ISSN: 2278-3369

International Journal of Advances in Management and Economics
Available online at www.managementjournal.info

RESEARCH ARTICLE

Road Communication Technologies and Safety Regulation Enforcement on Roads in Uganda

Derek Friday[1]*, Benjamin Tukamuhabwa[1], Moses Muhwezi[2]

[1]*Department of Procurement and Logistics Management, Makerere University Business School, Kampala, Uganda.*

[2]*Department of Management Science, Makerere University Business School, Kampala, Uganda.*

*Corresponding Author: E-mail: ***fderek@mubs.ac.ug***

Abstract

The growing concern for safety regulation enforcement is attributed to the increasing carnage of road injuries and deaths from road accidents in Uganda. With bad driver behaviours accounting for 80% to 95% road crashes, this study sought to establish whether road communication technologies can improve safety regulation enforcement and deter such behaviour. Data was collected from 285 respondents comprising of traffic officers and analysed using SPSS. The study also critics the Risk Homoeostasis Theory and makes numerous contributions to theory and practice and also provides both policy implications and recommendations to improve road safety regulation enforcement.

Keywords: *Roads, Road Communication Technologies, Safety Regulation Enforcement, Uganda.*

Introduction

An average increase from 750,000 to 1.3million deaths and 880,000 to 50million injuries annually on global roads to date, Robertson et al [1], of which 85per cent occur in developing countries like Uganda, has raised the need to quickly control this growing scourge. Comparing with Uganda, 14,390 accidents (1,438 fatalities and 12,946 injuries) were reported in year 2000, and had increased to 18,250 accidents (2,334 fatalities and 12,076 injuries) by the year 2008, Nassasira, [2]. Hospital based studies on accidents in Uganda showed pedestrians as the most frequent traffic casualties (43.5 per cent), followed by vehicle occupants (31.9 per cent), Mutto et al. [3]. From the Injury Control Centre Uganda (ICCU) community survey, traffic accidents contribute 46per cent of the severe injuries among urban children and also cost the country 2.7 per cent or 1-3 per cent of GDP in terms of lost lives, injuries, vehicles and property damage, Bishai et al [4]; Mutto et al [3]; Nasasira [2]. According to Baguley and Jacobs [5] approximately 1 per cent of Uganda's annual gross national product (GNP) is lost to road accidents. On the other hand, Bishai et al [4] confirmed a 9per cent effect on Uganda's USD300 GDP per capita. These statistics provide justification for proclamation by the UN General Assembly of the 2010-2020 call for a Global Decade of Action for Road Safety. The Ministry of Works and Transport (MOWT) also has plans to develop a national strategic framework that aims at reducing the road crash deaths in the period 2010 - 2020 by 50per cent in Uganda, Nassasira, [2]. Uganda being a land locked country, uses road transport for major haulage of its exports and imports to promote economic growth, attract Foreign Direct investments (FDI) and to promote commercial farming and manufacturing, thus the justification by the country for the need to identify measures to improve road safety and also obtain higher service standards, [6-7]. Human error, usually a result of bad driver behaviour and failure to comply with road safety regulations, accounts for about 80 per cent to 95 per cent of the road traffic crashes. These bad driver behaviours include; reckless driving, over speeding, inconsiderate use of the road, incompetent drivers and driving under the influence of alcohol or drugs [5] [2] [8]. Defective vehicle condition, environmental factors and road conditions contribute 10 per cent, and 5 per cent respectively. These bad driver behaviours can be reduced by ensuring compliance to road safety regulation through proper enforcement of the traffic laws. Enforcement of road safety regulations involves a wide range of complex

tasks, many of which demand the use by police of modern technologies [9]. Uganda has 1094 of the 2500 trained professional traffic officers required to enforce the Traffic and Road Safety Act, [10]. Though less by 1406 of the required number, the deployed traffic officers are supported by inadequate equipment like; speed guns and breathalyzers, not to mention the increasing growth in the vehicle population (17 per cent). These among other inadequacies in road safety regulation enforcement, are probably responsible for the continued increase in the number of accident deaths (6.3 per cent) between the years 2000 and 2009 respectively, [2]. Road safety regulation enforcement further suffered from abolition of mandatory vehicle inspection since the mid 1990s, the effect of which is the prevailing increase in the number of vehicles in a dangerous mechanical condition (DMCs) on the roads. Enactment of the Traffic and Road safety Act in 2004 for Speed limits, use of mobile phones, rules of roads, prescribed alcohol limits, express penalty schemes, speed governors, regulations on driving permits in 2005, weighing bridges in 2009 and regulations relating to driving schools and driver instructors in 2010, if implemented effectively can improve the level of driver compliance to increase road safety in the country [11]. Leon and Barry [12] and Goodrum and Yinggang [13] agree that Road safety regulation enforcement increases road safety. A report from the European Transport Safety Council revealed that investment in road communication technologies can lead to an average reduction of 19 per cent in the number of casualties in road accidents and with even larger reductions in urban areas up to 28 per cent. A Cost benefit analysis carried out in one of the states revealed that investment in only speed camera technology generated a return of 5 times the amount after 1 year and more than 25 times the amount after 5 years. The application of Road Communication Technologies (RCTs) like Database Management Systems (DMS), Geographic Information Systems (GIS), Genetic Algorithm (GA), Internet Technologies,[14], Electronic Data Interchange (EDI), Radio Frequency Identification (RFID) among others, are what is required to increase enforcement of safety regulations. By increasing the timeliness, accuracy and amount of information shared or exchanged among the traffic officers using road communication technologies Sambasivan et al. [15], safety regulation enforcement will improve and therefore lead to more lives saved on Ugandan highways. A study on driver compliance to safety regulations in Uganda, Mawanga and Ntayi, [16] was done emphasizing social norms as major contributors to non compliance by drivers to safety regulations. Douglas and Swartz [11] though in agreement, also reveal that enforcement has everything to do with driver compliance and attitudes towards the safety regulations. They further state that mandatory as opposed to voluntary compliance has had more effect on increasing compliance to safety regulations, and it is from their findings that this study anchored. Road communication technologies [14]; Young and Regan, [9] was identified as the variable that would enhance the enforcement of safety regulations to achieve mandatory compliance and therefore improve on the safety levels on Ugandan highways. On a lighter note, the study also critics the Risk Homeostasis Theory by Wilde [8]. Researchers have indicated the contribution of Safety Awareness and Road Infrastructure as the other variables influencing safety regulation enforcement to increase driver compliance,[1,3,11,12,13,14] These are only highlighted in this paper and therefore provide room for future research. Other parts of the paper include; the literature review, methodology, presentation and discussion of findings, research limitations and the related implications of the study.

Literature Review

This section focuses on reviewing literature from previous studies on road communication technologies and road safety regulation enforcement with guidance from: Chunlu and Yoshito [14], Sambasivan, et al [15], Young and Regan [9] and Douglas and Swartz, [11] studies. The study focused on establishing how to improve road safety regulation enforcement on Ugandan highways by introducing road communication technologies. The underlying aim was to achieve higher levels of road safety on the highways through mandatory compliance to safety regulations that should be a result of effective road safety regulation enforcement. During the year 2000, the Government of Uganda developed a five year road safety programme with a three year National Road Safety Action Plan whose implementation started in 2004 to build capacity in form of institution support, physical improvement of critical black spots on major highways and enhance Road safety regulation enforcement. To date, the road safety condition in Uganda is still unsatisfactory and road accidents, fatalities and injuries have been increasing in the last decade, Nassasira, [2]. Road accidents include any vehicle accident occurring on a public highway or road that is; originating on, terminating on, or involving a vehicle partially on the highway. These accidents include; collisions between vehicles and animals, vehicles and

pedestrians, vehicles and cyclists, or vehicles and fixed obstacles. Human error, usually a result of bad driver behaviour, Mawanga and Ntayi, [16] accounts for about 80 per cent to 95 per cent of the road traffic crashes. These behaviours; reckless driving, over speeding, inconsiderate use of the road, incompetent drivers and driving under the influence of alcohol or drugs, all provided for in the Traffic and Road Safety Act, are still on the increase due to the gaps in the safety regulation enforcement processes, Baguley and Jacobs [5]; Nassasira [2]. Road Safety Regulation Enforcement objective, according to the European Transport Safety Council, is achieved by deterring road users from committing offences which are related to road crashes and injuries and not the maximisation of the number of infringement notices or fines issued out by traffic officers. In Uganda, many enforcement activities are still and often directed towards detecting and apprehending the offending drivers. According to the council, safety regulation enforcers should focus on deterrence of traffic regulation offenders from committing these acts by deployment of visible traffic police officers or road communication technologies like street cameras. Continued deterrence creates driving behaviours that Douglas and Swartz, [11] have applied to study drivers attitudes towards safety regulations and the influence of these attitudes on compliance to safety regulations. They categorised the driver attitudes under; general regulatory attitudes, perceptions of the effectiveness of safety regulations, perceptions of the effectiveness of enforcement and perceptions of the reasonableness of the safety regulations. And, it's from their findings that this study developed constructs to measure road safety regulation enforcement. According to Young and Regan [9], the traditional enforcement of road safety regulations is out dated given the complexity of police tasks to date. However, they acknowledge that operational policing methods of deploying unmarked police cars more or less hidden at the roadside and an apprehension unit comprising of one or more marked traffic police cars, has just not reduced speed limit offenders but also had significant effects on other driver behaviours like drunken driving. But when the European Transport Safety Council report is put into consideration, research results clearly indicate that these traditional methods are not effective for safety regulation enforcement after the introduction of road communication technologies that are also very cost-effective. Interest in road Communication Technologies or what some refer to as vehicle telematics, comes from the problems caused by the luck of a synergy of information technologies for simulation, real-time control, and communications networks to control traffic on Ugandan roads. Transport information such as; the specification of road types, costs per mile and per delivery, exact vehicle mileage per route, accurate driving times, number of vehicles on the road, required traffic personnel, if accessed on time, is key in making decisions that will ensure drivers desist from their bad behaviour, Eibl, [17]. According to Nassasira [2], the government's plan to build the Kampala – Entebbe (airport) highway with automatic speed enforcement gantry, involving the installation of camera systems, vehicle monitoring devices to detect and identify vehicles disobeying speed limits or some other road legal requirements and automatically ticket offenders based on the license plate numbers, is evidence of the country's appreciation of road communication technologies in safety regulation enforcement , Butagira, [18]. Intelligent transportation systems that provide for road communication technology, offer variety in technologies applied, ranging from basic management systems to monitor applications and more advanced applications that integrate live data and feedback from a number of other sources, such as driver profiles, weather information, parking guidance etc, that would increase efficiency in decision making during safety regulation enforcement, Gladys, [19]. Baguley and Jacobs [5] recommend the use of Microcomputer Accident Analysis Package (MAAP) to improve road safety regulation enforcement in developing countries. MAAP is a powerful yet simple system that enables road safety regulation enforcers to obtain reliable data from the road communication technologies for; diagnosis, planning, evaluation and research purposes and also set up low-cost road engineering improvement schemes. It consists of two key components: a police report booklet or form with a recommended structure and a set of software applications for data entry and analysis. The relatively low-cost and increased availability of microcomputers in form of road communication technologies means that highway traffic officers can analyse their own data to help identify hazardous locations, the nature of the problems, choose appropriate counter measures and assess their effectiveness in safety regulation enforcement with increased efficiency. To measure the contribution of the road communication technologies on safety regulation enforcement, metrics like; web - enabled service metric, data reliability metric, time and cost metric, E - response metric, ticket presentation and payment metric, E - document management metric, Sambasivan et al [15]; Krauth et al [20] can be applied as performance indicators. Wilde [8], using the Risk homoeostasis theory, reveals

that as electronic safety features are added to vehicles (vehicle telematics) and roads, drivers tend to increase their exposure to collision risk because they are aware of the accident risk and feel better protected. The theory refers to this as Sub-optimal risk taking which occurs if the driver underestimates or over-estimates the danger of a given activity, because that person would either take too much risk or too little for greatest net benefit. However, Leon and Barry [12] indicate that 90 per cent of the reduction in road crashes is due to electronic road and vehicle modifications and that following the homoeostasis theory would be an excuse for not doing anything to improve driver compliance to safety regulations. In further disagreement from the theory, the European Transport Safety Council report reveals that the key to combating bad driver behaviour is to put more effort in increasing the perceived risk of apprehension of traffic law offender by application of communication technologies. Though in agreement on enforcement, Wilde [8] differs on the approach by suggesting that enforcement through reward for those with no accident record as opposed to punishment of safety regulation offenders, realises better results in driver compliance to traffic laws. The reward approach again points to Douglas and Swartz [11]'s aspect on the perception of the reasonableness of the safety regulations to improve driver behaviour. Both scholars seem to say that enforcing safety regulations will be made easier if the drivers perceive the regulation to be reasonable, in this case a form of reward. Much as the effectiveness of safety regulation enforcement is dependent on the efficiency of the legal system, the contribution of communication technologies Young and Regan, [9] in both aspects is significant. To deter road safety regulation offenders, traffic law in some countries is part of criminal law. The criminalisation of traffic law fits in with Douglas and Swartz, [11] aspect of enhancing the perception on effectiveness of the enforcement process to correct the bad driver behaviour or attitudes. While this may be appropriate for serious offences, it is hardly possible to process the myriad of offences without making an exceptional demand on policing manpower or clogging up the courts of law. To achieve this, automatic detection, registration and tolling is applied using road communication technologies supported by intelligent transport systems for offences such as speeding and red light running. These approaches have proved cost-effective and should therefore be widely adopted in traffic regulation enforcement strategies. Key to note is the focus accorded to just a few major traffic offences that usually include over speeding and driving under influence of alcohol. Other significant contributors to road accidents like fatigue, overtaking, driving so close to cars ahead (bumper to bumper), vision impairment, driving under influence of medical drugs that could affect judgement among others, are some of the bad driver behaviours ignored by traffic law enforcers either due ignorance or lack of means for enforcement in Uganda. For example, studies reveal that up to 10per cent of road crashes can be attributed to falling asleep at the wheel. Given that some of these driver behaviours are difficult if not almost impossible to detect, for example, impaired judgement due to medical drugs, use of intelligent transport communication technologies Young and Regan [9], would help safety regulation enforcers by collecting, analysing and interpreting of data based on the driver's behaviour behind the wheel. Inbuilt cameras would for example, show the driver dozing, overtaking in forbidden areas, sudden acceleration, breaking and swerving of the wheel and any other abnormal driving behaviours, can be captured by road communication technologies depending on the instructions and applications installed the micro computers. With this information, such drivers can be apprehended and road accidents pre-empted in time to save lives and damage to property. The increasing rate of road deaths for the last decade explains the country's lack of concern or knowledge on the effect of road accidents on the individuals and the economy. The government is probably aware of the devastating effect of accidents on its highways but is stuck with the traditional traffic policing methods and cannot adopt intelligent transport systems due to inadequate resources to invest in the project. Improving road safety will require commitment of the country's resources in road communication technologies and the institutions responsible for safety regulation enforcement. Although the major factors contributing to highway crashes may be related to the bad driver behaviour, driver error and ignorance, illness or fatigue, mechanical condition of the vehicles, lack of sight distance, poor roadside clear zones, inadequate signage, the sluggishness in which safety regulations are enforced cannot go without notice. Introduction of road communication technologies would not only increase the efficacy in enforcement but are also cheaper and more convenient during performance, monitoring and evaluation of traffic police activities.

Methodology

The research followed a cross sectional as opposed to the longitudinal study due to time constraints. A correlation survey research design was applied to find out the relationship between the variables. Trained traffic police officers deployed on

highways in the different regions of the country constituted the main focus of this study. A total of 1094 traffic officers Batalia [10] were targeted as the study population. Simple random sampling technique was used to allow an equal probability for all the members to be represented in the select respondents. Using the Krejice and Morgan [21] table to determine the sample, a total of 285 respondents was selected to comprise the sample for the study. The questionnaire was developed and pretested through a Confirmatory Factor Analysis (CFA) to assess the validity of each construct in the model while the reliability of the variables was assessed basing on Cronbach [22]. A total of 118 questionnaires were returned making a response rate of 41.4 per cent, Biersdorff, [23]. The questionnaire was self administered by respondents who selected a suitable number on the Likert scale; ranging from SD=1 Strongly Disagree to SA=5 Strongly Agree, as a response measure of their perception on the given variables. The structured questionnaire measured the following variables. Road Communication Technologies – measured using; web - enabled service metric, data reliability metric, time and cost metric, E - response metric, invoice presentation and payment metric, E - document management metric, Sambasivan, et al [15]. Krauth et al [20] have used some of these measures as performance indicators in logistics service provision studies. Safety Regulation Enforcement was measured using; the general regulatory attitudes, Perceived regulatory effectiveness and the perceived effectiveness of regulatory enforcement mechanisms, Douglas and Swartz, [11]. For ethical research reasons, Research Assistants were given a general introduction letter from Makerere University Business School that was presented to the Commissioner Traffics' office as proof that the intentions of the study were strictly academic and that the findings would only used for the later. It should also be noted that the questionnaire was reviewed by the Commissioner Traffic's office to ensure that the data to be collected would not compromise the security operations of the traffic police. For each respondent, consent was also sought by the questionnaire administrators in charge before handing over the questionnaire to be self administered. The respondents were asked to sign the questionnaire trucking sheet but not to include any information that would identify them on the questionnaire. Quantitative data analysis was carried out using a Statistical Package for Social Scientists (SPSS) to establish the correlation among the variables and a correlation coefficient was run to establish the direction and strength of the relationships between variables. A regression analysis was carried out to determine the predictive strength of the independent variables on the dependent variable. From the results, inferences on safety regulation enforcement were made.

Discussion of Findings

The response rate attained to generate these findings was hampered by the dynamic nature of the respondent's deployment system that made follow up for feedback complex. The sensitivity of the traffic police force activities on the bearing of the country's security also biased some of the respondents to stay away from providing the required information.

Characteristics of Respondents

The personal characteristics of the respondents indicate that the study was dominated by male traffic officers (74.4per cent), with the dominant age group being 25 to 35 years (48.7per cent). Most traffic officers had a certificate as their highest academic qualification (62.1per cent), with the majority earning below Shs.400, 000 Uganda shillings (94per cent). The study captured more field officers (71.3per cent) than middle level managers (28.7per cent) and no high level manager with majority having worked in the force for over 8years (48.3per cent). Likewise, most of the traffic officers that took part in the study were from the central region (63.6 per cent).

Correlation Analysis

A correlation analysis was done to determine the strength and direction of the relationships between the independent variables and safety regulation enforcement. (Refer to table 4.1 in Appendix I). Results in table 4.1 indicate that road communication technologies is positively correlated with road safety regulation enforcement ($r = .43$, $p<.01$).

Regression Analysis

Reference to table 4.2 in Appendix I shows that road communication technologies (Beta = .430, $p<.01$) has a significant positive effect on the enforcement of road safety regulations. The predictive power of the model was found to be low at 17.8per cent. However, the model was robust (Sig. $F<.01$), in that the independent variable in the model was found to be a precise predictor of road safety regulations enforcement.

Research Implications

From the findings in tables 4.1 and 4.2, there was a significant relationship between road communication technologies and safety regulation enforcement ($r = .43$, $p<.01$) and with the independent variable predicting a 17.8per cent

percent change in the dependant variable. From this, it is acceptable to infer that an increase in road communication technologies will result into a 17.8per cent improvement in the levels of safety regulation enforcement on Ugandan roads. This means that, the adoption of intelligent transportation systems Young and Regan, [9], ranging from basic management systems (car tracking and navigation, traffic signal control systems, variable message signs, automatic number plate recognition or speed cameras) to monitor applications (security CCTV systems), and then to more advanced applications that integrate live data and feedback (driver profiles, weather information, parking guidance), will increase efficiency in safety regulation enforcement, Gladys, [19]. It is also correct to deduce that such a driving environment surrounded with road communication technologies would positively improve the general regulatory attitudes of drivers towards road safety regulation enforcement. Significant to note is the connection between Wilde [8] Risk homoeostasis theory and Douglas and Swartz, [11,24] studies on the perception of drivers on safety regulations and there enforcement. While the approaches for enforcement might differ, Wilde [8] idea of rewarding drivers with no accident records as opposed to punishing offenders supports Douglas and Swartz's findings on the perception of the reasonableness of the safety regulations by drivers if there to comply to safety regulations. Intelligent transport communication technologies if adopted would make enforcement reasonable in terms of convenience and affordability by cutting cost through spot on tolling of road users and offenders. However, what this study disagrees with risk homeostasis theory is the issue of Sub-optimal risk taking that occurs if the driver underestimates or over-estimates the danger of a given road activity. From the literature reviewed and the findings of this study, putting more effort in increasing the perceived risk of apprehension of traffic law offenders, for example by installing cameras, automatic road blocks for rail way crossing, speed governors among others is a more efficient means for enforcing safety regulations as opposed to Wilde's view of drivers taking low risk on the roads because of the high perceived risk of danger. Baguley and Jacobs [5]'s recommendation for the use of Microcomputer Accident Analysis Package (MAAP) to improve road safety in developing countries is in line with Gladys [19] on the adoption of advanced telematics that can integrate live data from different sources to aid in safety regulation enforcement. MAAP will enable road safety regulation enforcers to obtain reliable data from the road communication technologies for; diagnosis, planning, monitoring and evaluation, research and provide real time information to help with decision making during safety regulation enforcement. With these applications installed in different traffic enforcement gadgets, traffic officers can analyse their own data to; implement spot tolls, cover hazardous locations, choose appropriate counter measures and assess their effectiveness in safety regulation enforcement with increased efficiency, Sambasivan et al [15]; Krauth et al [20]. The use of electronic traffic gadgets for immediate road tolling supports Douglas and Swartz [11] findings as it increases the drivers' perception of the effectiveness of safety regulation enforcement. Road communication technologies can contribute to the improvement in drivers' perceptions of the effectiveness of safety regulation enforcement through automation. For example; automated road blocks at rail way crossing, Wever et al [24], that will not allow vehicles to cross until it is safe, speed governors connected to car trucking systems that cut the engine speed once the set speed limit is exceeded, weighing bridges that will not allow trucks to proceed if their weight is beyond what is prescribed etc, are some of the road communication technologies deployed to ensure effectiveness in the enforcement for traffic regulations. However, safety regulation enforcement should not become a menace to businesses given its interruption in the physical distribution processes as trucks are pulled over for inspection by traffic officers. Distribution of physical goods is highly dependent on meeting the agreed delivery times, [25-26]. So safety regulation enforcers must be conscious on the amount of time trucks spend on the road side while being inspected. With the application of road communication technologies, the pairing of computerised devices in the vehicles with the safety regulation enforcement gadgets or micro computers would realise faster information exchange for real time decision making during safety regulation enforcement, based on accurate data.

Policy Implications and Recommendations

The revelation that road communication technologies can predict a 17.8per cent change in road safety regulation enforcement as a single variable is a significant contribution of this study towards improving road safety in Uganda. The significant positive relationship revealed in the findings implies that governments can increase the level of traffic law enforcement by equipping

Table 1: Showing the correlation analysis results

		Road safety regulation enforcement	Road communication technologies
Road safety regulation enforcement	Pearson Correlation	1	.430**
	Sig. (2-tailed)		.000
	N	118	118
Road communication technologies	Pearson Correlation	.430**	1
	Sig. (2-tailed)	.000	
	N	118	118

**. Correlation is significant at the 0.01 level (2-tailed).

traffic officers with more sophisticated electronic equipment like speed guns, scanners, breathalyzers, radio communication gadgets, among others, European Transport Safety Council [27]. The biggest challenge facing safety regulation enforcers is their inability to access and exchange real time information and because of this; the law offenders have taken this loop hole to manipulate them through presentation of fake driver's licences and providing false information. Employment of traffic surveillance using the latest telematics and applications like MAAP would put an end to these acts by allowing traffic authorities to quickly and easily access information using road communication technologies such as licence scanners and number plate detectors, where if supported by intelligent transport systems would process data immediately and provide feedback for faster decision making. Government needs to pass policies that will oversee the establishment of traffic data systems and there integration with relating organisations like the MOWT, insurance corporations and licence providers, Global Road Safety Partnership [28], to allow monitoring of traffic and a seamless flow and exchange of information during road safety regulation enforcement. Instituting of safety audits in the country's road transport system would provide a better perspective on how to enforce road safety regulations, but this can only be done when proper policies are in place. These audits should cover the entire road related infrastructure, vehicles and the drivers, traffic laws, the traffic officers and any other area of interest to allow the identification gaps in the road safety regulation enforcement process. With the right information collected and analysed by road communication technologies, government will be able to come up with the right policies to address the inefficiencies in road safety regulation enforcement. Given that over 80per cent of accidents are caused by bad driver behaviour, which is a result of either poor enforcement of road safety regulations or non compliance by drivers, it is important that government revisits some of the existing legislations and makes them more stringent. For example, the majority of the traffic law can be turned to criminal offences to attract severe penalties and deter drivers from the bad behaviours. Enacting laws that specifically target bad driver behaviours like; sleeping behind the wheel [29], driving under influence of alcohol or drugs by reducing the maximum amount levels of alcohol required for a driver behind the wheel and increasing the penalties to include jail sentences and disqualification from driving can be another option. As opposed to disqualification, experience with severe penalties such as prison sentences in Scandinavian countries, the USA, Canada and Australia indicate has shown their lack of success in deterring drinking drivers. So, stringent punishments combined with disqualification for offenders will deter bad behaviour and put less pressure on the road safety regulation enforcement process. Furthermore, the characteristics of the respondents also have significant bearing on safety regulation enforcement. Considering the issue of education and remuneration, it was established that majority of the traffic officers (62.1per cent) have a certificate as their highest academic qualification. This qualification is not adequate for an officer supposed to offer guidance on issues of; speed, authenticity and meaning of documents, reconstruction of accident scenes, verifying vehicles in dangerous mechanical condition or let alone apply the proposed road communication technologies suggested to increase efficiency in safety regulation enforcement. It is understandable that the force does not attract many graduates for employment, but a policy on training the existing ones is long overdue. In addition, where 94per cent of the traffic officers are earning below 400,000Ugsh in the current economic times of double digit inflation with the global economy in a recession does not make the situation any better. This could explain why

Table 2: Showing the regression model

Model	R	R Square	Adjusted Square	R Std. Error of the Estimate
1	.430[a]	.185	.178	.44302

a. Predictors: (Constant), Road communication technologies
b. Dependent: Road Safety Regulation Enforcement.

traffic officers take bribes as low as 2000 Uganda shillings (0.8USD) to let traffic law offenders off the hook, [30]. This scenario is similar to a master who lets out a hungry dog to guard him in the night; the dog will prioritise hunting for food over the designated job. Government must come up with labour laws and policies to address these issues if the country is to improve the road safety levels on the highways. Another area of concern requiring redress is the need to broaden the scope of offences traffic police should enforce to improve road safety. Other than driving under influence of alcohol, over loading, over speeding, checking third party insurance, then tyres and indicators, the rest of the accident related factors go unnoticed. Even with the few aspects under consideration, the traffic officers are ill equipped to enforce the law. For example, many if not most of them do not know the technical specifications of a vehicle in DMC, they cannot tell the actual specification of a worn out tyre or the required carbon emission levels. Besides the later, aspects of; driving under influence of medical drugs, overtaking, driving close to the cars ahead, fatigue, strapping of under aged passengers, are among the many dangerous road behaviours that go un enforced. Though provided for in the Traffic and Road Safety Act, government should be seen to develop policies that will facilitate the traffic officer's capture all the mentioned aspects during safety regulation enforcement. Conclusively, road safety regulation enforcement cannot be a one man's show, and neither can it only be improved by road communication technologies. Government needs to push for policies that facilitate the integration of all activities of the different stake holders in safety regulation enforcement in order to achieve significant impact in this area. Integration of activities relating to road traffic in; Uganda National Road Authorities, Traffic Police, Insurance Corporations, Uganda Revenue Authority, MOWT and the judiciary onto one electronic platform, would create a strong force that would improve safety regulation enforcement in the country. Government should also be recommended for the unpredictable time and place deployment strategy to apprehend drivers under influence of alcohol and publicising of the offenders in the local news papers. Though the strategies have produced significant results in the number of offenders apprehended, the traffic police positioning and dates have become predictable and culprits have found ways of beating the system by avoiding main roads or sharing information on the locations of traffic police. Key to note is the need to shift from the tradition traffic policing to the adoption of transport intelligent systems that will support the use of road communication technologies. Whether in built in cars or embedded in the road infrastructure, government needs to adopt communication technologies in order to improve safety regulation enforcement. In addition, the issue of focusing on apprehension as opposed to deterring traffic regulation offenders needs to be eliminated. Arresting of offenders is a post mortem activity and does not bring back the lost lives or the damaged property. Worst still, it is more costly in terms of; time and clogging of courts of law due to petty offences and the extra manpower required for enforcement.

Research Challenges and Limitations

Like any other study, this one did involve overcoming some challenges and limitations with the most significant being accessing the respondents for feedback given the sensitivity of their profession. The traffic force that formed the respondents of the study fall under the country's security system which meant limits on access and the amount of information as some of it is classified. However, we must acknowledge the contribution of the Commissioner Traffic's office that on request provided the researchers with the necessary assistance. Gaps were also identified on the availability of local information on the variables. It was established that there is less of empirical data and more general opinion information especially in the local newspapers and magazines regarding road safety and enforcement in road transport. This challenge was addressed by reviewing relevant literature from studies done in the more developed countries like Australia and the USA. Furthermore, a longitudinal rather than the cross sectional approach that was used for this study, would have been preferred to ease the trucking of issues relating to improvement in road safety regulation enforcement over the years. However, this was not feasible given the resource limitations in terms of time and funding. To incorporate the longitudinal aspect of time, literature reviewed was stretched as far back as the year 2000 in order to truck the changes in the road safety regulation enforcement process.

Areas for Future Research

Future researchers in this area can start by targeting different respondents. The selection of traffic officers as respondents without consideration of the road drivers' opinions creates

some bias in the findings. Other researchers can head out and establish how to improve safety regulation enforcement but this time targeting drivers as respondents. The other contribution would be in establishing other variables that positively affect road safety regulation enforcement besides road communication technologies. Studies have shown safety awareness and road infrastructure as some among the many other variables that could have a bearing on road safety regulation enforcement.

Acknowledgements

This research paper would not be accomplished without the generous contributions of the Faculty of Computing and Management Science, the Commissioner Traffic's office, with special recognition to the Dean, Dr. Ntayi Joseph and the Head of Department Procurement and Logistics Management: Mrs Bulamu Eyaa Sarah for the guidance offered during the study. Our sincere gratitude also goes to the management of Makerere University Business School for having funded this study.

References

1. Robertson et al. (2012) Global Decade of Action for Road safety. (Online) Available: http://www.makeroadssafe.org/publications/Documents/decade_of_action_report_lr.pdf (June 6th, 2012)
2. Nasasira J (2009) Call for a Decade of action for Road Safety. Launch of the Second Report of the Commission for Global Road Safety. Daily Monitor, 20th January, p.3
3. Mutto M, Kobusingye OC, Lett. RR (2002) The effect of an overpass on pedestrian injuries on a major highway in Kampala–Uganda. Injury Control Centre-Uganda, Makerere Medical School and The Canadian Network for International Surgery African Health Sciences, 2(3).
4. Bishai D, Asiimwe B, Abbas S, Hyder A, Bazeyo W (2008) Cost-effectiveness of traffic enforcement: Case study from Uganda. Johns Hopkins Bloomberg School of Public Health, Baltimore, MD21030, USA.
5. Baguley CJ, Jacobs GD (1999) Traffic safety issues for the next millennium. Transport Research Laboratory.
6. Banomyong R (2004) Assessing import channels for a land-locked country: the case of lao pdr. Asia Pacific J. Marketing and Logistics, 16(2).
7. Luiz J (2010) Infrastructure investment and its performance in Africa over the course of the twentieth century. Int. J. Social Economics. Emerald Group Publishing Limited, 37(7).
8. Wilde GJS (2002) Does risk homoeostasis theory have implications for road safety. Department of Psychology, Queen's University, Kingston, Ontario, Canada; 324:1149-52.
9. Young LK, Regan AM (2007) Intelligent Transport Systems to support Police enforcement of road safety laws. ATSB Research and Analysis Report, Australian Transport Safety Bureau.
10. Batalia CJ (2001) Enforcement of laws and regulations that govern the road transport industry in East Africa. National Transport Corporation, Dar-es-Salaam.
11. Douglas MA, Swartz SM (2009) A multi-dimensional construct of commercial motor vehicle operators' attitudes toward safety regulations. The Int. J. Logistics Management 20(2) Emerald Group Publishing Limited 0957-409.
12. Leon R, Barry P (2002) Are safer roads promoting risky driving? British Medical Journal. BMJ Publishing Group, pp. 11:324.
13. Goodrum, P. M. and Yinggang, W (2009) A decision-making system for accelerating roadway construction. Emerald Group Publishing Limited 16(2):119-120.
14. Chunlu L, Yoshito I (2001) Information technology applications for bridge maintenance management. Logistics Information Management, 14:5/6.
15. Sambasivan M (2009) Performance measures and metrics for e-supply chains. J. Enterprise Information Management, Emerald Group Publishing Ltd, 22(3):346-60.
16. Mawanga, F. F. and Ntayi, M. J (2010) Social norms and compliance with road traffic rules in urban areas: Initial impressions of drivers in Kampala, Uganda. SA e-Publications and Electronic Journals, ISSN: 19955235, pp. 138 - 150
17. Eibl PG (1994) Design and use of digitized road networks in international road transport. Logistics Information Management 7(4).
18. Butagira T (2010) New Entebbe toll road to smash cost record. Daily Monitor, 20th January, p.3.
19. Gladys F (2010) Traffic Management and Transport Demand Management. (Online) Available: http://www.google.co.ug/#hl=en&source=hp&biw=1280&bih=685&q=Gladys+Frame%2C+Consultant+Traffic+Engineer+%2B+the+world+bank&aq=f&aqi=&aql=&oq=&gs_rfai=&fp=9bb1c3799b6a5231(October 26th, 2010).
20. Krauth, E., Moonen. H., Popova, V. and Schut, M (2003) Performance indicators in Logistics service provision and warehouse management – A literature review and framework.
21. Krejcie RV, Morgan DW (1970) Determining Sample Size for Research Activities. Educational and Psychological Measurement, 30:607 - 10

22. Cronbach IJ (1951) Coefficient alpha and the internal structure of tests. Pyschometrica 16:297-334.

23. Biersdorff K (2009) How many is enough? The quest for an acceptable survey response rate. Bright Ideas, 1:3.

24. Wever R, Jasper VK, Casper B (2008) User centred design for sustainable behaviour. Int. J. Sustainable Engineering 1:1.

25. Friday D, Ntayi MJ, Muhwezi M, Eyaa S, Tukamuhabwa B (2011) Vertical Collaboration and Physical Distribution Service Quality. Int. J. Economics and Management Science, 4.

26. Friday D, Tukamuhabwa B, Eyaa S (2012) The effect of trust and commitment on vertical collaboration and physical distribution service quality. Int. J. Business and Behavioural Sciences, 2(4).

27. European Transport Safety Council. (2012) Police enforcement strategies to reduce traffic casualties in Europe. Retrieved June 3rd, 2012 from http://www.etsc.eu/oldsite/strategies.pdf.

28. Global Road Safety Partnership. (2011) Government, Business and Civil society, Working together to save lives. (Online) Available: http://www.grsproadsafety.org/knowledge road environment and infrastructure-34.html (March 17th, 2011)

29. Fourie C Holmes and Jackson A (2009) A Review of Fatigue Risk Management Systems and their potential for managing fatigue within the UK Road Transport Industry. Clockwork Research Ltd.

30. Rudaheranwa N (2010) Trade Policy and Transport Costs in Uganda. Centre for Research in Economic Development and International Trade, University of Nottingham.