

## **THE CAUSES OF BUS ACCIDENTS IN FIVE EMERGING NATIONS**

Technical field of this paper: Road Safety and Security for Daily Lives

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# 1 INTRODUCTION

Worldwide, there are approximately 0.8 million road accident fatalities and 20-30 million people injured annually, many with long term disabilities (Jacobs and Aeron-Thomas, 2000). Almost 70 per cent of these occur in the developing or emerging world. Whilst there is a general decline in the number of fatalities in industrialised countries the opposite is true elsewhere. If account is taken of levels of motorization by expressing accident statistics as the rate per registered vehicle, then less developed countries (LDCs) have rates at least 10 to 20 times higher than the best industrialised countries. The worst countries in these terms have fatality rates 100 times higher (Ghee et al 1997) as shown in figure 1.

Considerably higher proportions of those (reported as) injured in road accidents consequently die from their injuries in the developing world compared with industrialised countries. Thus, not only is the proportion of people injured per vehicle very high, but also the death rate is higher in developing countries.

Countries throughout the developing world are characterised by rapid urbanisation, high growth rates in traffic and, consequently, congestion and decreasing regulation of public transport. Because the majority of the developing world's inhabitants are dependent on public transport the need for safe, efficient and effective public transport services is essential to ensure adequate and affordable accessibility, for sustaining livelihoods and rural and urban development.

During the last three years, The Transport Research Laboratory (TRL) [funded by the British Government's Department for International Development (DFID) Knowledge and Research (KAR) Programme], has been studying the extent and likely causes of bus accidents in Nepal, Zimbabwe, Thailand, Tanzania and in the Indian State of Maharashtra, all of which are assumed to be representative of emerging nations. Data have been collected from official sources in the countries and interviews undertaken to obtain opinions as to the causes of bus accidents. In addition, the operating environment, vehicle condition and driver behaviour were assessed. A number of recommendations are discussed to reduce both the severity and number of public transport accidents in the future.

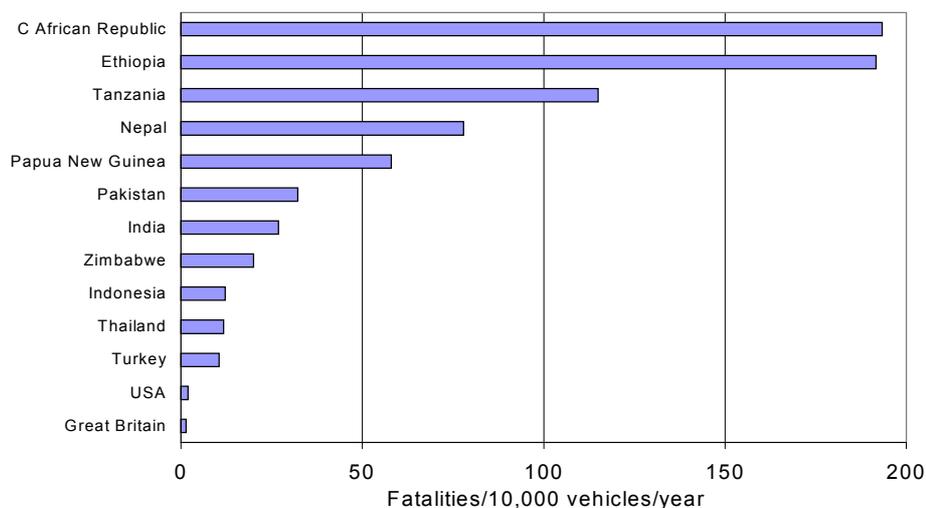


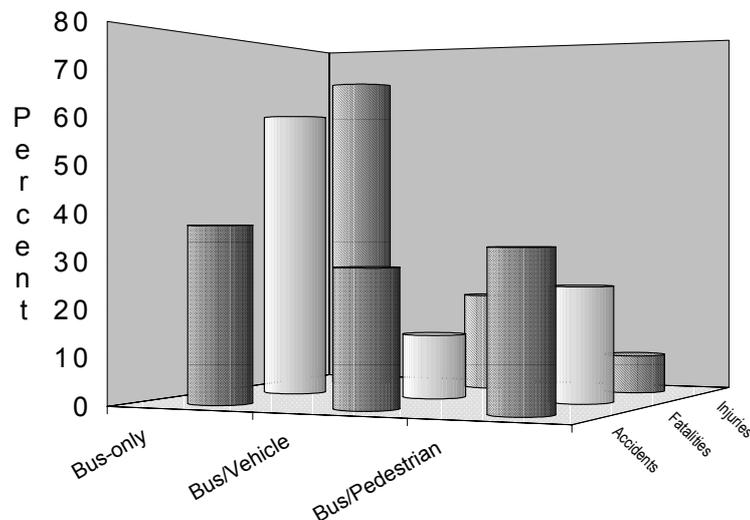
Figure 1 Fatality rates for selected countries

## 2 NEPAL

The first bus services in Nepal commenced in 1957 and since then the fleet has grown substantially, especially since 1992. By 1996 there were a total of 7800 conventional buses and 2752 minibuses operating public transport services throughout the country (Maunder et al 1998).

About 95 per cent of buses are owned and operated by the private sector, the remaining 5 percent being owned by the public or semi-public sector. Although vehicles are mainly operated on an individual basis, the "Dial system" predominates as Associations or Syndicates manage routes on behalf of owners. This ensures equal operational trips per bus for operators within the Association/Syndicate, as vehicles have to wait in a queue prior to departure. However, it does not permit an operator to offer a particular level of service but constrain the number of trips made by each bus thus limiting operator efficiency. Thus although the supply of permits is liberalised, the actual service provision is constrained throughout the Kingdom. In addition, owners who do not belong to an Association /Syndicate frequently encounter operational difficulties at bus parks.

During the period July 1995-June 1996, 479 serious bus accidents [14% of the total] resulted in 365 fatalities and 1751 injured persons. The totals represented 39 percent of all road fatalities during the 12 month period and 60 percent of all road casualties (figures for the 18 month period of November 1996 to April 1998 were similar in terms of the percentage of bus accidents and fatalities). Bus accidents therefore represent a significant proportion of all road accidents, fatalities and injuries in Nepal. Figure 2 illustrates the predominance of injuries and fatalities caused by bus-only accidents.



**Figure 2 Bus accidents in Nepal (1995/6)**

From comments made by the diverse groups interviewed, the likely causes of bus accidents can be categorised as follows:

- Drivers and driving habits
- Road condition
- Vehicle condition
- Other factors

Data for the 18-month period [Nov 1996 - April 1998] suggests that driver error was the major factor in 74% of bus accidents, external factors in 18% and vehicle condition in 8%. Everyone agreed that one single factor was unlikely to cause an accident and that a combination of causes was the likely explanation. The key factors raised in respect of drivers and their driving habits were:

- Ease of obtaining an Heavy Vehicle licence
- Lack of knowledge of the Highway Code and road
- Driver fatigue due to long working hours
- Overloading of vehicles to maximise revenue
- Night-time drivers consuming alcohol, drugs or speeding

Surveys of vehicle condition noted that 65% of buses had one or more faults in terms of tyres, wheel fixings, and front/rear lights yet all had passed a Vehicle Fitness Test and were legally fit to operate.

The poor condition of roads resulting from deficiencies in maintenance, alignment, traffic signs and safety features were all identified as possible accident causes. Weak enforcement of traffic regulations and a lack of road sense by pedestrians in rural areas especially when herding animals on the road or generally crossing the road were also mentioned as contributory factors.

### **3 INDIA**

Public transport in India is characterised by a wide range of vehicle type from non-motorised modes such as cycle rickshaws to surface rail and metro. Both public and private ownership exists; the scale is immense with 64 public sector road transport undertakings operating a fleet in excess of 110,000 yet representing just 30% of the national bus fleet.

Because of the size of India [1/4 million reported accidents leading to 60k fatalities and over 1/4 million casualties in 1995] it was decided that the study should be restricted to the State of Maharashtra. During the period 1961-1996 the registered motor fleet in the State grew by over 40 times whilst the road network increased by 3.5 times; thus the growth in vehicles far outpaced the growth of the road network and other infrastructure. As a consequence, over the two decades 1975/95 the number of road accident fatalities increased by 282% and injuries by 220%. Data for 1995 shows that buses and HGV's were involved in 35% of accidents, taxis cars and jeeps in 32%, two wheelers in 22% and other vehicles in 11%.

Data were obtained from the State-owned Maharashtra State Road Transport Corporation (MSRTC) which operates bus services throughout the State in competition with privately owned and Municipal bus companies. The MSRTC is the second largest operator in India with a fleet of 17,073 buses, employing 110,073 staff and carries 7.5 million passengers daily. During the operational year 1996/7 MSRTC buses were involved in 4,149 accidents and 688 fatalities ensued. Of these, the MSRTC management assessed that their driver was at fault in almost 50% of accidents. Driver inexperience appears to be a probable cause as 37% were aged between 24 and 32 and 46% had been driving for less than 4 years.

The opinions of the various drivers, conductors traffic police, passengers interviewed throughout the State suggested that the same probable causes relate to the Indian situation as they do in Nepal and for the same reasons.

### **4 ZIMBABWE**

The Zimbabwe United Passenger Company (ZUPCO), now wholly owned by the Government, operates both conventional buses and minibuses on urban public transport services (Maunder et al 1993). There are also privately operated commuter omnibuses, introduced in 1993, consisting of various vehicle types and capacity (Maunder et al 1993,1995,1996) which have been allowed to proliferate with few controls. Long-distance bus services (inter-city and rural) are provided by ZUPCO and the private sector.

The police collect accident data in Zimbabwe and the Zimbabwe Traffic Safety Board analyses the data. In 1992 there were a total of 27,150 reported accidents leading to 1,066 fatalities and 13,458 injured persons and by 1996 the totals had increased to 38,777, 1,205 and 18,070 respectively. Table1 shows that, most bus accidents [and consequently injuries] take place in urban areas but most fatalities result from long distance services.

**Table 1: Bus accidents in Zimbabwe [1996]**

	Accidents	Fatalities	Injuries
Long distance/Rural	28%	74%	22%
Urban	72%	26%	78%

Police statistics of bus accidents in 1996 showed that 58% of bus accidents were classified as blameworthy [i.e. human error] and led to 76% of bus fatalities and 75% of injuries. The most frequently quoted factors in respect of driver behaviour included reckless driving, inattention and a lack of judgement, speeding, driver fatigue and the use of unqualified and inexperienced drivers. One long distance operator suggested that "speed is used as a marketing tool" whereas in urban areas "speed is used to maximise earnings".

External factors include road conditions, stray animals, weak enforcement of regulations and adverse weather such as during the rainy season. Observations of vehicles showed that vehicle condition is generally satisfactory and that genuine spare parts are utilised.

## 5 TANZANIA

The organisational structure of the bus industry in Tanzania can broadly be categorised into urban operations and long-distance [including rural services].

Urban operations presently comprise conventional buses and minibuses [Daladalas]. The fleet of the state run bus company, "Usafiri Dar Es Salaam (UDA)", has dwindled and now comprises few conventional buses and minibuses. Privately owned Daladalas operate in almost all municipalities in the country and are generally capable of carrying 16 passengers. The Daladala fleet has grown considerably since their legalisation in 1983. Methods of remunerating the Daladala drivers encourage speeding, overtaking, poor parking and frequent vehicle stoppages to pick up or drop passengers on their way to anticipated destinations.

The operational environment for long distance services changed recently. Quantity and fare controls on routes have been liberalised and entry into the industry is now very much dependent on the roadworthiness of the vehicle. The most common buses are 45 - 65 seat capacities. Driver turnover is high and due to an increasing passenger fleet buses compete for passengers by employing touts. It is alleged that, buses race against each other in order to pick up intermediate passengers along the route, on the other hand, the competition for passengers has resulted in some operators introducing semi-luxury and luxury coaches on selected routes to attract more passengers.

The total number of reported accidents increased from 12,595 in 1993 to 14,335 in 1997 i.e. by 14%. The total number of fatalities increased each year from 1993 to 1996, but declined by approximately 10% to 1625 in 1997 and 1583 in 1998 [injuries were 12,490 and 11,381 respectively]. Measurable injuries have remained at a fairly constant level compared to reported accidents. It should be noted that national figures for 1998 have

shown a decline; it is likely that this is partly due to the effects of the global recession as well as increased safety awareness and enforcement.

In total, conventional buses and Daladalas accounted for 24% of vehicles involved in accidents during 1997/98 but generated 39% of fatalities and injuries. On average each long distance bus involved in a road accident resulted in 5 fatalities and 39 injuries while the approximate unit fatalities and injuries for other vehicle classes was insignificant. Within the public transport sector, long distance buses represented 1.3% of vehicles involved in accidents yet generated 41% of fatalities and 45% of injuries.

The travelling public blames deregulation of the public transport system for the increased number of accidents occurring on both urban and long distance services. Inevitably this has led to an increase in the number of buses servicing the network although demand has not similarly increased.

As per police analysis the causes of all road accidents [bus accidents reflect the same trends] can be divided into three main categories:

- Human factors = 76%
- Vehicle condition = 17%
- External factors = 7%

Interviewees' perceptions were that human errors are the principal contributory cause of road accidents. The causes of bus accidents as revealed by respondents are similar to the above but also includes an additional factor "lack of enforcement"

The human factor is perceived to be the principal cause of most bus accidents with factors similar to those found in Nepal. The contribution of human error in causing accidents is not only confined to drivers as passengers and pedestrians also contribute to accidents. It is common for passengers to try to disembark from a bus while it is in motion or to distract the attention of the driver. Some fatal bus accidents may occur when drivers take irrational decisions and attempt to cross flooded rivers. Drivers are often encouraged by passengers to cross flooded bridges and as a result make errors in judgement resulting in the bus being washed away.

In 1995, according to statistics from police records, approximately 20% of bus accidents were caused by bus defects. By 1997 this had declined to approximately 17% [Table 2 illustrates recent survey results], due, in part, to ongoing economic reforms that have led to a growth in vehicle sales and hence a younger bus fleet being operated.

**Table 2 Faults identified, Tanzania [1998]**

Component	Long distance buses	Daladala
Number of vehicles	30	50
Good bodywork	<5%	10%
Mirrors	<5%	30%
Windscreen wipers	<5%	10%
Tyres	5%	15%
Wheel nuts	5%	12%
Front lights	0%	15%
Rear lights	0%	14%
Brake lights	0%	30%

## 6 THAILAND

The conventional public transport sector in Thailand comprises fixed and non-fixed routes [nationwide mainly for tourists] with fixed routes defined as follows:

- Urban: the bulk of which are operated in Bangkok and a handful of provinces [27%]
- Inter-city: [23%]
- Rural services operated within provincial boundaries [50%]

The total conventional bus fleet in 1998 comprised 93,061 vehicles [0.5% of the total motor vehicle fleet] of which 94.5% were privately owned and operated and 5.5% publicly owned. The industry is strictly regulated by the Department of Land Transport in terms of standard of bus, route operated, timetable, fares etc.

Accidents peaked in 1994 at 102,610 and fatalities and injuries in 1995 [16,727 and 50,718 respectively] since when reductions have ensued. During 1996/7, approximately 70% of all accidents occurred in the Bangkok region and buses and trucks were involved in 10% of all accidents. The number of bus accidents has declined since 1993 when there were 6,895 buses involved in crashes to 3,717 in 1998 but still represents 5% of all accidents and generates an estimated 1,500 fatalities and 5,400 injuries.

According to Police records, 74% of all accidents on the inter-city and inter-district highways in 1997 were due to driver behaviour, with the remaining causes due to external and vehicle defects. During 1998 the national newspapers reported a total of 32 major bus accidents resulting in 65 fatalities and 692 injuries of which 50% constituted single vehicle accidents.

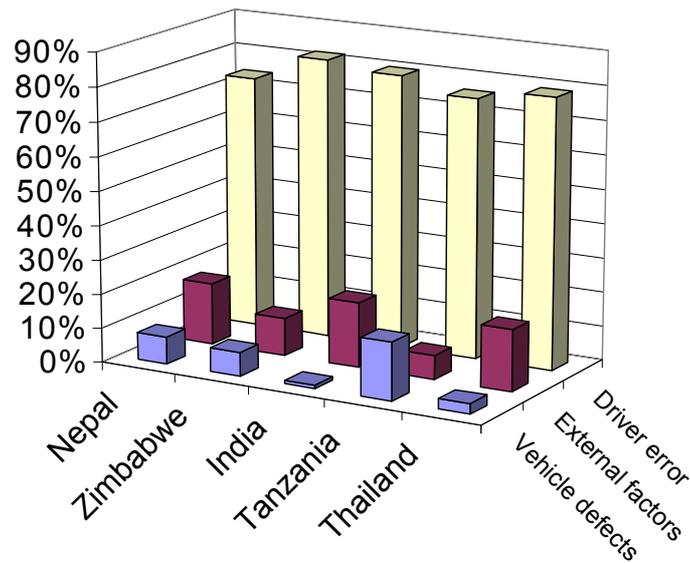
In 1998 the state owned Transport Company fleet was involved in 377 accidents of which 20% were single vehicle crashes and 80% multi vehicle. The management considered that their own vehicle was the cause of 58% of these accidents and other vehicles in 42%. Of the former the driver was considered at fault in 79% of the accidents, external factors in 18% and the vehicle in 3%.

As the above shows, driver error was the overriding factor involving Transport Company vehicles and this is likely to be the same throughout the industry. Interviews with operators and drivers confirmed this view. Vehicle condition was not cited and surveys of vehicles generally showed that vehicles were in a reasonable condition.

## 7 DISCUSSION

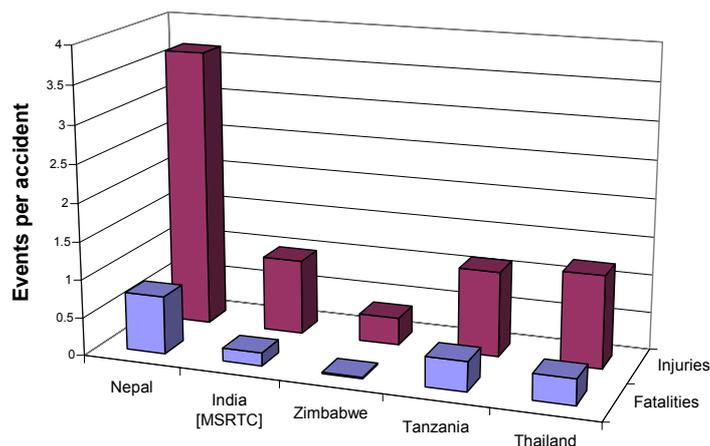
In all five countries, where studies have been undertaken by TRL, road accidents are increasing over time. Overwhelmingly driver behaviour is the major factor in bus accidents [see figure 3]. Public transport vehicles appear to be involved in a higher proportion of accidents than their numbers warrant. However, this is principally because buses cover a high annual mileage through their duty cycles. Considering the number of passengers transported a safety culture should be active and evident, however, it does not seem to be the case at the present time.

Figure 4 compares accident severity across the five countries. The need for high standards of driver behaviour and vehicles in Nepal, where nearly all the public transport sector is privatised, is emphasised by the significantly higher severity of accidents with a fatality rate twice as high and an injury rate over three times as high as Tanzania. Some of this difference may be due to the difficult terrain over which buses are operated. Interestingly, Tanzania and Thailand appear to have similar fatality and accident rates although the operating environment differs greatly.



**Figure 3 Bus accident causes by country [1996-98]**

In India, Zimbabwe and Tanzania, public transport services are increasingly being owned and operated by the private sector as liberalisation is encouraged. This has inevitably lead to a philosophy, by the private sector, of profit maximisation by minimising costs rather than increasing efficiency as in the case of Nepal. Driver behaviour appears to suffer under the auspices of liberalisation and low enforcement. In Thailand, although 95% are privately owned, there is strong enforcement of bus regulations but not of driving standards.

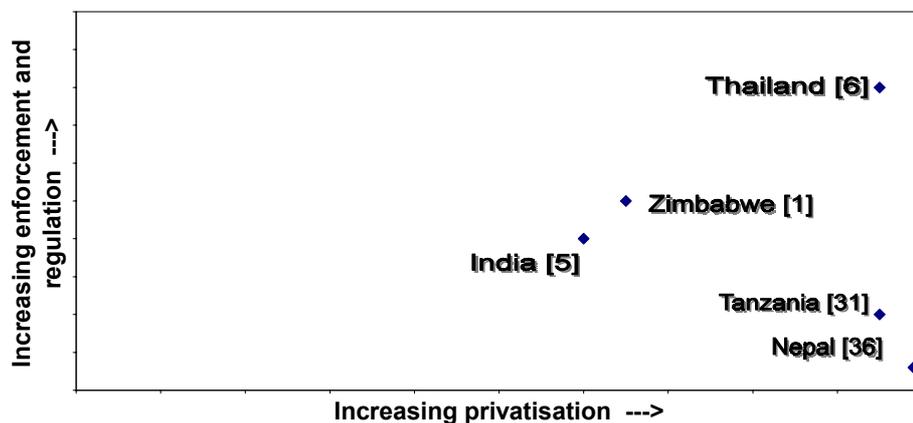


**Figure 4 Comparison of fatality and injury rates**

**Table 3 Summary of findings**

Country	Operating environment	Bus accidents as % of total	Fatalities/ bus accident	Bus fatality index*
Nepal	99% private Largely self regulated Poor enforcement	14%	0.76	36
India	70% private Medium regulation Moderate enforcement	8%	0.17	5
Zimbabwe	65% private Medium regulation Reasonable/good enforcement	15%	0.02	1
Tanzania	95% private Medium regulation Low enforcement	24%	0.39	31
Thailand	95% private Good regulation Variable enforcement	5%	0.34	6

There does appear to be a link between the degree of privatisation, the amount of regulation or enforcement and the severity of accident [Table 3]. The bus fatality index highlights the seriousness of the accident situation in Nepal and Tanzania. Figure 5 attempts to illustrate the need for good regulation and enforcement with increasing privatisation and shows the bus fatality index. It is recognised by the authors that their estimates are not quantifiable in terms of enforcement and regulation.



**Figure 5 Comparison of privatisation status and enforcement levels**

\* Bus fatality index is the product of bus accidents [as percent of total] and fatalities per bus accident normalised to Zimbabwe

## 8 SUMMARY AND RECOMMENDATIONS

Clearly the overriding factor to be addressed is how to improve bus driver behaviour. Suggestions to improve bus driver behaviour are listed below. It is clear however that drivers need to be better educated and trained when initially learning to drive but in particular:

- They should be taught technical, social and psychological skills to be a safe, responsible professional driver.
- Bus drivers, like all HGV drivers, should participate in refresher driver training courses so that bad habits can be eliminated rapidly.
- Owners should provide financial incentives for drivers who have been 'accident free' during the previous 12-month period.
- Medical and health checks need to be provided regularly for all but especially ageing drivers.
- Drivers should be encouraged to work within existing legal maximum hours.

These may increase costs but are likely to be less expensive in the longer term than the cost of human tragedy, vehicle replacement and other third party costs.

As well as improving the behaviour of the bus driver, various road safety media campaigns need to be funded and encouraged so that all road users are better educated as to how to behave when crossing and using the road and when herding animals on the rural road network.

Owners and operators need to be encouraged to maintain their vehicles to a much higher standard than at present. Preventative maintenance can improve performance and productivity and extend the operational life of the vehicle. A safe, smart vehicle is also more likely to attract passengers than an unsafe and poorly maintained vehicle and also passengers might be encouraged to afford a slightly higher fare for such a vehicle/service. Owners/operators also need to understand that regular vehicle maintenance is a cost effective business practice which can minimise vehicle downtime and costly, time consuming breakdowns whilst in service.

Improvements in bus safety cannot be achieved by one individual or discipline, they are a collective responsibility and a collective spirit is required of all those involved including:

- Bus owners, drivers, conductors and mechanics
- Operator associations/unions
- Police and government departments
- Road Safety Associations/
- Driver training schools
- Manufacturers and repairers of vehicles, spare parts and tyres
- ALL road users

Hence, whenever liberalisation is being considered in respect of the provision of public transport services, enforcement of existing (and new) legislation in terms of vehicle condition, numbers allowed to operate etc needs to be strict. Operational regulations and procedures must also be implemented rigorously to ensure that safe and effective service provision prevails for the benefit of passengers and all road users.

## 9 ACKNOWLEDGMENTS

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## 10 REFERENCES

- Fouracre PR and Jacobs GD (1976). *Comparative accident costs in developing countries*. TRRL Supplementary Report 206. Crowthorne: Transport Research Laboratory
- Ghee C, Silcock D, Astrop A, Jacobs GD (1997). *Socio-economic aspects of road accidents in developing countries*. TRL Report 247, TRL, Crowthorne, UK.
- Jacobs G and Aeron-Thomas A and Astrop A (2000). *Estimating Global Road Fatalities*. TRL Report 445, TRL, Crowthorne, UK
- Maunder DAC and Mbara TC (1995). *The initial effects of introducing commuter omnibus services in Harare*. TRL Report 123, TRL, Crowthorne, UK.
- Maunder DAC and Mbara TC (1993). *The effect of ownership on the performance of stage bus services in Harare, Zimbabwe*. PR25, TRL, Crowthorne, UK.
- Maunder DAC and Mbara TC (1996). *Liberalisation of urban public transport services: What are the implications?* Indian Journal of Transport Management Vol.20 No 2 February 1996.
- Maunder DAC and Pearce T (1998). *Bus Safety in Nepal*. Indian Journal of Transport Management Vol. 22 No3 March 1998.
- Maunder DAC and Pearce T (1999). *Public Transport Safety in Nepal and Zimbabwe*. Journal of the Institution of Highways and Transportation. H & T Journal Vol. 46 No10 October 1999.
- Pearce T, Maunder DAC, Mbara TC, Babu DM, Rwebangira T. *Bus accidents in India, Nepal, Tanzania and Zimbabwe*. TRB Conference, Washington DC, January 2000.

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