A RELATIONSHIP BETWEEN ACCIDENT TYPES AND CAUSES

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ABSTRACT

A study was done on a road in the Western Cape of South Africa, the R44, to investigate the causes of road accidents. The causes of the accidents on this 25km stretch of road were deduced from analysing 404 accident reports and from relationships that were determined with other factors. Risk factors (human-, vehicle- and environment factors) are proposed for the 14 accident types that occurred on the R44. The risk factors were determined from the analysis of the accident reports, relationships found and literature studied. When the risk factor percentages are weighted with the number of times the accident type occurred, the human factor is the biggest factor (75.4%), followed by environment factors (14.5%) and vehicle factors (10.2%). The main human factors were negligence, excess speed, dangerous overtaking, pedestrians in road and inconsiderate driving behaviour. The vehicle factors were mostly faulty brakes and tyres. The main environment factors were daylight, rush hour traffic and inadequate facilities for pedestrians. These risk factors are in the range that the South African Department of Transport issued, which implies that the risk factors per accident type can be used as a starting point to determine the causes of road accidents.

1. INTRODUCTION

The purpose of this paper is to introduce risk factors (human, vehicle and environment factors) for 14 accident types that can be used as a reference point to determine the likely cause of an accident of a specific type. The data that were used to determine the risk factors are from accidents that occurred on the R44 in the Western Cape for the period October 1999 to September 2003. The road section of the R44, consists of two sections, namely from Somerset West to Stellenbosch (10km, 20 000 vehicles per day), a four-lane divided facility; and from Stellenbosch to Klapmuts (15km, 10 000 vehicles per day), a two-lane, two-way rural road. The speed limit on both sections is 100 km/h. 404 accident reports including fatal, serious, slight and damage only accidents were analysed during this study.

2. LITERATURE STUDY

According to Austroads (1994), road accidents occur as the result of one, or more than one of the following factors:

- Human factors
- Vehicle factors
- Road and environment factors

Human factors are described as that which the person did, or did not do at the time of the accident. It includes the following characteristics: speeding, inappropriate speed for circumstances, traffic violations, alcohol, drugs, negligence, driver error and age. Vehicle factors refer to design or mechanical faults of a vehicle, which includes a lack of maintenance. Road environment factors include all aspects of road design and maintenance, construction work, weather conditions and problems with signage and lighting. Figure 1 shows the contribution of the different factors. The most notable is the human factor, which, in conjunction with the other two factors, contributes to 95% of all accidents.
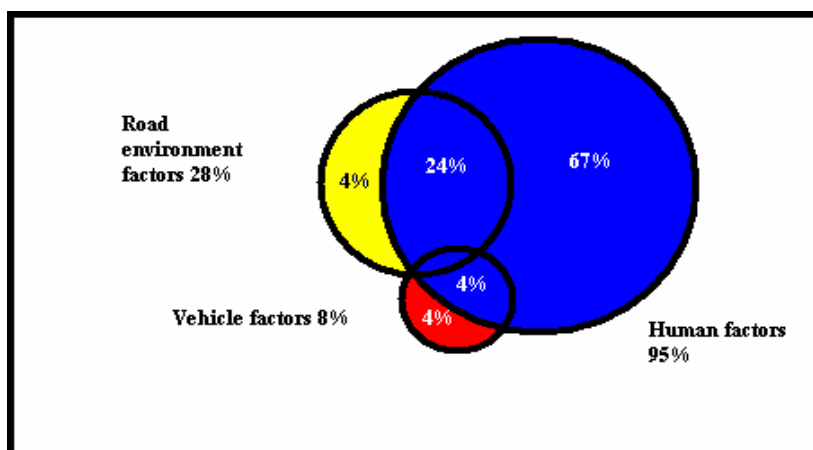

Figure 1: The three factors that contribute to road accidents (Austroads, 1994)

From 1972 to 1977, the "Tri-Level Study" was undertaken at the Indiana University in America to determine the causes of road accidents. The following were analysed:

- 13 568 accident reports
- 2 258 on scene investigations
- 420 in depth investigations

Factors that caused accidents were classified as definite, probable or possible. Figure 2 shows the results of this study. The human factor was again the greatest contributor.
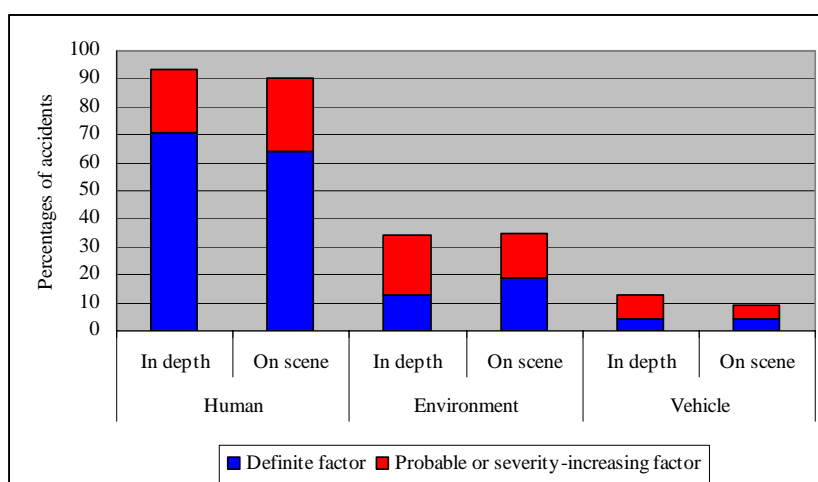

Figure 2: Factors that contribute to accidents according to the "Tri-Level Study" (Treat, JR. *et al*. 1979)

The team conducting the in depth investigation could not determine 20% of the accidents' definitive causes, and the on scene team could not determine 26% of the accidents' causes. The on scene team could however, determine one or more probable causes in most cases.

According to the South African Department of Transport, the three factors contribute to accidents in the following proportions:

- Human factors (70-80%)
- Vehicle factors (10-15%)
- Road environment factors (5-10%)

It can be noted from the literature that in South Africa vehicle factors play a larger role than road environment factors, in contradiction to research in Australia and America. Although the results of this study did not indicate this occurrence, it is said that one out of every ten vehicles on South African roads are considered to be unroadworthy (Department of Transport, 2004), which is the likely cause of this phenomenon.

The National Department of Transport (2004) who organises the Arrive Alive campaign claims that 95% of all road accidents are the direct result of a traffic violation.

3. METHODOLOGY

The methodology of this study was to deduce the causes of the accidents from the relevant accident reports and seeking relationships with other contributing factors (variables) on the accident reports obtained from the database. The database is at the Provincial Administration of the Western Cape (PAWC).

The term "accident report" which is referred to in this article is the AR- (accident report)/OAR (officer's accident report) form that traffic officers or police fill in following an accident.

3.1 Verifying accident type

Aside from analysing the accident reports to deduce the causes of the accidents, the classification of accident type was also checked for every accident analysed. This was done to ensure the risk factors are set up correctly.

Out of the 404 accidents analysed, 76 (18,8%) accident types were corrected to more accurate classifications for the purpose of this study. This was done with great caution and only when it was obvious from the information on the accident report that the current classification was wrong. The accident types below indicate which accident types are commonly misunderstood.

The accident types with the faultiest classifications were:

- "Unknown" (20)
- "Other" (19)
- "Sideswipe: opposite directions" (13)

The corrected accident types with the highest occurrences were:

- "Sideswipe: same direction" (22)
- "Accident with fixed object" (14)

- "Sideswipe: opposite directions" (8)
- "Head/Rear end" (8)

Another two accident types (which represent four accidents) were changed to reduce the number of accident types in order to enhance the statistical analysis. These two accident types were "Turn right from wrong lane", "Turn left from wrong lane", and they were put into one accident type "Turn left/right from wrong lane".

To define the accident types more accurately 30 accident types were changed. These changes does not fall under the 76 incorrect classifications, because a mistake was not made on the traffic officer's/police's part. For example, there is not an accident type that depicts an accident with a cyclist.

The four accidents where cyclists were involved were originally classified as "Other" and this classification was changed to "Accident with pedestrian", which is a better description than "Other".

There were five accidents where objects were blown into vehicles that were originally classified as "Other" and "Unknown" and these classifications were changed to "Accident with fixed object".

A new accident classification was introduced to represent accidents where a single vehicle leaves the road, but do not capsize, namely "Other: Vehicle left road". There were 21 accidents of this type. Current classifications do not include this possibility.

If more than one accident type occurred in one accident, e.g. a "Sideswipe: same direction" followed by an "Accident with fixed object", then the accident would be classified according to the initial accident type.

Table 1 shows the 14 accident types after corrections that occurred on the R44 during the study period. It is obvious that the accident types with the highest occurrence risk factors are presented with the most confidence.

Table 1: Accident types analysed on the R44 during 1999-2003.

Accident type	Number	%
Head/Rear end	103	25.5
Sideswipe: same direction	56	13.9
Accident with pedestrian	42	10.4
Accident with fixed object	40	9.9
Single vehicle overturned	39	9.7
Sideswipe: opposite directions	35	8.7
Other: Vehicle left road	21	5.2
Approach at angle-both travelling straight	21	5.2
Accident with animal	18	4.5
Turn right in face of oncoming traffic	11	2.7
Head on	10	2.5
Turn left/right from wrong lane	4	1.0
Reversing	2	0.5
Approach at angle-one or both turning	2	0.5
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The distribution of accident types on a national basis is available for fatal accidents only and could not be compared to these statistics.

3.2 Determining the causes of the accidents

The most relevant information on the accident report that was used to deduce the causes of the accidents were the following:

- What the driver was doing
- Damage to the vehicle, e.g. burst tyre
- Statements by the involved parties and traffic officer/police
- Animals or pedestrians in road
- Sketch (if drawn)

Accident causes were divided into seven categories only to enhance the statistical analyses. They are explained below.

- Negligence – The accident would not have occurred if the driver were not negligent. Examples are unsafe overtaking, colliding with an oncoming vehicle in the opposite or same direction, and losing control over a vehicle due to speeding or inattention if there is not a vehicle fault.
- Pedestrian in road – When a pedestrian crosses the road in an unsafe manner or walking in the road and causing an accident.
- Alcohol use suspected – A driver is being suspected of being over the alcohol limit, but this was not tested (only one accident report reported a test having been done).
- Vehicle problem – A burst tyre, faulty lights or any other vehicle faults that caused the accident.
- Road problem – This includes an accident scene, oil, water, pothole or rock in the road, poor road markings or road signs and road works obstructing a road.
- Animal in road – An animal crossing the road and causing an accident.
- Unknown – The cause could not be deduced from the accident report.

In summary, when another definitive cause of a accident e.g. a burst tyre could not be found, a accident's cause was classified as negligence, except when it was impossible to deduce any cause for lack of adequate information. The road geometry was not analysed due to the poor data quality of the accident locations (Vogel 2004).

The above causes are divided into the three contributing accident risk factors as follows:

Human factors
- Negligence
- Pedestrian in road
- Alcohol use suspected
Vehicle factors
- Vehicle problem
Road environment factors
- Road problem
- Animal in road
Unknown factors
- Unknown

4. RESULTS

The causes of the accidents on the R44 can be seen in Table 2.

Table 2 Causes of accidents on the R44 during 1999-2003

Cause	Number	%
Negligence	266	65.8
Pedestrian in road	39	9.7
Unknown	35	8.7
Vehicle problem	26	6.4
Animal in road	23	5.7
Liquor suspected	9	2.2
Road problem	6	1.5
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Nearly two thirds of the accidents that occurred on the R44 can be attributed to negligence. Pedestrians caused a further 9.7%, and 8.7% of the accidents had unknown causes. Road problems were the smallest cause, because this cause generally only included objects in the road such as rocks, oil, water etc causing an accident. The alignment of the road could not be investigated at hazardous locations, because the kilometre measurements of the accident reports proved to be very inaccurate (Vogel 2004). To produce the risk factors for every accident type, factors out of the literature were used to determine other road factors e.g. sight distance and curve problems.

5. STATISTICAL ANALYSIS

The primary method that was used to determine relationships between risk factors was association analysis. The data was analysed with the statistical programs "CBA" and "Statistica". Relationships were sought between the following risk factors:

- Day of the week
- Time of the accident
- Vehicle type
- Accident type
- Cause of the accident
- Guilty party
- Gender of guilty party
- Age of guilty party
- Registration letters

Due to limited personnel at PAWC, more variables could not be extracted from the database, which limited the study.

Note that the variables are categorical variables with varied number of levels. The levels of the variable "accident type" is for example "Head/Rear end", "Sideswipe: same direction" etc.

The principal of association is to identify levels of different variables that "regularly" occur together. The program CBA was used to record when a level of a variable occurs at least 5%, and a level of a second variable occurs at least 50% together with the first variable. These relationships were verified that the particular relationship between the variables

does occur more frequently than the levels of the variables apart from each other. This was done with the program Statistica, and it made the number of relationships found by CBA considerably less.

6. RISK FACTORS

The risk factors for the 14 accident types that occurred on the R44 are given in Table 3. The risk factors were deduced by the information gained by analysing the accident reports, the relationships that were statistically determined and literature that was studied. The percentages for the human-, environment- and vehicle factors are approximations and should only be used as a reference point. Every accident has unique risk factors.

Table 3 Risk factors

Accident type	Risk factor			Statistically significant relationships
	Human	Environ-ment	Vehicle	
Head/Rear end	75	5	20	Negligence, close following, speeding, steep gradients, road works, faulty brakes, smooth tyres, LDV's
Sideswipe: same direction	75	25	5	Negligence, dangerous overtaking, sight distance, faulty indicators, cars.
Pedestrian	75	25	0	Driving on shoulder, pedestrian visibility, speed, alcohol, pedestrian facilities, cars
Fixed object	80	15	5	Negligence, losing control, speed, alcohol, fatigue, road signs, steering, brakes, cars
Overturned	70	5	25	Lost control, speed, alcohol, fatigue, sight distance, burst tyre, trucks
Sideswipe: opposite direction	90	10	0	Dangerous overtaking, speed, males, sight distance
Vehicle left road	70	5	25	Lost control, inattention, speed, fatigue, curves, pedestrians, burst tyre, cars
At angle: both straight	90	5	5	Negligence, failed to stop, intersections and control, faulty brakes, access spacing, brakes, cars
Hit animal	10	90	0	Speed, fencing, lighting
Turn right in face of oncoming traffic	95	0	5	Negligence, turning in front of traffic, no use of indicators, no indicators, cars
Head on	95	5	0	Dangerous overtaking, inconsiderate driving, speed, sight distance, road markings
Turn from wrong lane	95	5	0	Inattention, no use of indicators, road markings
Reversing	95	0	5	Inattention, illegal movement, faulty brakes
At angle: one or both turning	95	5	0	Inattention, road signs

7. COMPARISON OF RISK FACTORS

This risk factors determined in this study were weighted with the number of times they occurred, and then averaged to be comparable to other findings.

In Table 4 the risk factors determined in this study are compared to other findings.

Table 4 Comparison of risk factors

Reference:	Risk factors (%) that cause road accidents		
	Human factors	Vehicle factors	Environment factors
Austroads (1994)[1]	67	4	4
Austroads (1994)[2]	95	8	28
(Treat, JR. *et al.* 1979)[3]	71	13	4
(Treat, JR. *et al.* 1979)[4]	64	19	4
Department of Transport (2004)	70-80	10-15	5-10
This study	75.4	10.2	14.5

[1] These risk factors do not overlap.

[2] These risk factors overlap with other risk factors.

[3] These are definite risk factors determined by the in-depth team.

[4] These are definite risk factors determined by the on scene team.

It is recognised that risk factors and accident types will be different for different types of road. In this study an effort was made to relate the causes of accidents to the accident type through a statistical analysis of the risk factors as determined for each individual accident.

8. CONCLUSIONS

Firstly, it can be seen in Table 4 that this study supports the fact that the human factor is the biggest cause of road accidents. Secondly, because the risk factors calculated in this study are in the range that the Department of Transport (2004) states, the risk factors can be used as a reference point to determine the causes of road accidents.

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