
RURAL TRANSPORT SAFETY STRATEGY

Objectives of the paper

Abstract

This paper intends to highlight the magnitude of rural safety problems in developing countries, and to identify important components of a safety strategy for rural transport.

Studies carried out by TRL have demonstrated that road crashes in the developing world are:

- A serious problem, in terms of fatality rates being, at least in the order of magnitude, higher than those in industrialised countries.
- An important cause of death and injury.
- A considerable waste of scarce financial (and other) resources, typically costing at least 1% of a country's Gross National Product per annum.

Key issues

- The objective of this topic is to discuss the issues of road safety problems in developing countries, so as to provide a thorough understanding of the issues required for an effective safety improvement strategy. Recommendations for improvement on rural roads are included, based on the detailed research carried out by TRL over the last 20 years.

Key topic areas

- Rates and trends of road crashes in developing countries
- The cost of road crashes
- The nature of road crashes in developing countries
- Improving road safety on rural roads

1. INTRODUCTION

A recent study was carried out by TRL (Jacobs et al., 2000) with the following objectives:

- To derive an estimate of road crash fatalities world-wide and on a regional basis for the year 1999 and to derive forecasts of the likely number of deaths in the years 2010 and 2020,
- To provide an estimate of crash costs world-wide (based on crash costs as a percentage of Gross National Product (GNP)),
- To obtain regional analyses of fatality trends, rates and risk (deaths per 10,000 vehicles and per 100,000 population respectively) and casualty trends by age, sex and road user type.

The main points mentioned in the study are summarised below:

2. ESTIMATING GLOBAL ROAD FATALITIES

Previous reviews of global fatalities undertaken by TRL, World Bank and others have produced a wide range of estimates and whilst the problem of data reliability and under-reporting has been regularly acknowledged, previous forecasts have been based on the use of officially published statistics based in turn on police reports. Using these values to obtain a more accurate estimate of the current global fatality situation (on a regional basis) required several factors to be taken into account as follows:

1. Updating the fatality figures given for the latest year available (usually 1995/96) to 1999.
2. Estimating for those countries where fatality data was not available.
3. Making adjustment for those countries which do not use the definition of a road death occurring when a person dies within 30 days of the crash taking place. This ranges from 'on the spot' to 'within a year of the crash occurring'. Furthermore many developing countries state that they use the '30-day' definition and may do so at the local level (for prosecution purposes) but at the same time, official statistics are often based on preliminary information which is not always updated.
4. Adjusting official figures to take into account the under reporting of fatal crashes. Figures derived for both developed and developing countries were based on detailed research undertaken in recent years on this particular topic. Rather than use one figure for under-reporting in developing countries, upper and lower adjustment factors were calculated.

There is no standard approach to regional groupings used by the many different international organisations concerned with road safety. However in order to aid interpretation of data, a total of 192 countries were assigned to six major regional groups as follows:

- Africa.
- Asia/Pacific.
- Central and Eastern Europe (CEE).
- Latin/Central America and the Caribbean (LAC).
- Middle East and North Africa (MENA).
- Highly motorised countries (HMC), i.e. North America, Australia, New Zealand, Japan and Western Europe.

Less motorised countries (LMC) is the collective term used to describe the first five regions where motorisation is typically much lower than in the industrialised HMCs.

2.1 Current global fatality estimate

Based on the factors described above, a realistic estimate of global road deaths is between 750,000 and 880,000 for the year 1999. The calculations and regional totals are presented in Table 1. Understandably, with greater speeds on rural roads, it is estimated that about 60% of deaths take place on busy inter-urban roads.

Table 1: 1999 Estimated road fatalities with under-reporting (UR) adjustments

	1999 estimate	30 day fatality		Lower UR estimates		Upper UR estimates	
		Adjustment factor	Estimate	Adjustment factor	Estimate	Adjustment factor	Estimate
HMC	98,834	ECMT*	105,654	1.02	107,767	1.05	110,937
Africa	58,319	1.15	67,067	1.25	83,834	1.50	100,600
C/E Europe	63,540	1.15	73,071	1.25	91,339	1.50	109,607
Asia-Pacific	228,405	1.15	262,666	1.25	328,332	1.50	393,999
LAC	64,699	1.15	74,404	1.25	93,005	1.50	111,606
MENA	28,864	1.15	33,194	1.25	41,492	1.50	49,790
Global	542,661		616,056		745,769		876,539

*ECMT standard adjustment factors applied

It can be seen that the burden of global road fatalities is in the LMCs where 86% of the world's road fatalities occur, with almost half of all fatalities in Asia.

2.2 Estimate of global injuries

Whilst the under-reporting of injuries is known to be even worse than with fatalities, a minimum estimate within a likely range has been derived. Based on the International Road Traffic and Crash Databases (IRTAD) report and earlier studies that had estimated approximately 50% of road injuries were reported, it was decided that a ratio of 100 injuries for every fatality would apply in the HMCs. For LMCs, a ratio of between 20 to 30 was taken to be a minimum estimate. These values produce annual road crash injury estimates for 1999 of at least:

- 11 million in HMCs;
- 12 to 23 million in LMCs;
- global estimate of between 23 and 34 million road crash injuries per annum.

3. ECONOMIC COSTS OF ROAD CRASHES

3.1 Introduction

Apart from the humanitarian aspect of reducing road deaths and injuries in developing countries, a strong case can be made for reducing road crash deaths on economic grounds alone, as they consume massive financial resources that the countries can ill afford to lose. In order to assist in the allocation of resources, it is essential that a method be devised to determine the cost of road crashes and the value of preventing them.

Road crash cost figures are necessary to ensure that the best use is made of any investment and that the best (and most appropriate) safety improvements are introduced in terms of the benefits that they will generate in relation to the cost of their implementation. Failure to associate specific costs with road crashes will almost certainly result in the use of widely varying criteria in the choice of measures and the assessment of projects that affect road safety. If safety benefits are ignored in transport planning then there will inevitably be associated under-investment in road safety.

A study conducted by Fouracre and Jacobs (1977), estimated road crashes to cost on average 1% of a country's gross national product (GNP). As countries have developed, a higher range, 1 to 3%, has been suggested by the World Bank and others (but it should be stressed, with limited supporting evidence) for road crash costs. Expressing crash costs as a percentage of GNP provides an albeit crude but useful approach to costing crashes, particularly on a global or regional basis. That said, there is no real substitute in individual countries to carrying out a detailed appraisal of national crash costs.

3.2 Results of crash costing procedures

Information was obtained of 21 studies world-wide which had attempted to cost road crashes. (One in Latin America, seven studies in Asia, four in Africa, one in the Middle East and eight in developed countries). An analysis of these studies showed all developing countries using the 'Human Capital' approach whilst the majority of developed countries used the 'Willingness to Pay' approach. (For a critique on costing road crashes, the reader is referred to TRL Overseas Road Note 10, 1995). Values derived of national crash costs (usually for the year 1995 or 1996) were expressed as a percentage of GNP for the different countries and results ranged from 0.3% in Vietnam and 0.5% in Nepal and Bangladesh to almost 5% in Malawi and Kwa Zulu, Natal. However relatively little is known about the accuracy of the costing procedures used in each country. Overall it does appear that in most countries, costs exceed 1% of GNP which may now be considered to be an under-estimate of national crash costs.

The following table provides a crude estimate of global and regional costs assuming that the annual cost of road crashes is about 1% in developing countries, 1.5% in transitional countries, and 2% in highly motorised countries.

Table 2 implies that road crash costs may be of the order of US\$65 billion in developing and transitional countries, and US\$453 billion in highly motorised countries, making a crude estimated total of US\$518 billion world-wide.

Table 2: Road crash costs by region (US\$billion) 1997

Region	Estimated annual crash costs		
	Regional GNP	Per cent GNP	Cost
Africa	370	1.0	3.7
Asia	2,454	1.0	24.5
Latin America/ Caribbean	1,890	1.0	18.9
Middle East	495	1.5	7.4
Central & Eastern Europe	659	1.5	9.9
Highly motorised countries	22,665	2.0	453.0
Total			518.0

4. REGIONAL ANALYSES

4.1 Introduction

The study referred to earlier provides a detailed summary of the road safety situation in the individual regions. However the differences within the regions are often as wide as those between them. The most common indicator method used in motorised countries is the number of injury crashes per million vehicle kilometres per annum (which clearly relates crashes taking place to a measure of exposure to traffic) but few developing countries have vehicle usage data. Instead, the number of reported fatalities per 10,000 motor vehicles have been used by TRL and others to compare traffic safety records between countries. Yet fatality rates might be considered to be of less importance to a specific country than the actual number of deaths taking place. Fatality risk, the number of reported fatalities per 100,000 population, is the most common indicator used by the health sector to prioritise diseases and other causes of death.

4.2 Results

Fatality rates (i.e. death per 10,000 vehicles) are shown to be lowest in developed countries (in the range 1.1 to 5.0) whilst the highest (frequently in excess of 100) were found in African countries, particularly Ethiopia, Lesotho and Tanzania. Comparisons of crashes on rural roads would almost certainly present a similar picture. Fatality risk (i.e. deaths per 100,000 population) was shown to be highest in a disparate group of countries including Malaysia, Korea, Latvia, Saudi Arabia and Colombia.

Table 3 shows an interesting comparison of the global distribution of road crash deaths and licensed vehicles by region. Thus highly motorised countries with 60% of global vehicles have only 14% of global deaths. Conversely Asia/Pacific with only 16% of vehicles has about 44% of global deaths. Central and Eastern Europe, Africa and the

Middle East show a similar pattern. Latin America/Caribbean is the only region of the developing world where the global distribution of road deaths and vehicles match.

One of the most important differences between developed and developing regions is that over the last ten years or so the number of deaths taking place actually fell by about 10 per cent in Western Europe and North America, whilst in the Africa, Asia/Pacific and Latin America regions road deaths continued to rise. Fatality trends in South Africa and Poland differ from other African and East European countries respectively whereas in the other regions trends in the major and other countries tend to show a reasonably similar pattern. Thus over the period 1987-95 deaths in the Asia Pacific region rose by 39%, in Africa by 26% (excluding South Africa) and in the MENA region by over 36% and in the Latin America/Caribbean region by over 100% (excluding Brazil). In Africa and Asia there is now some evidence that the rapid increase in road deaths throughout the 1970s and early 1980s is now slowing down.

Table 3: Current distribution of global deaths and licensed vehicles

Region	Global percentage of		
	Road fatalities	Vehicles	Population
Highly motorised countries	14	60	15
Asia/Pacific	44	16	54
Central/Eastern Europe	12	6	7
Latin America/Caribbean	13	14	8
Africa	11	4	11
Middle East/North Africa	6	2	4
Total	100	100	100

As might be expected, the majority of people killed in the West are car drivers and passengers but with about 15 to 20% being pedestrians. In Asian countries, a wide variation was found with, for example, almost 70% of those killed being pedestrians in Hong Kong and about 50% in Korea. In China, Malaysia and Thailand, pedestrian deaths were surprisingly low at around 10-15% of the total. Conversely in Singapore, Taiwan (China) and Malaysia over 50% of deaths were motorcyclists. When deaths involving pedestrians, non-motorised vehicles and motorcycles are combined in Asian countries to form the overall category 'Vulnerable Road Users' (VRU's), they represent a significant proportion of all people killed. For example in Hong Kong, Singapore, Malaysia and Taiwan, VRU's form 80-89% of all fatalities and in Fiji and Korea about % (ADB, 1997).

In African countries (Gorell, 1997), pedestrians were again one of the main classes of road users involved in fatal crashes. Pedestrian deaths also featured strongly in Middle Eastern countries (usually over 30% of all deaths). An analysis of deaths by gender showed wide variation between countries (even within regions). The overall tendency however was for females to be more involved in non-fatal crashes than in fatal. The

overall tendency was for there to be proportionately more females involved in both fatal and non-fatal crashes in the higher income countries.

An analysis of casualties and fatalities by age showed that young people are involved in proportionately more crashes in Africa, Asia and the Middle East than in the West. In general, the data from all regions indicated that road crashes involving the economically active in the age group 25-40 dominate.

Limited data available suggests that crash patterns derived at the national level also apply to crashes taking place on rural roads. That said, there are proportionately more high speed crashes on rural, as opposed to urban roads but proportionately fewer involving pedestrians.

5. INSTITUTIONS & INFORMATION SYSTEMS

5.1 Organisational Requirements

In road safety matters, as in many other sectors, there is a need to strengthen the various institutions responsible for road safety, and to increase their capability for multi-sectoral action. The whole process of planning and implementing road safety improvements should be multi-disciplinary.

The setting of targets is a well-established management strategy and, when applied to crash reductions, has proved very effective in many developed countries. A national target does need to be disaggregated so that all those with safety responsibilities are given their own specific and realistic targets, with adequate funding directly related to those targets. To manage this efficiently, it is recommended that the authorities produce an annual Road Safety Plan, which clearly states current crash reduction targets and how they are to be achieved.

Road safety organisations should thus be established on a full-time basis, and be capable of:

- Diagnosing the road crash problem
- Drawing up an integrated plan of action, including the setting up of goals and objectives
- Co-ordinating the work of all organisations involved
- Procuring funds and resources
- Producing design guides
- Designing and implementing improvements
- Monitoring implementation and evaluating measures
- Feeding back information from the evaluations and amending the action plan as necessary

In a survey of African countries' roads safety activities (Yerrell, 1991) 35% of the countries reported active national road safety organisations. Although this level of activity appears very encouraging, in many cases the functions of road safety

organisations were somewhat limited, and clearly more institutional improvements are still necessary.

5.2 Road Crash Databases

One of the key activities listed above was the diagnosis of the road crash problem. The most important source of data for this is the police road crash report. In the early 1970's, a survey of road crash information systems in use in developing countries (Jacobs et al, 1975) indicated that only 15% of the countries had adequate crash report forms, and none had computer analysis facilities. In order to improve their crash investigation and research capability in developing countries, TRL developed its Microcomputer Accident Analysis Package (MAAP), which is now used in over 50 countries.

MAAP consists of two key components: a police report booklet or form with a recommended structure, and a set of software programs for data entry and analysis. The relatively low cost and increased availability of microcomputers means that individual highway authorities can analyse their own data to help identify hazardous locations, the nature of the problems, choose appropriate countermeasures, and assess their effectiveness.

6. IMPROVING ROAD SAFETY ON RURAL ROADS

6.1 Engineering and Planning

Despite the fact that human error is probably the chief causal factor in most road crashes, there is little doubt that engineering and planning improvements can affect road-user behaviour and reduce the frequency with which errors occur. Engineering and planning can improve road safety through two distinct mechanisms:

1. **Crash prevention:** resulting from good standards of design and planning of new road schemes and related development; and
2. **Crash reduction:** resulting from remedial measures applied to problems identified in the existing rural road network.

6.1.1 Crash Prevention

There has been very little research in developing countries into the relationships between highway design standards and crash rates. As a result, many developing countries have just adopted standards from developed countries, or have modified such standards without evaluating the consequences. Often the traffic mix and road usage, especially in the rural context, is very different in a developing country from that encountered in more industrialised countries.

To attain this balance, Hills et al (1984) have suggested that a radically different approach to the geometric design of highways may be required in developing countries, especially for low-volume roads. Studies of the relationship between geometric design and road crashes in Kenya and Jamaica and research in Chile and India indicated, not

unexpectedly, that junctions per kilometre was the most significant factor related to crashes, followed by horizontal and vertical curvature. Kosasih, Robinson & Snell (1987) have examined geometric design research and standards around the world, and have made recommendations for developing countries.

6.1.2 Crash Reduction

The approaches used by developed countries for crash reduction would also seem to have considerable potential for developing countries. It is recommended that countries with limited resources should place initial emphasis on introducing low-cost improvement schemes at hazardous locations. Such schemes have proved very effective in industrialised countries; for example, in a survey of UK schemes (Hellier-Symons & Lynam, 1989) First Year Rates of Return were estimated to range from 65 to 950%.

Since the 1970's, industrialised countries have benefited considerably from improvements in engineering approaches to road safety. Developing countries on the other hand, have been slower to adopt these approaches. Roads are often built or upgraded with little consideration given to road safety, and as a result black spots are still being created. TRL's road safety guide for planners and engineers entitled "Towards Safer Roads in Developing Countries", is designed to be a first point of reference on road safety issues, drawing on best practices around the world.

6.2 Vehicle Safety

In developing countries, the safety design of vehicles sometimes lags behind that of industrialised countries, particularly when vehicles are locally manufactured or assembled. Similarly, vehicle condition is likely to be more of a problem when it is difficult to obtain spare parts. Overloading of goods and passenger vehicles is another factor that commonly contributes to high crash severity and casualty rates.

Legislative controls on the overloading of passenger-carrying vehicles, combined with improvements in the design of such vehicles would also seem to have some potential for crash and casualty reduction in developing countries. For example, in Papua New Guinea (PNG), it is common for passengers to be transported in open pick-ups and, perhaps not surprisingly, an exceptionally high proportion (45%) of the road crash casualties come from such vehicles. This is especially important in rural areas where a high demand for transport services, but low supply of vehicles proliferates the overloading of passenger vehicles, which substantially increases the crash risk on feeder roads.

6.3 Education and Training

6.3.1 Road Safety Education

In developing countries the child pedestrian crash problem is generally more serious than in developed countries; a problem exacerbated in areas which experience low school attendance figures. It is therefore important that education, through community programmes, is considered in addition to the school system.

It is recognised that road safety education programmes should be graded and developmental (OECD, 1978, Downing, 1987) and that teachers need guidelines on what and how to teach. To meet these requirements, many countries have produced syllabus documents and teacher guides, including some in developing countries (Leberu, 1990). However, it is in this area that the transferability of developed country solutions to developing countries is less certain, and much more research is needed.

6.3.2 Driver Training and Testing

In developing countries, the problems of poor driver behaviour and knowledge described earlier are likely to be due, to some extent, to inadequacies in driver training and testing. Professional driver instruction tends to be limited because:

- Driving instructors are not properly tested or monitored
- There are no driving or instruction manuals
- Driving test standards and requirements are inadequate

Consequently, there is likely to be considerable scope for raising driving standards by improving driver training and testing. TRL recently collaborated with the United Nations Economic Commission for Africa (ECA), in producing a driving guide specifically for truck drivers (TRL,1990). This group of drivers tends to have a greater involvement in crashes than in developed countries, and inadequate training clearly plays some part in this.

As well as providing such advice on driving standards, many countries need to improve the licensing, training, testing and monitoring of instructors to ensure that these standards are taught. In training systems where learner drivers are free to choose how they learn, it is important that driving tests demand a high standard of driving especially for the practical 'on the road' assessment. More difficult tests should encourage learners to purchase more lessons from professional instructors.

6.4 Enforcement

A large number of studies have examined the effectiveness of enforcement systems in developed countries, particularly with respect to traffic police operations. A conspicuous police presence was shown to lead to improvements in driver behaviour in the vicinity of the police.

In developing countries, the traffic police are generally less well trained and equipped and are often non-mobile, i.e. stationed at intersections. Traffic police operating under such conditions are likely to find it difficult to influence moving violations, and this was certainly shown to be the case in a study by Downing (1985) of the effects of police presence in Pakistan. Following the introduction of highway patrols on inter-city roads, a 6 percent reduction in crashes was achieved in Pakistan. Improvements in traffic policing have considerable potential for both improving driver behaviour and reducing crashes, provided that the police's capability to enforce moving violations is enhanced.

Research in developing countries (Mercer, 1985) suggests that changes in the way that traffic police operate need to be well advertised to ensure maximum effect on road-user behaviour. It is equally important that developing countries integrate changes in enforcement tactics with appropriate publicity campaigns.

7. CONCLUSION

Many developing countries have a serious road crash problem. Fatality rates are high in comparison with those in developed countries. Apart from the humanitarian aspects of the problem, road crashes cost countries of Africa and Asia at least one percent of their GNP each year - sums that these countries can ill afford to lose. Road crashes are a significant cause of death in developing countries, and the lack of medical facilities results in the exacerbation of high death rates. Problems are compounded on rural roads due to higher vehicle speeds, which result in crashes almost inevitably involving death and serious injury.

In order to identify priorities for action, it is important that there is a clear understanding of the road crash problem on rural roads, and the likely effectiveness of road safety improvements. It is therefore a priority for countries to have an appropriate crash information system (for example MAAP) that can be used to identify crash patterns, the factors involved in road crashes, and the location of hazardous sites. It is also essential that developing countries set up procedures for costing road crashes, which will ensure that investment is allocated appropriately.

Other basic requirements are likely to include the following:

- Adapt a scientific, quantitative basis for road safety policy. Establish research centres, establish data systems, and integrate with transport policy.
- Create an institutional focus for road safety plans and actions that must be multi-disciplinary. Form road safety councils, train safety teams, and establish realistic targets.
- Behaviour and training: target young road users. Legislate against and control drink driving. Improve targeted enforcement.
- Vehicles: priority given to seatbelts, and to helmets for two-wheelers. In low-income countries, target public and parastatal freight and bus fleets (for general vehicle condition as well as other measures).
- Carry out road safety audits on rural roads and ensure that safety features are incorporated at the planning and construction stages.

Developing countries have accelerated their efforts to improve road safety in recent years. It is hoped that these trends will continue and that all countries will, through joint programmes of research and development and by sharing information, maintain an effective and scientific approach to reducing road crashes and their severity, particularly on rural roads throughout the world.

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