A CAUSAL-BASED MULTI-SECTORAL APPROACH TO THE PREVENTION OF ROAD TRAFFIC ACCIDENTS AND PRIORITIZATION OF RESPONSE MEASURES IN SOUTH AFRICA

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ABSTRACT

Road transport plays a critical role in promoting mobility, accessibility and poverty alleviation. While average household car ownership rates in the developing world remain low, there has generally been an unprecedented growth in vehicle population, particularly in urban areas. This has also seen a rapid increase in road accidents and fatalities. The causes of road carnages are multiple. They can however be classified broadly under engineering, environmental, mechanical and human factors, usually termed: Human (H), Vehicle (V) and Road (R) environment factors. These broad categories need to be adequately and critically analyzed for each accident in order to design sustainable, integrated and effective preventive responses. Accident statistics, particularly in the developing world, are generally incomplete and inadequate. This makes it very difficult to carry out holistic analyses, design responses and preventive measures and prioritize them. As a result, most responses are rather reactive, thereby only addressing the symptoms. This has resulted in many people continuously getting injured or losing their lives daily.

This paper proposes a multi-pronged approach, which utilizes the above broad causes to holistically analyze accidents. It makes use of a simple approach which weights the different causes in order to identify and trace the causal chain involved in a particular accident. Such a holistic causal analysis of different accidents is useful in the determination and prioritization of responses and preventive measures. It also provides a framework for predicting the possibility of accidents occurring at particular locations and hence the determination of black spots. It also ensures that responses and preventive measures are driven from a multi-sectoral basis.

INTRODUCTION

Despite having lower vehicle populations in developing countries, worldwide trends show that the total number of people who lose their lives or get injured in road carnages continues to rise. This is not the case in the developed and highly motorized countries. Statistics show that between 1987 and 1995, road fatalities were highest in Latin America (over 60%) followed by the Asia-Pacific countries (40%). African countries accounted for over 25% although North Africa had as high as 36%. On the contrary, during the same period, road deaths in the developed world declined by an average of over 10 per cent during the same period. (NDoT: 2007).

It is appreciable that many developing and transitional countries have undertaken a number of infrastructure rehabilitation and modernization programs to deal with growing vehicle populations on their roads. However, it should also be understood that generally such efforts fail to integrate road safety at an early stage in these massive infrastructure projects. For instance in South Africa, statistics show a high proportion of accidents involving cars and pedestrians as well as cyclists (NDoT: 2009). It was only recently that non motorized modes of transport have been seriously considered as legitimate users of road space. Most road infrastructure projects fail to accommodate the latter, thereby resulting in fatalities and/ or life threatening injuries.

A critical analysis of accident trends in developing, transitional and developed countries shows that there is no direct relationship between car ownership levels and road traffic accident distribution. Instead other factors influence the distribution and occurrence of road carnages across different countries. Generally these factors can be broadly classified under engineering, traffic management, environmental, mechanical and human factors. A closer analysis of these broad factors is required in order to determine the chain of events that take place to result in an accident.

This is important in highlighting black spots and designing of remedial measures to avoid future accidents.

This paper acknowledges the deficiencies associated with accident investigation and statistics in the developing world and how it handicaps exhaustive analyses of the above broad factors. For instance the Minister of Transport (2007) acknowledged the dearth of accurate and up to date accident statistics in most local authorities in South Africa, as well as the associated difficulties of engaging in holistic analyses. (Internal Question Paper Number 36, 2007). The author strongly advocates for an exhaustive investigation, recording and reconstruction of accidents. The author however acknowledges the amount of work involved given the number of accidents that take place annually. Records should reflect all the useful data required in the analysis and designing of interventions to prevent future loss of life. Such data should indicate the exact location of the accident, traffic conditions, driving behaviour, speed limits, environmental conditions, traffic management systems in place, etc.

BACKGROUND TO ROAD TRAFFIC ACCIDENT FACTORS

The use of the term “road accident” gives an impression that it is the supernatural act of God which nobody has absolutely any control over. This shuts out all opportunities for proactive prevention. Terms such as “collision, crash, incident” etc are indicative that they are the result of some fault and that something can be done to avoid or prevent them. They are indicative of the existence of certain factors that caused the accident, injuries or death e.g. reckless, drunken and negligent inconsiderate driver behavior, non wearing of seatbelts, etc). Black spots are areas where traffic conflicts develop into accidents. Usually black spots cannot be defined through statistics only. It is critical to establish the traffic conflicts and address them to prevent loss of life or injuries, before accidents happen. (Sedan, 2008)

Accidents should be visualized by answering the questions ‘what, who, where, when, how and why? These give a reflection of the type of vehicles, location, persons involved, time and type of accident as well as the key contributory factors. Generally accidents are a product of multiple events or factors described above. Such factors include behavioral (B), vehicle (V) and highway (H) factors. In investigating accidents, it is critical to understand that they involve a chain of links. The challenge is to establish the strongest link in the causal chain. B- factors are human and include drunkenness, fatigue, poor vision, sleepiness, sickness, over speeding etc, which affect the driver’s capacity to control the vehicle. Earlier detection and addressing of these factors can result in most accidents being prevented. Unfortunately, the reality is usually that it takes an accident to prevent another. (Sadan: ibid).

V-factors have to do with the mechanical set-up of the vehicle. These include the functional condition of brakes, lights, steering wheel, tyres and the presence and condition of passive and active safety devices on the vehicle. A combination of these V-factors influences the ability of the driver to control the car. For instance several accidents have been recorded where one or a combination of these factors played a part. Non functional brakes can cause collisions, running down of pedestrians etc. Tyre bursts can result in vehicle overturns or collisions. It is important that vehicles undergo regular fitness tests to ensure that these factors are addressed to prevent accidents and loss of lives. (Sadan: ibid).

H-factors have to do with the road infrastructure. Like other factors, they normally occur as a combination to influence the occurrence of an accident. For instance the geometric design of the road, confusing or unclear lane markings or traffic signs, wet and slippery surface, etc can act together to cause an accident. Some of these factors are shown in Plate 1 below.

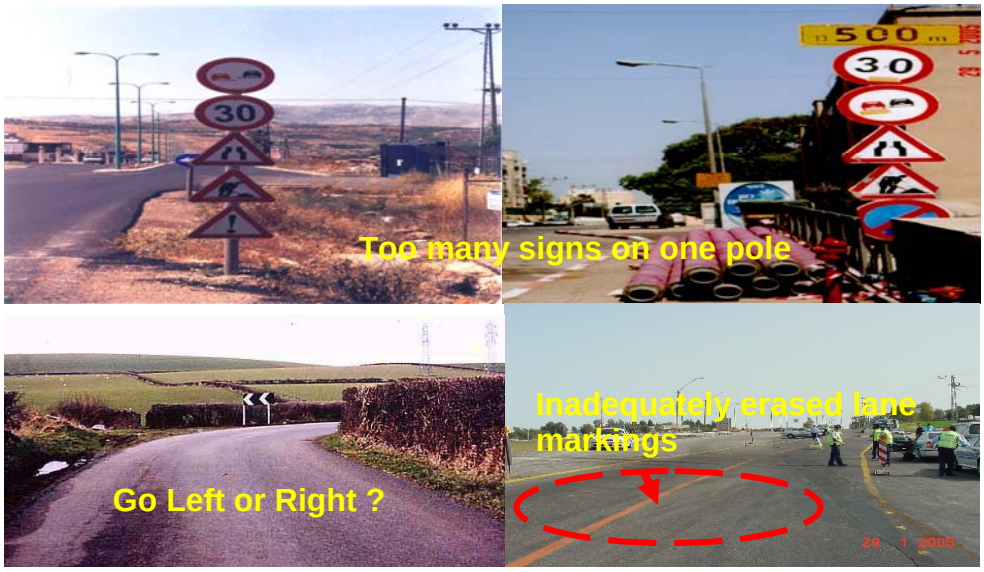

Plate 1: Accident Causing H-Factors (Source Adopted from Sadan: 2008)

For an accident to occur, usually it takes a combination of a number of different factors. It is critical to establish the most influential ones and the strongest causal link and patterns involved in different carnages. This would assist decision makers to design appropriate intervention measures that best address the problem and prevent other accidents in the future.

ROAD ACCIDENT INVESTIGATION IN SOUTH AFRICA

South Africa's road safety ranks fourth worst in the world. This warrants critical accident investigation. (Joubert. et al: 2006), Accident investigation can be defined as the use of scientific techniques to evaluate physical evidence at an accident scene, coupled with what witnesses have seen. The process therefore envisages more than the jotting down of a few details and clearing the road to allow traffic flow. Accident investigation involves the recording, investigative and reconstruction phases. The recording phase involves accident response, scene or incident management and protection, medical response, information gathering and reporting. The investigative phase requires a critical and analytical approach. It involves the proper preservation of evidence, detailed analysis of the different causative factors, collection and preservation of photographic evidence and scientific calculations to determine preliminary speed. The reconstruction phase involves the drawing of plans, reconstruction reports, and determination of pre-accident factors, preparation of files for police and judiciary; as well as expert testimony. (Rooyen: 2004).

Accident investigations should provide as much detail as possible to enable a holistic analysis. Rooyen (ibid) lamented the state of accident investigation procedures in South Africa. He noted that it is not clear as to whose responsibility it is among the South African Police Services (SAPS), Provincial and Local Traffic Departments, Metropolitan Police, and the Road Traffic Management Corporation. He noted that the unclear institutional set-up is a result of the absence of clear legislative investigative powers in the Road Traffic Act. Joubert. et al (ibid) echoed the same sentiments that The Act does not really give a clear legal mandate for accident investigation.

An assessment of road accidents across the world has shown that more than 90 percent are a result of human factors. Rooyen (ibid) noted that sadly, most irate motorists escape prosecution for accident causative violations, and literally get away with "murder" cases. The main reason is the poor and substandard quality of accident investigations and the resultant reports. Poor and unprofessional accident reports make it easier to apprehend than prosecute offenders. In South Africa, the collation of accident statistics nationally, provincially and locally is usually inadequate, characterized by huge backlogs. More than 45,000 unprocessed accident report backlogs are not uncommon. The Minister of Transport (2009) also highlighted how such incomplete accident data handicaps the effective deployment of law enforcement resources, particularly during high mobility periods of the year.

The other weakness of the process in South Africa has to do with the exclusion of civil engineers from accident investigation. In most cases, law enforcement officers are ill-equipped to deal effectively with engineering factors during accident investigation. Thus H-factors are hence not given critical analysis resulting in unaddressed black spots along the road network. In Israel, the police force has a specialized unit of engineers trained in forensic investigations. On the contrary, in South Africa these are not only very few but also expensive. Protection and preservation of evidence is also not given high priority. While the role played by emergency and vehicle recovery services in saving lives and property is highly appreciated, these institutions usually act as evidence eradicators, making it impossible to conduct thorough accident investigations and reconstruction. There is need for the provision, standardization and prioritization of training, procedural and legislative requirements governing accident investigation and the protection of accident scenes. (Rooyen: 2004, Joubert. et al: ibid).

Response times by law enforcement officers are also unacceptably high (usually more than 45 minutes) (Rooyen: 2004). Accident investigation in South Africa generally takes an average of two years (Arrive Alive, 2008). Some of the most common causes of delays include late deployment of qualified investigators/ reconstructionists, jurisdictional conflicts, etc. For instance there are cases where public law enforcement institutions deny private contractors access to information. In other cases the release of vital evidence such as autopsy reports, blood alcohol results, etc is delayed due to too much workload. Generally the process is characterized by too many accidents which are not properly investigated due to too few and ill-equipped officers.

ACCIDENT STATISTICS IN SOUTH AFRICA

Road accidents statistics in South Africa have always been on an upward trend until the last festive season. In his key note address, the Minister of Transport (2009) attributed the changes to proper coordination of campaigns and law enforcement as well as transformations in travel behavior. For instance the Arrive Alive campaigns have been expanded beyond festive periods while the RTMC has also streamlined road safety and strengthened the coordination of law enforcement efforts. The strict implementation of the administrative adjudication of road traffic offences (AARTO) process was also cited as a major front in dealing with habitual traffic offenders. Generally the government is pushing for a deliberate paradigm shift from zero tolerance to 100 percent compliance.

The RTMC embarked on a number of measures to improve accident management. For instance, the institution has bolstered its forensic capacity by contracting out the service to the private sector. It also conducted a series of training programs to empower SAPS members. Currently there are measures meant to improve the collection, processing and dissemination of information from the Arrive Alive information Centre (NDoT: 2009).

The recorded reduction in road fatalities have taken place despite the upward trend in vehicle population which increased by 2.61 percent between 2007 and 2008. This also clears the fallacy of a positive relationship between growth in vehicle population and road fatalities. In the Eastern Cape there was a record 36.8% drop in accidents, while the Free State had a 9.60% reduction. In terms of aggregate crashes there was a national average reduction of about 33.8% during the 2008/09 festive season as compared to the same period in 2007/08 (NDoT: 2009). Provincially, only Limpopo recorded an increase in fatalities during the 2008/09 festive season. Gauteng had the highest reduction in fatalities of 49.61%. The trends of road fatalities for the past five years are provided in Table 1.

Table 1: Road Fatalities Trends in South Africa

Year	Total Fatalities	Percentage Change
2004	1237	
2005	1454	17.5
2006	1467	0.9
2007	1535	4.6
2008	1130	-26.4

Source: (NDoT: 2009)

Figure 1 below illustrates the provincial distribution of road fatalities during the same period.

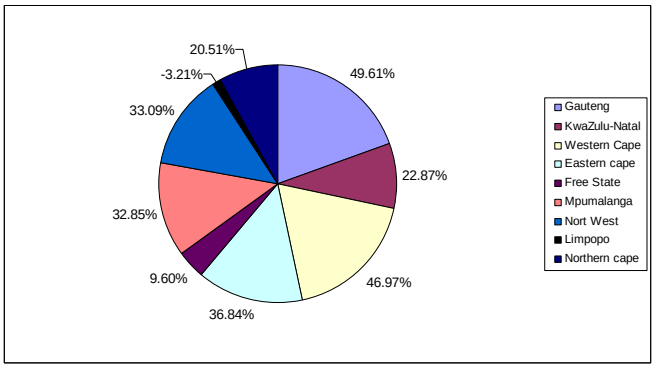

Figure 1: Provincial Distribution of Fatalities in 2008/09 (Source: NDoT: 2009)

Pedestrian fatalities were the highest distribution averaging 35.69% of all fatalities in 2008, although there was a 39.02% reduction as compared to the same period in 2007. This still shows that South African roads remain dangerous to non-motorized transport users. A lot still needs to be done to protect them particularly in settlement areas dissected by high speed mobility ways. Pedestrian travel behavior will also need to be investigated in order to adequately inform law enforcement institutions on how to deal with irate road users. Single vehicles over turnings were the second highest type with 321 accidents recorded countrywide during 2008 the festive season. Head on collisions had the lowest modal split with 200 accidents recorded. The last two types of crashes were attributed mainly to human factors such as fatigue, drunken driving, over speeding, unsafe and illegal overtaking, etc. Most crashes were recorded between 18:00 and 23:00 hours, while more than 60 percent were on Fridays, Saturdays and Sundays. The distribution of traffic offenses recorded was also highest for drunken driving and overspeeding which accounted for 91 percent. Mechanical factors such as worn out tyre bursts, overloaded vehicles, etc also contributed to some extent. The distribution of fatalities by age group revealed that the 20-39 groups had the highest modal share of about 20 percent, during the same period (NDoT: 2009). Trends in accident statistics per causal factor in 2006 are provided in Figure 2 below.

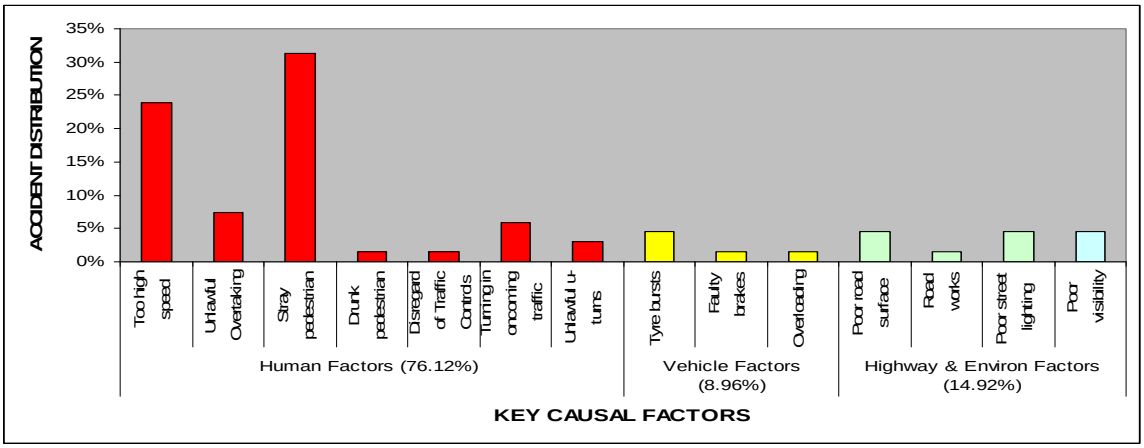

Figure 2: Distribution of Accidents in SA per Causal Factor (Source: Internal Question Paper no. 30- 2007)

Reduction in road crashes and fatalities were also achieved despite a 4.04 percent growth in driver population during the same period. While the above achievements are highly appreciable, the inadequacies associated with accident data in South Africa, requires that any conclusions drawn be treated with caution. Whereas the Department of Transport attributed the achievements to improved law enforcement, other authorities had different explanations. For instance Allafrica.com (2009) reported that a number of analysts attributed the reduction in crashes and fatalities to changes in travel demand associated with the current economic recession. They indicated that average propensity for long distances travel has fallen drastically due to the current economic hardships. Handfield-Jones of the Automobile Association of South Africa, explained that South African roads remain more dangerous compared to those of the developed world. For instance in 2006, the former had 12.02 fatalities per every 100 million vehicle kilometers compared to 0.9 for the United States of America. The same view was share by Labuschagne who pointed out that the

country's accident records need to be improved. H-factors such as road conditions, traffic signs etc need to be addressed urgently. (http://allafrica.com/stories/200901160155.html).

A MULTI-SECTORAL APPROACH TO ACCIDENT EVALUATION

Accident evaluations must be professionally comprehensive. This not only helps in convicting offenders, but also in streamlining necessary interventions. An accident report should highlight the key causal factors. Accident reconstruction should indicate the chain of events that took place, resulting in the crash. Generally an accident involves a combination of factors which must be clearly understood during accident investigation and reconstruction. An example of the chain of events involved in an accident is provided in Figure 3 below.

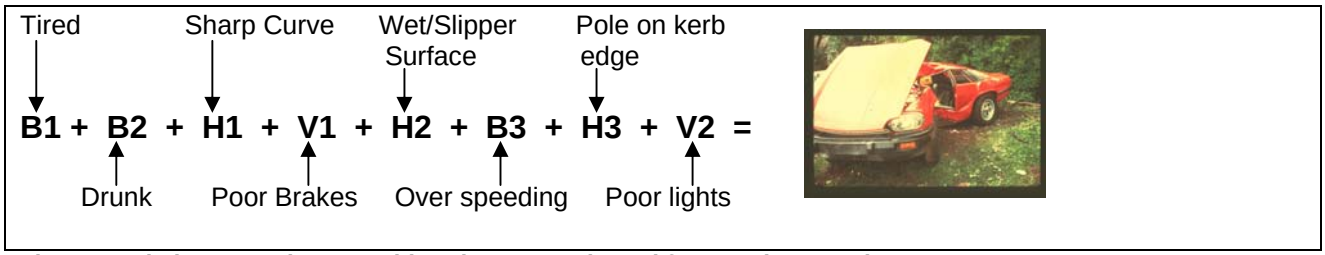

Figure 3: Chain Events in an Accident (Source: Adopted from Sadan: 2008)

Apart from indicating the chain of events, accident reports should also clearly indicate the exact location of the accident on the road network. An indication of chain events helps in the prosecution of offenders. For instance, the different factors will be weighted such that the key cause(s) will be highlighted. If human behavioral factors such as drunkenness, over speeding, etc were the main causes, then it will be easier to prosecute the driver. Similarly if vehicle factors were the main cause, it will assist law enforcement officers in determining the road worthiness of the vehicle prior to the accident. However, focus should not only be on prosecution. Analysis of highway factors help in identifying accident hot spots on the road network. Engineers will then be able to focus investigations on these spots and adjust the geometry of the roads, change speed limits, install energy absorbers, traffic calming measure etc, to prevent further accidents.

In Israel the forensic section of the Police Services make use of a technique called Square Analysis. It uses a matrix to record all the key causal factors in an accident. The matrix is used together with a road map to indicate the exact location of the accident. Accident reconstructionists will then make use of these tools to establish the chain of events that would have taken place prior and during the accident. The law enforcement units are also aided by security cameras and other vehicle-to-vehicle and vehicle-to- infrastructure communication devices in perfecting the investigations and reconstruction exercises. An example of the Square Analysis Matrix is provided in Figure 4 below.

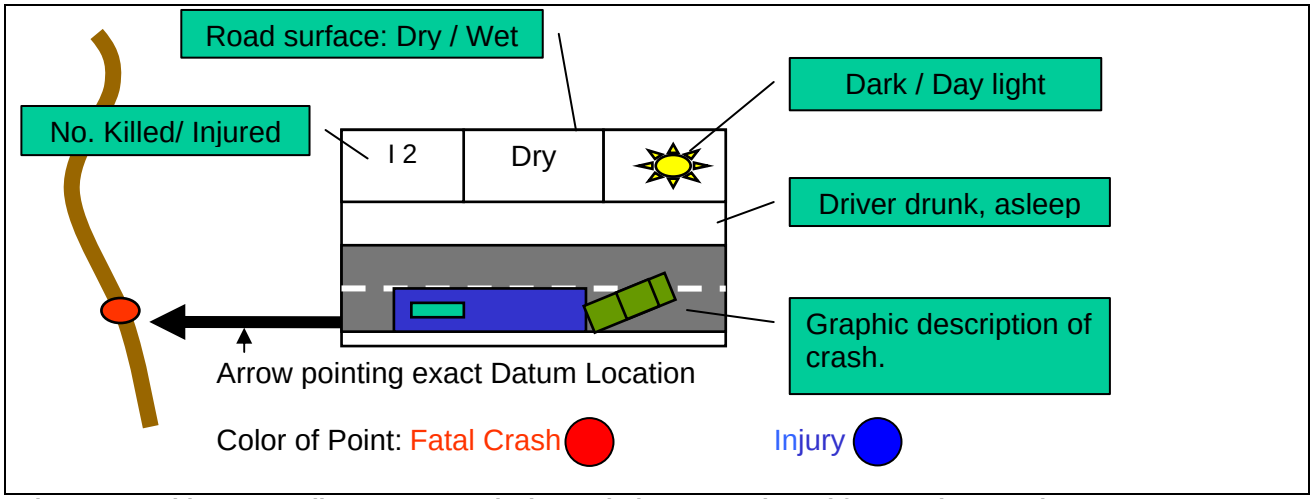

Figure 4: Accident Recording Square Analysis Matrix (Source: Adopted from Sadan: 2008).

Figure 5 below illustrates how the matrix is used to isolate black spots along the road network.

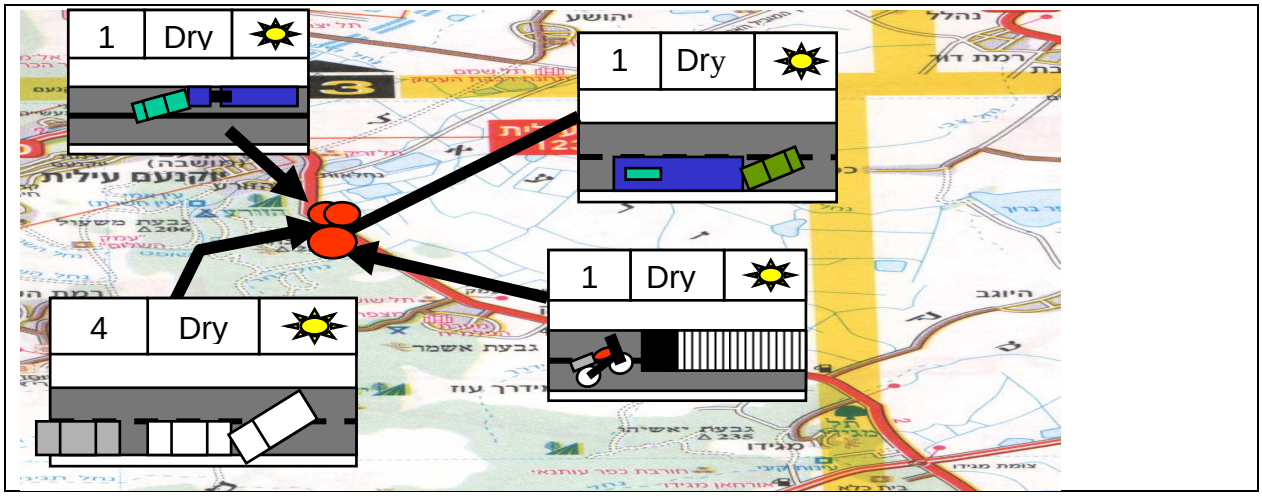

Figure 5: Location of Black Spots Using Square Matrix (Source: Sadan: 2008)

The utility offered by a holistic accident investigation and reconstruction approach envisaged above, cannot be overemphasized. It should however be complemented by a proactive multi-pronged and integrated strategy which addresses enforcement, education, engineering as well as community awareness and change of travel behavior. Figure 6 below illustrates an integrated approach to analyzing and addressing road safety problems.

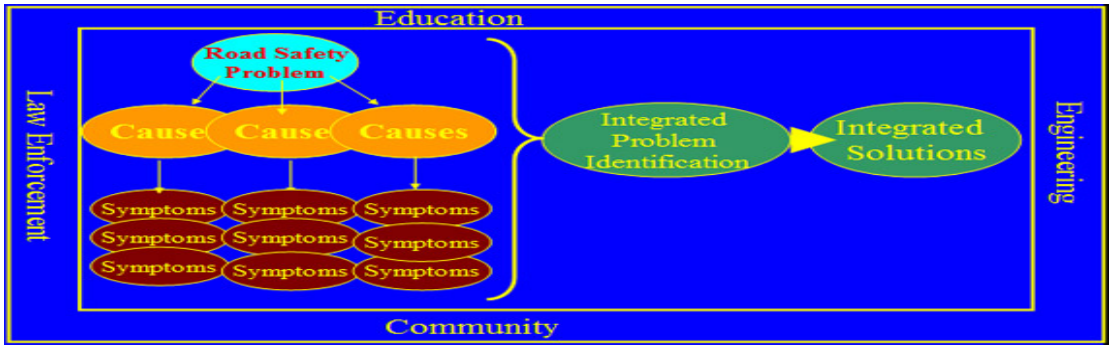

Figure 6: An Integrated Approach to Road Safety Analysis. (Source SANRAL: 2007)

The approach should not only be focused at addressing the symptoms. It should be informed by adequate problem structuring, which draws from professional investigation and a holistic causal analysis of accident reconstruction reports. Identified black spots should be critically evaluated so that appropriate measures or combination of interventions can be prioritized, funded and implemented.

CONCLUSIONS AND RECOMMENDATIONS

Road safety in South Africa remains critical. However, trends in crash and fatality statistics for the 2008/09 festive season show a major decline, for the first time in the decade. Although the figures should be treated with care due to the current deficiencies associated with accident data, there is hope that the roads are becoming less dangerous. While accident investigation helps in planning remedial solutions, a more proactive involving regular road safety audits and assessments is strongly recommended. Road safety in South Africa is still not comparable to that in the developed world. However current efforts to educate road users through the Arrive Alive program as well as coordinated law enforcement and accident information dissemination through the RTMC are highly appreciable.

There is still a lot to be done in terms of properly mainstreaming accident investigation, reconstruction, recording, as well as accessibility to accident statistics. The country's law enforcement units should be more capacitated to professionally investigate accidents and compile

detailed reports that can be effectively used as litigation evidence in prosecuting offenders. It is also worth investing in Intelligent Transport Systems (ITS) that help in accurately locating accidents, communicate their occurance and assist in mobilizing emergency services as well as diverting traffic from the scenes. Overally accident investigation, reconstruction and recording should not only help in prosecuting offenders but also act as a planning aid for the design, prioritization, funding and implementation of interventions to prevent future carnages.

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