.
- The GDOT should review and evaluate their process continuously based on the feedback from users of the roads and develop their process based on the feedback received.

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