WAYS OF REDUCING ACCIDENTS ON SOUTH AFRICAN ROADS

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ABSTRACT

Road accidents claim between 13,000 and 14,000 lives annually in South Africa. Many victims are jaywalking pedestrians, often under the influence of alcohol or drugs. Motorists are involved in fatal accidents due to various human, vehicle and road factors. With the annual increase in vehicle ownership and use, the question is how to lower the fatality rate in South Africa?

In order to substantially lower the fatality rate on South African roads, stringent speed enforcement should be implemented and measures adopted to bring amenities closer to informal settlements prone to jaywalking; coupled with education, enforcement and engineering.

Fine-tuning the annual reduction of road fatalities involves enforcement to reduce vehicles prone to tyre bursts and engineering techniques to minimise road sections that are wet, slippery or have sharp bends.

1. INTRODUCTION

Road carnage in South Africa is caused by human, vehicle and road factors. In order to reduce the number and severity of accidents on South African roads, contributing factors need to be identified. Ways of reducing fatalities and the severity of road accidents can be adopted from international practices. Education of the public about the importance of adhering to traffic rules and regulations in conjunction with enforcement and engineering should form the basis of ways of reducing the fatality rate.

International experiences and several South African sources provide information to estimate the potential decrease in annual road fatalities

2. FACTORS CAUSING ROAD ACCIDENTS

There were 9 918 fatal road accidents in South Africa during 2002 [1]. The main contributory factors to fatal accidents in December 2002 were categorised as follows: human factors 78%, road factors 12% and vehicle factors 10% [6].

2.1 Human Factors

Human factors are the main causes of road fatalities in South Africa. An individual's ability to hear, see, evaluate and react to information influences traffic safety [3]. Information that a driver is subjected to includes: on-coming traffic, adjacent vehicles and pedestrians or bystanders, and vehicles behind or in front of the driver. Human factors that reduce a driver's ability to safely interact with this information include: speeding, alcohol or drug abuse and fatigue. Other aspects of human behaviour that influence the road safety risk are: jaywalking, age, gender, and the violation of traffic rules and regulations.

In order to lower the fatality rate most substantially, the major contributory factors need to be identified. Between 2001 and 2003, the highest number of fatalities occurred in December. The festive season in December is characterised by excessive consumption of alcohol, speeding and long distance travel. Table 1 shows human, vehicle and road factors with their respective percentage contribution to the national fatality rate in December 2002. These statistics allude to the fact that the South African fatality rate is not purely influenced by one contributory factor (see Table 1).

Lowering the national fatality rate entails identifying the top tier of contributory factors and determining ways of reducing these factors. In December 2002, the main contributory human factors were: jaywalking 47% and speeding 30% (see Table 1). As stated earlier, in December 2002, human factors constituted 78% overall. National road safety campaigns should therefore, primarily focus on lowering the occurrence of jaywalking, alcohol or drug abuse and speeding.

Jaywalking is when pedestrians cross roads at undesignated crossings with motorists not anticipating their presence, collisions result out of inevitability. Jaywalking also involves pedestrians under the influence of alcohol or drugs that cross or walk along side high mobility routes. Informal settlements next to highways are characterised by high pedestrian travel. Residents of these settlements often need to access amenities (e.g. shops, access to public transport, etc) on the other side of highways [5]. The direct desire lines are across highways as detours via pedestrian bridges are very long. This land use is inappropriate, as high mobility routes should not have direct vehicular or pedestrian access.

Speeding occurs when motorists do not adhere to stipulated speed limits. Inertia keeps the driver and fellow passengers moving forward at the same speed as prior to the collision, after the vehicle is stationary due to an accident. Therefore, higher travel speeds increase the impact and severity of the accident. Head-on collisions result in all the occupants of both vehicles being subjected to the impact of the combined speeds.

2.2 Vehicle Factors

Aspects of vehicles that increase the likelihood of accidents when travelling are vehicle factors. These factors include: unroadworthy vehicles, worn-out tyres, wrong air pressure, overloading of vehicles, faulty brakes and vehicle lights. In December 2002, the main contributory vehicle factors were: tyre bursts 56% and brakes 19% (see Table 1). In these cases, drivers have little control over vehicle factors and accidents are almost inevitable.

Tyres are designed to carry certain vehicle loads under specific tyre pressures. Worn-out tyres have reduced wall thicknesses, increasing the likelihood of tyre bursts under vehicle loads. Long distance travel heats up tyres increasing internal air pressure but this increase is magnified depending on the vehicle load. Overloading of vehicles greatly increases the likelihood of tyre bursts, especially on long distance trips without regular stops. When the tyre bursts and the vehicle is in motion, the weight of the vehicle, passengers and goods are transferred onto the burst tyre, will often result in overturning, especially if the brakes are applied simultaneously.

Table 1. Adjusted contributory factors to fatal accidents for December 2002.

Human Factors	Urban	Rural	Total	Group %	Group %
Unknown			0	0	
Pedestrian: Jaywalking	76	272	348	47	
Speed	30	191	221	30	
Overtaking	1	34	35	5	
Turn in front	9	25	34	5	
Disregard of traffic signals/ stop signs	7	10	17	2	
Following too close	2	6	8	1	
Driver-alcohol suspected	3	24	27	4	
Pedestrian: alcohol suspected	4	16	20	3	
Fatigue	1	27	28	4	
Subtotal	133	605	738	100	78
Vehicle Factors	Urban	Rural	Total	Group %	Group %
Unknown			0	0	
Overload	0	9	9	10	
Brakes	1	17	18	19	
Tyre burst	1	51	52	56	
Tyres smooth	1	2	3	3	
Lights	0	11	11	12	
Subtotal	3	90	93	100	10
Road Factors	Urban	Rural	Total	Group %	Group %
Unknown			0	0	
Poor visibility	34	6	40	34	
Poor street lighting	9	1	10	8	
Sharp bend	18	2	20	17	
Blind rise/corner	6	0	6	5	
Poor road surface	12	3	15	13	
Road wet/slippery	18	2	20	17	
Poor/defective road signs	1	0	1	1	
Narrow road	2	0	2	2	
Road works	3	1	4	3	
Subtotal	103	15	118	100	12
Total	239	710	949		100

Source: Festive season report on road accidents, NDOT, 2003

Malfunctioning brakes prevent drivers from avoiding colliding with adjacent vehicles, bystanders, objects or pedestrians. When brakes are not functioning, the use of hand brakes will often result in overturning of the vehicle due to inertia. Accidents are almost inevitable due to malfunctioning brakes, as hooting may not move objects out of the path of collision in time.

2.3 Road Factors

Finally, road factors increase the likelihood of accidents when travelling. Road factors include: road surface type, slippery roads, poor visibility or inadequate street lighting, sharp curves, inadequate road fencing and sight distance. In December 2002, the main contributory road factors were: poor visibility 34%, sharp bends 17% and slippery roads 17% (see Table 1).

Poor visibility is due to sections of road having inadequate street lighting or dense fog. Inter visibility is reduced between vehicles making accidents almost inevitable as perception-reaction time is limited.

Sharp bends require low travel speeds in order to avoid driving off the road at a tangent. When faced with a sharp bend at certain travel speeds, motorists struggle to keep vehicles on the road as the vehicle tends to travel straight. This tangential vehicular movement results in accidents with adjacent surroundings or overturning.

Slippery road sections prevent motorists from avoiding collisions with adjacent vehicles, bystanders or objects. At a certain speed, drivers feel in control of the vehicle but slippery roads prevent the vehicle from stopping in time.

3. STATISTICAL MODEL TO ESTIMATE ACCIDENT REDUCTION

In order to substantially lower the fatality rate, measures need to be determined that will reduce the top tier of human, vehicle and road factors.

As stated earlier, in December 2002, human factors comprised 78% of the fatality rate. Nationally efforts should focus on lowering the main contributory human factors i.e. jaywalking, alcohol or drug abuse and speeding.

Lowering the occurrence of **jaywalking** in South Africa involves preventing human settlements close to freeways. Theoretically, these high mobility routes should not allow direct pedestrian or vehicular access. Building high concrete walls does not remove surrounding trip attractions that make residents walk alongside or cross freeways. In the event when informal settlements crop up next to freeways, a study should be done to determine [5]:

- How pedestrians get involved in accidents adjacent to freeways,
- What trip attractions give residents incentive to walk alongside or cross freeways,
- What measures would bring these trip attractions closer to informal settlements, removing the need to walk alongside or cross these high mobility routes and
- The effectiveness of implementing these measures.

The author strongly feels that this approach would yield a 90% reduction in pedestrian fatalities. This reduction rate was assumed as the average pedestrian, sober or not, would have no reason to cross these high mobility routes or walk alongside but allows for a one in ten chance of the odd jaywalker. Nationally, this would mean reducing pedestrian fatalities from 348 to 17 in December 2002 (see Table 1).

Speeding is the second main contributory factor to fatalities in South Africa. Educating the public about the dangers of speeding should be done using signboards and road safety campaigns via the media.

Currently 40% of South African drivers exceed the 120km/h speed limit, 80% the 100km/h limit and 90% the 60km/h limit [1]. It can be stated that 40% of motorists on rural roads exceed the speed limit and 80-90% of motorists on urban roads. Speed is a contributory factor in 75% of accidents on South African roads and the higher the speed, the greater the impact [1]. Higher travel speeds increase the number and severity of accidents. This explains why, although fewer drivers exceed the speed limit on rural roads, there are more fatal accidents on rural roads. This highlights the need for more traffic police to be assigned to urban roads and for very costly fines to speed limit violators on rural roads. Due to shortage of traffic police, 90% of urban roads can be fitted with speed cameras.

By law, the speed limit is exceeded when one travels 10% over the stipulated limit i.e. 66km/h in urban areas and 132km/h on roads in rural areas. Speed enforcement by traffic police would keep motorists within the speed limit i.e. 6km/h speed reduction in urban areas and 12km/h in rural areas (in research done by the CSIR (1980's) it was found that a reduction of 1km/h could lead to a reduction of 9 fatal and 120 total crashes per month).

A unit change in urban speed limits resulted in a change in fatalities in South Africa from 0.6% to 4.0% [4]. These South African fatality rates reflect a varying range. It was decided to use a conservative rate of 3.5%.

The decrease in fatalities in determined as follows:

- Urban 60km/h: 6km/h x 0.9 x 3.5/100 = 0.19
- Urban 100km/h: 10km/h x 0.8 x 3.5/100 = 0.28
- Rural 120km/h: 12km/h x 0.4 x 3.5/100 = 0.17

Total = 0.64

Table 1 indicates that 221 fatalities were due to speed in December 2002 with 30 in urban areas and 191 in rural areas. These decreases in fatality rates were applied to the number of fatalities shown in Table 1 as shown in Table 2.

Enforcement should involve the use of speed cameras and violators paying spot fines or have their vehicles impounded until the fine is settled. Speed enforcement should also involve the use of Intelligent Speed Adaptation (ISA) in public transport vehicles and motorists apprehended travelling at 160 km/h. These motorists should have their drivers' licences being tagged electronically; indicating the number of speed limit violations and above a certain number it is nullified. This approach should be adopted throughout the year, and not merely over the festive season.

Table 2. Estimated reduction in fatalities nationally during December 2002.

	Urban roads (60 km/h)	Urban roads (100 km/h)	Rural roads
Reduction in average travel speeds	6 km/h	10 km/h	12 km/h
Decrease in fatality rate	0.19	0.28	0.17
Number of fatal accidents	30	30	191
Number of fatal accidents reduced	6	8	32

In order to primarily lower the fatality rate nationally, these measures should be adopted to reduce jaywalking and speeding. Secondary measures should seek to lower vehicle and road factors.

Preventative measures should be taken to avoid vehicles factors e.g. routine checks on the functionality of brakes, tyres, lights, indicators and overall vehicle roadworthiness.

Tyre bursts often result in vehicles overturning, head-on collisions, sideswipes and head-rear accidents. The public should be educated via the media about how load rating causes tyre bursts. Motorists should also be educated about the importance of regular stops on long-distance trips. Drivers (especially long distance public transport drivers) should be made aware that regular stops prevent overheating of tyres, thus minimising the chance of tyre bursts. It can be assumed that public education could reduce one out of five possible tyre bursts i.e. a 20% reduction of fatal accidents. This reduction rate in fatalities is assumed because four out of every five drivers simply want to get to their destination as soon as possible.

Traffic police should also ensure that overloaded vehicles are not permitted to undertake long-distance trips. It can also be assumed that stringent traffic-law enforcement reduces one out of every five possible tyre bursts i.e. a 20% reduction of fatal accidents. This reduction rate in fatalities is assumed because the shortage of traffic police would only stop one out of five overloaded vehicles along high mobility routes during the peak hours only.

Education and enforcement collectively adds up to a 40% reduction rate of fatalities. Under this assumption, this would translate to 21 tyre bursts out of 52 being prevented due to public education and stringent traffic-law enforcement.

Every driver is aware of the safety risk of travelling with **faulty brakes,** but not all ensure that they are in proper working condition. It is hard for traffic police to check whether brakes are in a proper working condition because it requires heavy, specialised equipment that is fixed into roadworthy testing stations. Corruption in roadworthy testing stations put vehicles with faulty brakes on South African roads. Given the various problems associated with trying to curb faulty brakes, it can be assumed that public education, traffic-law enforcement and testing of vehicle roadworthiness will reduce one out of 10 accidents due to faulty brakes i.e. a 10% reduction of fatal accidents. This reduction rate in fatalities is assumed because traffic police never check for faulty brakes and probably one out of ten motorists would immediately fix their faulty brakes once detected. This translates into two accidents due to faulty brakes being avoided nationally in December 2002.

Educating the public and engineering solutions are required to mitigate road factors i.e. poor visibility, sharp bends and slippery roads.

Poor visibility hinders motorists from making the necessary manoeuvres preventing road accidents. Accidents caused due to misty weather or inadequate street lighting can be avoided by improving visibility i.e. increasing light intensity. If the level of light is raised from 1 to 2cd/m^2, the incidence of nighttime accidents can be reduced by up to 65% [3]. This assumes that all fatal accidents after dark are due to motorists not having adequate lighting. It does not take into account other factors that cause accidents at night (e.g. driver fatigue, alcohol or drug abuse, speed, etc). The author assumes fatal accidents that occur after dark are purely because of inadequate lighting due to objects suddenly appearing in front of a moving vehicle. This usually occurs where roads with animals in the vicinity are not fenced off or when pedestrians jaywalk at night. Fencing off the roads will eliminate wild and domestic animals being hit by vehicles. The author assumes that one out of 20 fatal accidents after dark are due to animals suddenly appearing in front of vehicles and pedestrians jaywalking. In December 2002, 40 accidents were caused by poor visibility. Increasing light intensity from 1 to 2cd/m^2 would thus prevent two fatal accidents due to poor visibility. However, more research is required to determine the actual reduction in fatality rates due to purely poor visibility be improved as other factors could be at play e.g. fatigue.

Traffic engineers can identify **sharp bends** but these road sections cannot be re-aligned, as it is not cost effective. Travel speeds on sharp bends should be reduced to safe speeds in relation to available stopping sight distance. Traffic engineers can apply various speed reduction measures to ensure motorists reduce their travel speeds. In addition, adequate road signage would make the sharp bends more visible. It can be assumed that the right speed reduction measures can lead to three out of five motorists lowering their speeds. This would ensure a 60% reduction of fatal accidents i.e. 12 fatal accidents would have been prevented nationally in December 2002. This reduction rate in fatalities is assumed because two out of every five drivers could be under the influence of alcohol or drugs, extremely tired or simply risk takers.

Traffic engineers can also identify **slippery road sections**. These road sections can have a layer of single or double seal applied to increase skid resistance. It can be assumed that increased skid resistance would reduce fatal accidents caused by slippery roads by 80% ie.16 fatal accidents would have been avoided nationally in December 2002. This reduction rate in fatalities is assumed because there is a one out of five chance that accidents at these road sections are due other human or vehicle factor.

Table 3 is a summary of the estimated reductions in fatalities nationally in December 2002. This table shows that in order to substantially lower the national fatality rate, measures to reduce jaywalking and speeding need to be implemented. Fine-tuning the reduction in fatalities involves applying measures to lower the occurrence of tyre bursts, malfunctioning of vehicle brakes, poor visibility, sharp bends and slippery road sections.

Table 3. Reduction in number of fatal accidents nationally in December 2002.

Contributory factors	Fatal accidents	Reduction in fatalities	Measure
Jaywalking	348	313	Study to reduce crossing of freeways
Speeding	221	46	Education and enforcement
Tyre bursts	52	21	Education and enforcement
Vehicle brakes	19	2	Education and enforcement
Poor visibility	40	2	Fencing off roads
Sharp bends	20	12	Speed reduction measures
Slippery roads	20	16	Apply a layer of single or double seal
Total	720	412	

Between 16h00-16h59 on Fridays is when the highest number of accidents (i.e. fatal, serious, slight injury and damage-only) occurs in the Western Cape [2]. It is assumed that **alcohol and/or drug abuse** is one of the major causes as the weekend drinking spree starts and mental exhaustion is highest. This could explain the high accident rates. The author assumes that if traffic police set up roadblocks on Fridays from 12h00 until 18h00, two out of five accidents could be prevented. This denotes that 5 281 accidents would be avoided annually. This reduction rate in fatalities is assumed because three out of every five drunken or extremely tired drivers will not get apprehended due to the various travel routes used. This approach in the Western Cape should be used in all other provinces after it is established when most accidents occur in other provinces.

Studies suggest that **truck-driver fatigue** may be a contributing factor in at least 30 to 40% of all heavy-truck accidents [1]. Conversely, educating the public (especially heavy-duty truck drivers) about the importance of resting periodically during long-distance trips and the provision of shower facilities at filling stations along national routes can reduce heavy-truck accidents by 30-40%. 5 274 vehicles with Gross Vehicle Mass (GVM)> 3 500kg were involved in accidents during 2001 [2]. This constitutes 7% of all accidents in Cape Town. Public education in terms of driver fatigue could prevent 1 582 - 2 110 accidents. This notion should be applied nationally to reduce the incidences of heavy-truck accidents in all the other provinces.

Western Cape statistics (derived from www.capetown.gov.za/reports) do not indicate which vehicle factors cause accidents.

The type of vehicle involved in the majority of accidents simply reflects that the likelihood of a particular vehicle type having an accident increases, as it comprises a larger percentage of vehicle types.

According to Table 4, mini-bus taxis have more accidents than heavy trucks (GVM>3500kg) due to more frequent public transport trips made, even if heavy trucks make up a larger percentage of vehicle types. Motorcars make up the largest percentage of vehicle types. The probability of this vehicle type being involved in accidents would therefore be very high as shown in the accident statistics in Table 4. Generally, lighter vehicle types are involved in more accidents due to higher travel speeds and more vehicle-kilometres travelled. Motorcycles have the same accident risk as motorcars although they constitute a lower percentage (see Table 4). This could be due to higher acceleration capabilities of motorcycles and lack of dedicated lanes for this vehicle type.

Table 4. Types and number of registered vehicles involved in accidents (Cape Town; 2001).

Vehicle type	No. of vehicles involved in accidents	%	No. of registered vehicles	Risk per registered vehicle type
Motor car/ station wagon	85 825	66.0	551 892	0.16
Light delivery vehicle	18 227	14.0	147 306	0.12
Combi/ Mini bus	8 428	6.5	10 254	0.82
GVM >3500 kg	5 274	4.1	18 090	0.29
Unknown	5 254	4.0	3 240	1.62
Motor cycle	3 073	2.4	19 717	0.16
Bus	1 394	1.1	5 202	0.27
Other	1 361	1.0	14 515	0.09
Articulated trucks	1 212	0.9	2 601	0.47
Total	130 048	100.0	772 817	

Source: Cape Town metropolitan council website- www.capetown.gov.za, 2003

All vehicles are registered, which does not necessarily mean that all are roadworthy at the time of the accident. This is because vehicle roadworthiness is only tested when vehicles change owners. It can be assumed that buses and trucks are in a better roadworthy condition than taxis. This assumption was made as buses and trucks are run by commercial firms unlike taxis owned by individuals that perceive upkeep and vehicle maintenance as unrecoverable costs. The risk per registered vehicle type is a reflection of driver behaviour among vehicle types. Generally, drivers of mini-bus taxis have very little regard for traffic rules and regulations. This is reflected in Table 4, with combi/ mini-bus taxis having the highest accident rate or risk per vehicle type.

Furthermore, government should legislate to fit semi-open ISA in all mini-bus taxis and buses. This is vital as speed is a factor in 75% of all accidents. As seen earlier, stringent traffic law enforcement is estimated to reduce the fatality rate by 28% in urban areas and 17% in rural areas. The author assumes that the reduction in fatality rates is applicable in urban areas of the Western Cape and to all the accident rates. These measures would prevent 2 360 mini-bus taxis, 1 477 vehicles with a gross mass greater than 3 500kg, 390 buses and 339 articulated trucks from being involved in accidents in 2002. This approach should be adopted in all the other provinces as part of the national model.

The fatality rate is highest after dark [2]. If the level of light is raised from 1 to 2cd/m^2, the incidence of night accidents can be reduced by up to 65% [4]. As mentioned earlier, other factors contribute to accidents after dark. The author assumes that one out of 20 fatal accidents after dark are due to animals suddenly appearing in front of vehicles and jaywalking. Therefore, increasing the light intensity by 1cd/m^2 would prevent six fatal accidents, 18 serious accidents and 522 of all accidents after dark. It is assumed that one out of every 20 accidents after dark is due to animals because most wild animals are deep in the bush, far away from the nearest road with the odd domestic animal not in its kraal.

More accidents occur on dry rather than wet roads [2]. It can be said that most of the time it is not raining (i.e. roads are dry), explaining the high frequency of accidents on dry roads. Reducing the risk of accidents on any road surface type involves addressing various human, vehicle and road factors.

The Western Cape accident statistics could not be used to develop a national model to estimate decreases in the fatality rate, but were used to complement the national model.

Road safety audits should be carried out at the worst known road sections and intersections in accordance with the South African Road Safety Manual.

Proper data collection by the SAPS and traffic police in conjunction with further research by national and provincial authorities would accurately quantify the decrease in the fatality rate due to these measures.

4. ANNUAL NATIONAL MODEL AND COST ESTIMATES

Table 5 shows the unit cost of fatal and serious accidents in the Western Cape. It is assumed that the unit cost of accidents in the Western Cape does not vary substantially with national unit costs.

Table 5. Unit costs (R) of accidents in South Africa (2001) [2].

Severity	Drivers/Passengers	Pedestrian	All
Fatal	694 584	225 457	471 424
Serious	148 549	57 387	108 098

Table 1 shows the various contributory factors of road fatalities in December 2002. It is assumed that this worst-case scenario gives a representative percentage split between the various contributory factors annually. This analogy has been used to estimate the percentage split between the various contributory factors annually, as shown in Table 6. This table only takes into account the top tier of contributory factors. The statistical model used in Table 3 was derived from accident statistics in December 2002. The author strongly feels that the established worst-case scenario is representative of annual trends related to causing and preventing accidents. In light of this, it was decided to use reduction rates estimated for December 2002 annually, as shown in Table 6.

Table 5 is incorporated into Table 6 to determine the annual cost savings due to fatalities reduced. These cost savings are considered theoretical because the likelihood of the relevant transport authorities or government annually implementing the various measures is not definite.

The author strongly believes that the likelihood of the relevant transport or government authorities to implement the various measures to reduce pedestrian fatalities is 25%, speeding 35%, faulty brakes 5%, tyre bursts 10%, poor visibility 5%, 10% for sharp bends and wet/ slippery roads. These percentages were chosen because of the current enforcement of speed, disuse of worn-out tyres and engineering measures continually adopted to address sharp bends, poor visibility and wet/ slippery roads. It is envisaged that likelihood of the relevant government or transport authorities to adopt measures to bring amenities closer to informal settlements prone to pedestrian fatalities is 25%.

Table 6 indicates the viability in implementing the various measures and cost savings thereof.

Table 6. Annual Cost savings due to estimated accident reductions in South Africa [2].

		Fatal 2004	% Reduction	Theoretical Fatal reduced 2004	% Likelihood to implement	Estimated Fatal reduced 2004	Theoretical Costs saved 2004	Estimated Costs saved 2004
Human Factors	%		%		%		R Millions	R Millions
Pedestrian: Jaywalking	47	3 861	90	3 475	35	1 216	R 784	R 196
Speed	30	2 452	33	809	25	202	R 562	R 197
Subtotal	100	8 189	52	4 284	33	1 419	R 1 346	R 393
Vehicle Factors								
Brakes	19	200	10	20	5	1	R 14	R 1
Tyre burst	56	577	45	260	10	26	R 180	R 18
Subtotal	100	1 032	27	280	10	27	R 194	R 19
Road Factors								
Poor visibility	34	444	5	22	5	1	R 15	R 1
Sharp bend	17	222	60	133	10	13	R 92	R 9
Road wet/slippery	17	222	80	178	10	18	R 123	R 12
Subtotal	100	1 309	25	333	10	32	R 231	R 22
Total		10 530	47	4 897	30	1 478	R 1 771	R 434

Theoretical cost savings are derived from implementing the various proposed measures while estimated costs take into account the likelihood of various government and transport authorities actually applying these measures.

5. CONCLUSIONS

In South Africa, pedestrians are more prone to road fatalities than motorists. In order to substantially lower the fatality rate on South African roads, measures need to be implemented to reduce pedestrian fatalities, speeding and alcohol abuse among pedestrians and motorists. Table 6 justifies the annual implementation of measures to reduce speeding and jaywalking in order to lower the national road fatality rate.

December was the month with the highest number of fatal accidents from 2001 to 2003. Applying measures that reduce pedestrian fatalities, speeding and alcohol abuse in December, should also be practiced throughout the year to lower the national fatality rate.

Fine-tuning the reduction of fatalities in South Africa involves adopting measures to reduce the occurrence of:

- Vehicles prone to tyre bursts or have faulty brakes
- Road sections with poor visibility, sharp bends or are slippery

Table 6 indicates that fine-tuning the annual reduction of road fatalities involves enforcement to reduce vehicles prone to tyre bursts and engineering techniques to minimise road sections that are wet/ slippery roads or have sharp bends.

More research is required to validate some of the assumptions made in reducing fatality rates caused by human, vehicle and road factors. Improved data collection among traffic police can be a source of valid accident statistics needed to quantify fatality rate reductions due to various measures and techniques proposed.

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