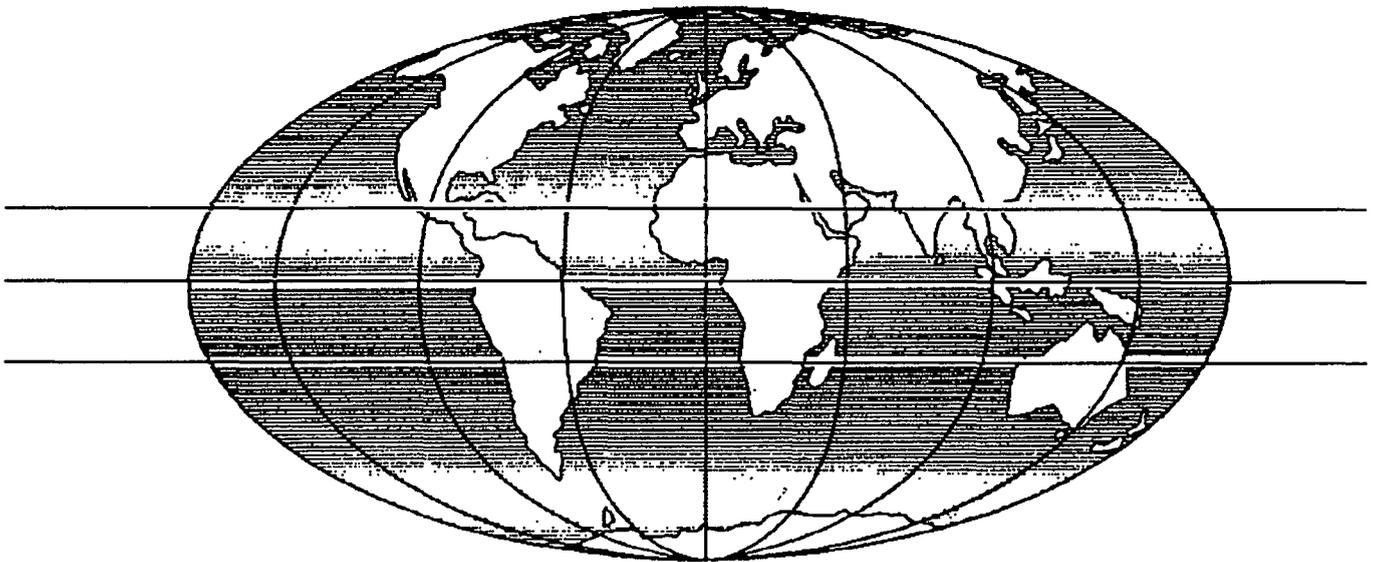




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TITLE Safe roads: A dream or a reality?

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SAFE ROADS : A DREAM OR A REALITY?

by

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1. INTRODUCTION

Independent studies by both the Transport Research Laboratory (TRL) and the World Bank have estimated that about 500,000 people lose their lives each year as a result of road accidents and over 15 million suffer injuries. The majority of these, about 70 per cent, occur in those countries which the World Bank classifies as low or middle income. Whereas the road accident situation is slowly improving in the high income countries, most developing countries face a worsening situation. As infectious diseases are brought increasingly under control, road deaths and injury rise in relative importance. In Thailand for example, more years of potential life are lost through road accidents than from tuberculosis and malaria combined (Yerrell, 1992). The author believes that whilst there can be no such phenomenon as a completely 'safe' road system (due in no small part to human behaviour), very high road accident death rates are not the inevitable price that has to be paid by these countries for the mobility of people and goods, but that there is much scope for improving their road safety situation whilst developing into a more industrialised society.

This paper presents a broad review of the road safety problems in developing and emerging countries as a thorough understanding of these must be gained before an effective improvement strategy can be devised.

2.1 Rates and trends

The rate used by TRL to compare the seriousness of the road accident problem in different countries throughout the world is the number of deaths from road accidents per annum per 10,000 vehicles licensed. This is far from ideal as an indicator of relative safety in different countries. For example, the injury accidents per million vehicle-km travelled per annum may be a much better parameter to use but, unfortunately, the reporting of non-fatal accidents in most Third World countries is poor and few carry out traffic surveys and censuses which provide information on annual travel by different classes of vehicle.

Results for a number of countries (1990-93) are shown in Figure 1. It can be seen that whilst countries of Western Europe and North America are characterised by a death rate (as defined above) of often less than 2, some developing countries have a death rate in excess of 150. In most developing countries there will be an under-reporting of road accident deaths and an over-estimate of licensed vehicles because as vehicles are scrapped they tend not to be removed from the vehicle register.

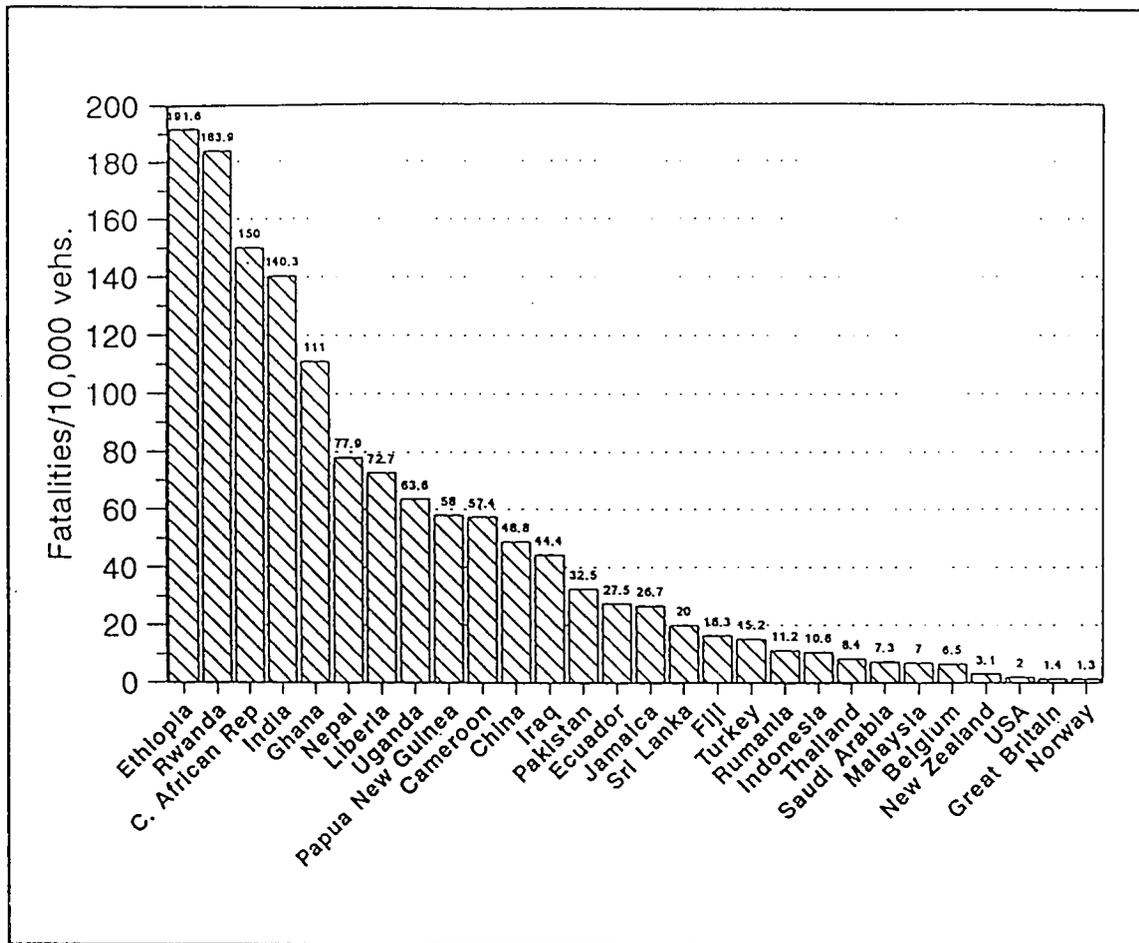


Fig. 1 Road Accident Fatality Rates (deaths/10,000 registered vehicles) in selected countries (from latest data available from 1990-1993)

In 1984, TRL carried out a study in Colombo, Sri Lanka, comparing 'official' road accident statistics from police records with those held by hospitals. It was found that less than 25 per cent of the hospital records (of fatal and serious road accidents) were identified in the police data. Matching of accidents involving children was particularly low. Studies such as these suggest that the road safety problem in developing countries may be much worse than official statistics suggest.

Figure 2 shows the percentage increase or decrease in the actual number of road accident fatalities over the period 1968 to 1990 for four groups of countries. It can be seen that over this given time period the number of road accident deaths in 14 developed countries actually fell on average by 30 per cent. Conversely in 6 Asian and Middle Eastern countries and 12 African countries (for which reasonably accurate statistics were available) there were increases of about 200 and 340 per cent respectively. In these countries, therefore, there is obviously need for much effort and investment in safety measures to reverse this trend - as has been the case in the developed world.

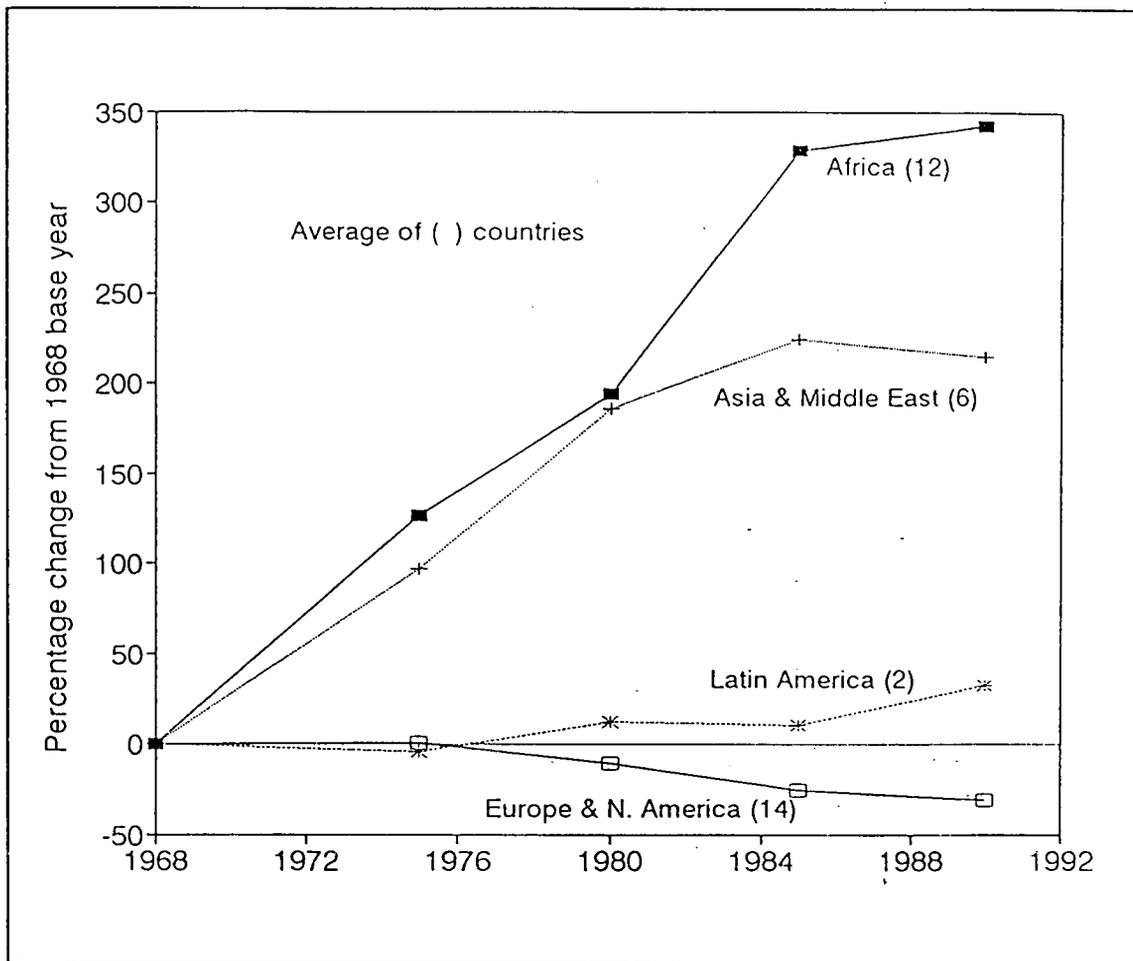


Figure 2 Percentage change in road accident fatalities over 22-year period

2.2 The cost of road accidents

Apart from the humanitarian aspects of road safety, it must also be borne in mind that road accidents are responsible in developing countries for a loss of scarce financial resources that these countries can ill-afford to lose. An analysis carried out by TRL (Fouracre & Jacobs, 1976) showed that road accident costs were the equivalent in any country, be it developed or developing, to approximately 1 per cent of its annual gross national product. In current prices this suggests that road accidents in Indonesia for example may be costing about £600 million per annum, in Pakistan £260 million, in Egypt £200 million, in Chile £150 million, in Kenya £60 million, etc. If one assumes road accidents to cost 1 per cent of GNP in all countries, then for those countries of Africa and Asia below an average GNP/capita of \$3,500 (figure used by the World Bank to define 'developing' countries), it is estimated that the total annual cost of road accidents is approximately US\$30 billion. If the reduction in the substantial pain, grief and suffering caused by road accidents in the Third World is not sufficient motivation, there is also a very strong economic case to be made in the significant loss of resources each year due to accidents. Even in the United Arab Emirates with a total population below 2 million people, 1 per cent of GNP suggests an approximate annual cost of road accidents of almost US\$380 million per annum.

3. THE NATURE OF THE ROAD ACCIDENT PROBLEM

3.1 Accident Patterns

There are some accident characteristics which are common to a number of developing countries and yet are somewhat different from those in developed countries. For example, in the Third World (see Fig 3 and Table 1), a relatively high proportion of fatalities are pedestrians and children aged under 16 years, and many fatal accidents involve trucks, buses and other public service vehicles (see Downing, 1991).

In many cases, these higher percentages are an obvious consequence of the differences between the traffic and population characteristics of developed and developing countries. For example, the average percentage of the population aged 5 to 14 years in a sample of 16 developing countries was 28 per cent compared with 15 per cent for 9 developed countries (Downing and Sayer, 1982). As pedestrians, children and professional drivers constitute such a large proportion of the accident problem, it is clear that many Third World countries need to give priority to improving the safety of these (often neglected) three groups.

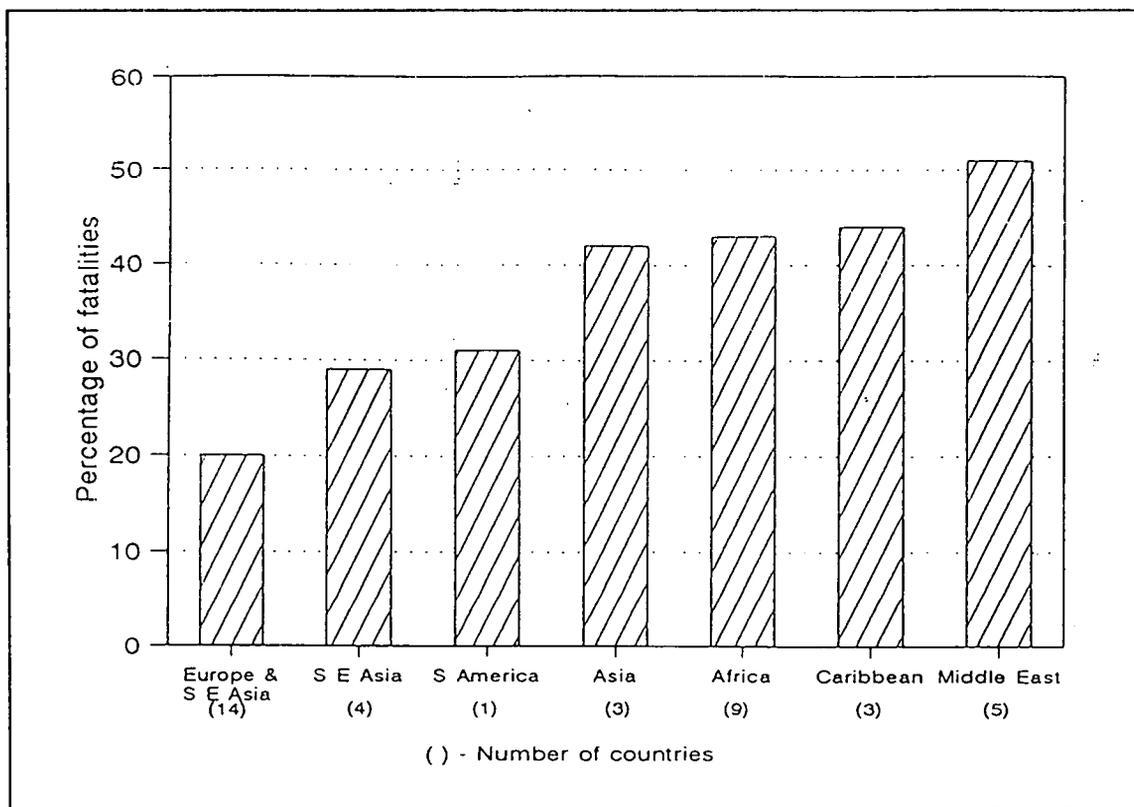


Figure 3 Pedestrian fatalities as a percentage of all road accident fatalities

3.2 Contributory Factors

In most countries, police road accident reports give some information about the factors or causes which contributed to the accidents. In general these data have to be treated with some caution as the police investigating the accidents are unlikely to have been trained as engineers

and they may therefore underestimate the contribution made by road engineering problems. Their main aim is usually to determine whether there has been a traffic violation and therefore the emphasis of the investigation is likely to be placed on detecting human error and apportioning blame.

In the United Kingdom in the early 1970s a more reliable approach, namely 'On-the-Spot' investigation, was carried out by a research team from TRRL in an area of South East England (Sabey and Staughton, 1975). This study demonstrated the importance of the road-user factor which contributed to 95 per cent of the accidents and the strong link between road-user error and deficiencies in the road environment, which together contributed to over 25 per cent of accidents (see Table 2).

TABLE 1

Characteristics of fatal accidents

Country	Percentage of fatalities which:	
	were children under 16 years	involved trucks and buses
Botswana (1988)	16	25
Egypt (1984)	12	37
Ghana (1989)	28	50
Pakistan (Karachi) (1988)	14	44
Papua New Guinea (1987)	20	37
Zimbabwe (1989)	11	45
United Kingdom (1988)	9	21

TABLE 2

Causes of road accidents as determined by the police in developing countries

Country	Main Cause of Accident (%)			
	Road-user error	Vehicle defect	Adverse road conditions or environment	Other
Afghanistan 1984	74	17	9	-
Botswana 1982	94	2	1	3
Cyprus 1982	94	1	5	-
Ethiopia 1982	81	5	-	14
India 1980	80	7	1	12
Iran 1984	64	16	20	-
Pakistan 1984	91	4	5	-
Philippines 1984	85	8	7	-
Malaysia 1985	87	2	4	7
Zimbabwe 1979	89	5	1	5
TRRL On-the-Spot Study 1975*	95	8	28	

*In about 30% of accidents, multiple factors were identified

Constraints of expertise or funding currently prevent a study of this type in developing countries, so police reports are the only source of information available. From Table 2 it can be seen that, in general, the data highlight the seriousness of road-user errors in developing countries but give little indication of any road environment factor other than in the case of Iran. It seems likely that the road environment factor has been considerably underestimated by the police in their statistics. The condition of main roads is poorer in developing than in developed countries (see, for example, Harral and Faiz, 1988) and the pace of introducing engineering improvements to reduce road accidents is considerably

slower in the Third World. By speeding up this process the inevitable rise in accidents in many Asian and African countries could certainly be slowed down.

3.3 Road User Behaviour and Knowledge

Studies of road-user behaviour (Jacobs et al, 1981) at traffic signals and pedestrian crossings in a number of Third World cities indicated that road-users tended to be less disciplined than in the United Kingdom. Also, observations in Pakistan (Downing, 1985) demonstrated relatively high proportions of drivers crossing continuous "no-overtaking" lines (15 per cent) and not stopping at stop signs even when traffic was near (52 per cent). Although the relationship between these differences in behaviour and accidents has not been determined, the results suggest that road safety measures which are not self enforcing, such as road signs and markings, may be much less effective unless they are integrated with publicity and enforcement campaigns. Poor road-user behaviour exhibited by drivers in some developing countries may be due to their lack of knowledge about road safety rules and regulations or their general attitude towards road safety matters. A study of drivers' knowledge in Jamaica, Pakistan and Thailand (Sayer and Downing, 1981) indicated that there were only a few topics where a lack of knowledge was widespread. One such example was stopping distances where 87 per cent of the drivers underestimated the distance required to stop in an emergency when travelling at 30mph. Answering questions on stopping and following distances also proved to be a problem for professional drivers in Cameroon and Zimbabwe (Downing, 1991), with truck and bus drivers unable to answer more than half the questions on driving knowledge and skills correctly. Other areas of driver behaviour, such as not stopping at pedestrian crossings, traffic signals and stop signs were found to be due to poor attitudes rather than to poor knowledge. Although attitudes are notoriously difficult to change, there would seem to be some potential for improving them by introducing publicity and enforcement campaigns.

4. INSTITUTIONS AND INFORMATION SYSTEMS

4.1 Organisational Requirements

In road safety matters, as in many other sectors, there is a need to strengthen the various institutions responsible for the various aspects of 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 and dynamic.

Road safety organisations (with trained staff) should be established on a full-time basis and be capable of:

- 1) diagnosing the road accident problem
- 2) drawing up an integrated plan of action including the setting up of goals and objectives
- 3) coordinating the work of all organisations involved
- 4) procuring funds and resources
- 5) producing design guides
- 6) designing and implementing improvements
- 7) monitoring implementation and evaluating measures

- 8) feeding back information from the evaluations and amending the action plan as necessary.

4.2 Road Accident Databases

One of the key activities listed above was the diagnosis of the road accident problem. The most important source of data for this activity is the police road accident report. In the early 1970s, a survey of road accident information systems in use in developing countries (Jacobs et al, 1975) indicated that only 15 per cent of the countries had adequate accident report forms and none had computer analysis facilities. Therefore, to help countries improve their accident investigation and research capability, TRL's Overseas Centre, with ODA's support, developed its Microcomputer Accident Analysis Package (MAAP), initially in collaboration with the traffic police in Egypt, (Hills and Elliott, 1986) and it is now in use in over 50 countries with 9 countries using it as their full national database. MAAP has been configured to operate in several languages including Arabic, Chinese, French and Spanish. The software has been gradually developed and improved over the years, and it is interesting to note that MAAP is also now used by a number of Police and Local Authorities in the UK.

MAAP is a powerful yet simple system which enables users to:

- 1) obtain good data for diagnosis, planning, evaluation and research purposes
- 2) set up low-cost engineering improvement schemes similar to those which have proved so successful in developed countries.

It 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, all with increased efficiency and, therefore it is hoped, accuracy.

5. IMPROVING ROAD SAFETY

In most African and Asian countries, the evaluation of improvements is essential because of the lack of data on the benefits (or otherwise) of road safety measures. It is recommended that improvements are introduced on a pilot basis and evaluated before being implemented nationwide. The Overseas Centre at TRL is giving priority to researching road safety counter-measures but, owing to the long term nature of many of the studies and the limited resources available, there are only a few published results. In spite of this lack of information the remainder of this paper attempts to give an idea of likely priorities for future road safety action and research by reviewing studies of remedial measures in developing countries with reference to developed country findings where appropriate.

5.1 Engineering and Planning

Despite the fact that human error is probably the chief causal factor in most road accidents,

there is little doubt that engineering and planning improvements can affect road-user behaviour in such a way that errors are less likely to occur or, when they do occur, the environment can be made more 'forgiving'. Thus whilst roads can never be completely safe for all road users (be they drunk, inexperienced, fatigued or intent on driving dangerously) they can be made safer. Thus, there has been a growth in emphasis on engineering and planning countermeasures over the past two decades both in Europe and North America.

Engineering and planning can improve road safety through two distinct mechanisms, ACCIDENT PREVENTION, resulting from good standards of design and planning of new road schemes and related development and ACCIDENT REDUCTION, resulting from remedial measures applied to problems identified in the existing road network.

There has been very little research in developing countries into the relationships between highway design standards and accident 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 is very different in a developing country from that encountered in more industrialised countries. Also, there is usually a greater need to minimise costs; the challenge is to achieve this whilst at the same time maintaining an acceptable level of safety.

The approaches used by developed countries for accident reduction would also seem to have considerable potential for developing countries. In particular, 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 (Helliier-Symons and Lynam, 1989) First Year Rates of Return were estimated to range from 65 to 950 per cent.

A few developing countries have begun to introduce such schemes on a trial basis and the Overseas Centre is currently carrying out joint research to evaluate their effectiveness in Egypt, Ghana, Indonesia, Malaysia, Pakistan and Papua New Guinea. These trials, which have been made possible by the introduction of the TRL Microcomputer Accident Analysis Package (see earlier) are still at an early stage. However, preliminary findings suggest that countries which have relatively low levels of road-user discipline are less likely to have success with very low-cost measures such as road signs and markings.

It has already been noted that, since the 1970s, 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. In many locations, roads are being built or upgraded with little consideration given to road safety, and as a result blackspots are still being created. One factor contributing to this situation could well be the difficulty in acquiring information about the latest techniques and standards. To encourage the transfer of suitable technology in this field, the TRL has published "Towards Safety Roads in Developing Countries" (TRRL, 1991), a road safety guide for planners and engineers. This was produced in association with the Ross Silcock Partnership and is designed to be a first point of reference on road safety issues. It draws upon appropriate material from many existing manuals and standards around the world as well as giving many photographic examples of good and bad practices.

5.2 Urban Traffic Control

Coordinating the operation of traffic signals by Urban Traffic Control (UTC) is a common technique used to reduce traffic delays in urban areas. The aim of the coordination is to improve traffic conditions and to minimise delay by reducing the number of vehicles approaching red traffic signals and having to stop. Therefore, a UTC system, which is obeyed by drivers, should reduce the number of potential conflicts controlled by traffic signals. However, there is little hard evidence of the effects of UTC on road safety.

When UTC was first introduced in the UK (in Leicester) in 1974, a reduction of personal injury accidents was identified in the area brought under control (Gillam and Withill 1990). Whilst a study of the effects of SCOOT, the traffic responsive UTC system, on safety in the UK (Hunt et al 1990) found a small overall decrease in accidents, another study of accidents at four-arm urban signal controlled junctions (Hall 1986) found little effect of UTC. Melbourne, Australia, used dynamic advisory signs linked to UTC to inform drivers of how fast to drive for optimum benefit from the signal coordination and to warn them when they would have to stop at the next signal. All accidents reduced by 7 per cent on the trial corridor, compared with an increase of 15 per cent on other roads (Trayford et al, 1989).

It should perhaps be emphasised that the studies of UTC and accidents refer to experience in countries where traffic signals are normally obeyed and so may not be simply transferable to developing countries. In addition a UTC system works by coordinating the traffic signals for the average speed of traffic and the variation in traffic speeds in the urban areas of the more industrialised countries is not great, hence coordination of signals has great benefits. In many developing countries, the variation in speeds may be much greater if, for instance, animal drawn vehicles, bicycles or cycle or scooter rickshaws form a significant proportion of the traffic and can delay motorised vehicles between junctions.

5.3 Vehicle Safety

The benefits to individual road-users of improving vehicle design and of wearing seat belts and helmets are likely to be much the same from one country to another so the general adoption of both primary and secondary vehicle safety measures is to be encouraged. However, the total benefit of such measures to a developing country as a whole will depend on the characteristics of its accident and casualty problem and in some cases on the degree of road-users' compliance with traffic legislation. Thus, for example, seat belt wearing laws would lead to only small casualty savings if few casualties came from cars or if most drivers and passengers ignored the law.

From Table 2 it is clear that the police in some developing countries have blamed a relatively high proportion (up to 17 per cent) of accidents on vehicle defects. Although many of these countries may have inadequate controls to ensure minimum safe standards of vehicle condition, it would seem more appropriate that they should start by introducing low-cost random roadside checks using simple equipment rather (as is often the case) than expensive networks of vehicle testing centres with sophisticated technology.

5.4 Education and Training

It is important for road-users to be educated about road safety from as young an age as possible. In developed countries a number of approaches have been tried both through school systems and through parents, and most children receive some advice. However, in developing countries where the child pedestrian accident problem is generally more serious (see Section 3.1), a study of children's crossing knowledge (Downing and Sayer, 1982) indicated that children were less likely to receive advice (from members of their family, teachers or the police) than in the UK. There is clearly a need to improve road safety education, but as some countries will have low school attendance figures it is important that education through community programmes is considered as well as through 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 a few in the Third World (Leburu, 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. TRL is currently developing material for use by teachers in Ghana so that the important concept of road safety education can be conveyed effectively to children at a relatively early age.

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 driving instruction tends to be limited because:

- 1) driving instructors are not properly tested or monitored
- 2) there are no driving or instruction manuals
- 3) 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. One recent contribution by the Overseas Centre in collaboration with the United Nations Economic Commission for Africa (ECA), is a driving guide specifically for truck drivers (TRRL, 1990). This group of drivers tends to have a greater involvement in accidents than in developed countries and inadequate training clearly plays some part in this. The guide was designed to be easy to read (average reading age of 9 years) and its usefulness appears promising, as a study by Downing (1991) demonstrated that reading sections of the guide helped drivers improve their scores on knowledge tests by up to 25 per cent on some topics.

5.5 Enforcement

A large number of studies (OECD, 1974 and Spolander, 1977) have examined the effectiveness of enforcement systems in developed countries, particularly with respect to traffic police operations. Many of them demonstrated that a conspicuous police presence led to improvements in driver behaviour in the vicinity of the police, but the evidence for accident reductions was less convincing.

In developing countries, the traffic police are generally less well trained and equipped and often they are non-mobile ie 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. However, studies of improved training and deployment of traffic police have indicated large reductions in moving violations (see Downing, 1985). Also, following the introduction of highway patrols on intercity roads, a 6 per cent reduction in accidents was achieved in Pakistan, and a similar scheme in Egypt produced accident reductions of almost 50 per cent (Gaber and Yerrell, 1983). Therefore, it would appear that improvements in traffic policing have considerable potential for both improving driver behaviour and reducing accidents provided that the police's capability to enforce moving violations is enhanced.

6. CONCLUDING REMARKS

Most high-income countries have had half a century to learn to cope with the problems of ever-increasing motorisation. The less wealthy nations or the emerging nations of South East Asia and the Middle East have had less, and for most the pace of change has been much greater.

In order to identify priorities for action, it is important that there is a clear understanding of the road accident problem and the likely effectiveness of road safety improvements. It is therefore a priority for countries to have an appropriate accident information system (such as TRL's MAAP) which can be used to identify accident patterns, the factors involved in road accidents and the location of hazardous sites. In order that an overall budget for, say, a five-year action programme can be determined, it is essential that developing countries set up procedures for costing road accidents. This will also do much to ensure that the best use is made of any investment and that the most appropriate improvements are introduced in terms of the benefits that they will generate in relation to the cost of their implementation.

Other basic requirements for the lower and middle-income countries are likely to include the following, though this list may not be exhaustive:-

- i) Adapt a scientific, quantitative basis for road safety policy. Establish research centres, establish data systems and integrate with transport policy.
- ii) Create an institutional focus for road safety plans and actions which must be multi-disciplinary. Form road safety councils, train safety teams and establish realistic targets.
- iii) Press for long-term land-use and transport policies to reduce the use of the more dangerous modes and mixes of traffic.
- iv) Highways: plan well-defined hierarchies of use, reduce the unexpected on highways, institute safety audits, low-cost remedial works and low-speed/pedestrian priority areas in cities.
- v) Behaviour and training: target young road users. Legislate against and control drink (and drug)/driving. Improve targeted enforcement.

- vi) 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).
- vii) Improve emergency medical services for those who survive the first few minutes after a crash but die within the next few hours (often two-thirds of all fatalities),
- viii) With all measures, adopt, experiment and evaluate - and let the results be known and transferred on a national and international basis.

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 accidents throughout the world. Clearly there is no such phenomenon as a completely safe road but much can be done throughout the countries of Africa, Asia and the Middle East to improve the overall safety of drivers and pedestrians using the road network.

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