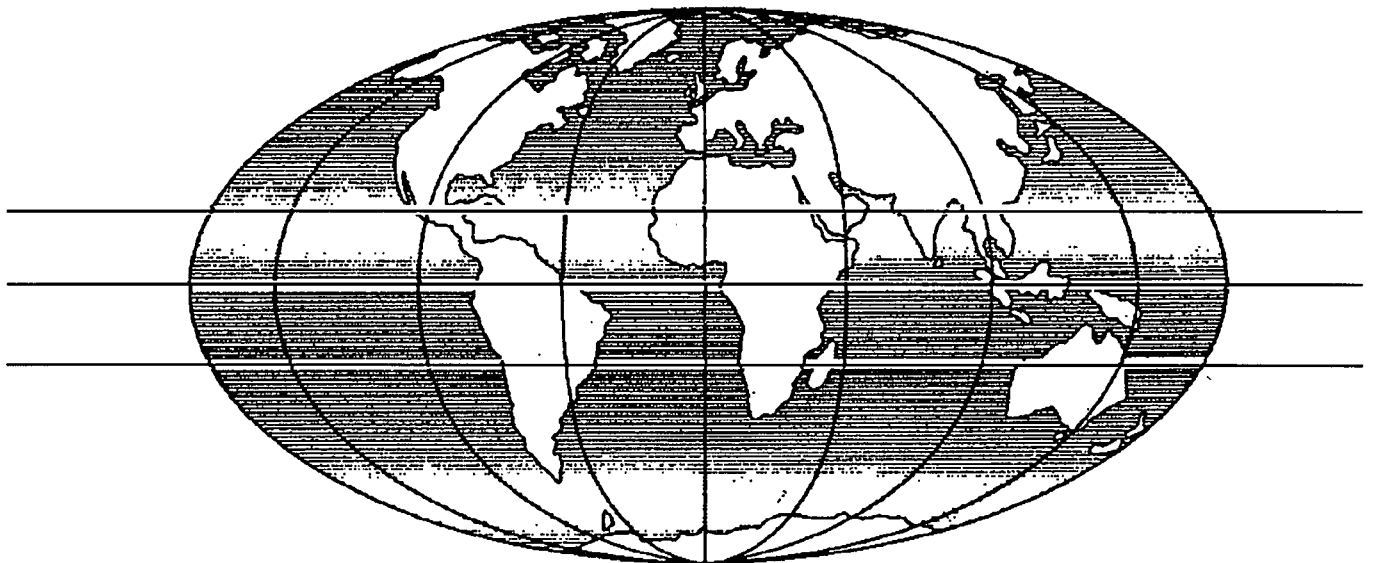




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ROAD SAFETY IN THE EMERGING NATIONS

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ABSTRACT

Independent studies by both the World Health Organisation and the World Bank (1990) have estimated that 500,000 individuals lose their lives each year as a result of road accidents, and over 15 million suffer injuries. The majority of these - around 70 per cent - occur in those countries which the World Bank classifies as low or middle income. However, a significant proportion also take place in countries in Asia and the Middle East that are often described as 'Emerging'.

Whereas the road accident situation is slowly improving in Europe and North America, most developing and emerging countries face a worsening situation. The authors believe that this is not the inevitable price that has to be paid by these countries for the mobility of people and goods, and that there is much scope for improving their respective road safety situations whilst developing into advanced industrialised societies.

This paper presents a broad review of the road safety problems in developing and emerging countries, since a thorough understanding of these must be gained before an effective improvement strategy can be devised. In particular the road safety situation in selected Middle Eastern countries is identified and put into perspective in terms of levels of motorisation. The nature of the problem is also assessed. The importance of a sound database is emphasised together with an outline of how existing systems can be improved. Recommendations for improvements are included, based on the detailed research carried out by the Overseas Centre at the Transport Research Laboratory (TRL) over the last 20 years.

1. INTRODUCTION

The problem of road accidents is now acknowledged to be a global phenomenon; authorities in virtually all countries of the world are concerned about the growth in the number of people killed on their roads. This growing awareness of the problem is reflected in the fact that international lending agencies such as the World Bank or Asian Development Bank and national aid organisations such as Britain's Overseas Development Administration (ODA) now include a road safety component in all highway sector loans.

Independent studies by both the World Health Organisation and the World Bank (1990) have indicated that about 500,000 road fatalities occur worldwide each year. Of that total over 70 per cent occurred in countries of the 'developing and emerging' worlds. The classification

'developing country' usually refers to the poorest countries of the world where the gross national product (GNP) per capita is less than, say, US\$1,000 per annum. The terms 'emerging nation' is in some ways difficult to define but usually refers to recently industrialised countries that may have been considered developing ten or more years ago but where the average GNP per capita is in excess of, say, US\$3,000 to US\$4,000 per annum. These countries may still, however, be in the process of developing and expanding their infrastructure. Within this definition would be Asian countries such as Korea and Malaysia, and a number of countries throughout the Middle East.

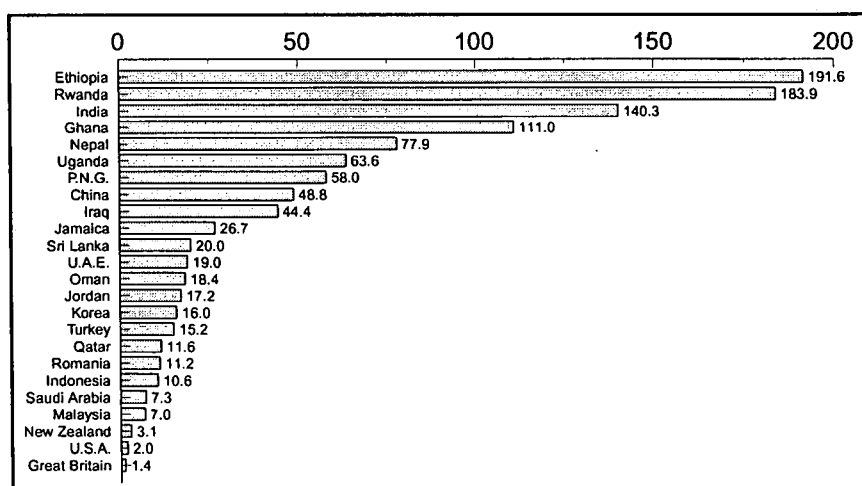
This paper presents a review of the road safety problem in emerging nations and outlines briefly recommendations for improvement.

2. RATES AND TRENDS

One convenient method that can be used to compare the seriousness of the road accident problem in different countries throughout the world is to use the number of road accident deaths per annum per 10,000 vehicles licensed. This is far from ideal; for example the injury accidents per million vehicle-km travelled per annum may be a better parameter to use but the reporting of non-fatal accidents in most countries is poor and little information is available on annual travel by different classes of vehicle.

Results from a number of countries (mainly 1993) are shown in Figure 1. It can be seen that whereas countries of the developed world are characterised by a death rate of often less than 2, some developing countries have rates in excess of 100. Rates in African and Asian countries could, in fact, be higher than Figure 1 suggests in that even road accident deaths are under-reported and scrapped vehicles tend not to be removed from the vehicle register.

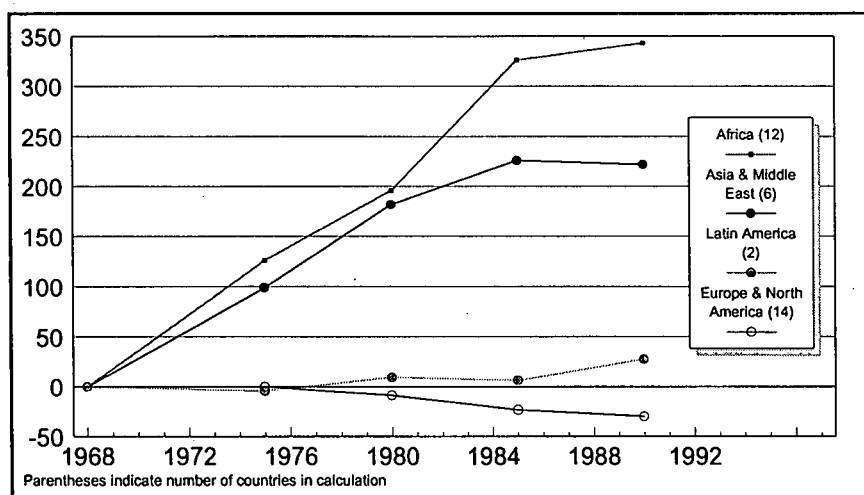
Figure 1
FATALITIES PER 10,000 REGISTERED VEHICLES PER YEAR
LATEST AVAILABLE DATA



Emerging nations have fatality rates that are considerably less than those of Africa and most countries of Asia but are nevertheless considerably more than those of Western Europe and North America. Thus in countries of the Middle East, fatality rates range between 7.3 (Saudi Arabia) to 19.0 (U.A.E.). Countries such as Korea and Turkey lie within this range. From Table 1 therefore it would appear that there is considerable scope to reduce road accidents in these countries.

Figure 2 shows the percentage increase or decrease in the number of road accident deaths over the period 1968 to 1990 (i.e. 1968 is used as the base year) for different regions of the world. Over the period shown, the number of deaths in the 14 developed countries actually fell on average by 30 per cent (this despite the large increase in vehicle numbers). Conversely in six Asian and Middle Eastern countries and 12 African countries, where reasonably accurate statistics were available, there were increases of about 200 and 340 per cent respectively.

Figure 2
PERCENTAGE CHANGE IN ROAD ACCIDENT FATALITIES
OVER 22-YEAR PERIOD



In these countries there is obviously a need for greater effort and investment in road safety in order to reverse this trend. For example in Great Britain, expenditure on road safety has been particularly effective in recent years. Thus between 1965 and 1994, road accident fatalities fell by over 50 per cent whilst over the same time period the number of licensed vehicles almost doubled.

3. THE IMPORTANCE OF ROAD ACCIDENTS AS A CAUSE OF DEATH

In cooperation with the World Health Organisation, an early study (Jacobs & Bardsley, 1977) compared deaths from road accidents in selected developing countries with other causes of death, including diseases considered to be of concern in the Third World. Information was obtained from 15 countries which tended to be at the top end of the 'Third World spectrum'

(such as Jamaica, Colombia, Peru, Malaysia, Brazil, Venezuela, South Africa, etc) which could not be said to be representative of the entire Third World (and some of which we would now consider as 'emerging' nations). The results nevertheless are of interest in that they show that in these countries road accidents were by no means insignificant as a cause of death. For all age groups combined, road accidents were the tenth most important cause of death (behind causes such as bronchitic, circulatory, parasitic and infectious, enteric diseases, etc). For the age group 5-64 years road accidents were the sixth most important cause of death and for the age group 5-44 years they were second in importance.

Another way to highlight the importance of road accidents from a social point of view is to compare deaths from road accidents with other violent causes of death such as fire, drowning, suicide, homicide, etc. Table 1 shows deaths from various causes for three groups of countries, developed, developing and Middle Eastern.

It can be seen that in all three groups of countries there are more deaths from road accidents than any other violent cause. In developed countries suicides and next in importance whilst in developing countries homicide is the second most prolific. In Middle Eastern countries, however, road accidents dominate with over 50 per cent of all recorded deaths being from this single cause.

Table 1
FATALITIES BY VIOLENT CAUSE
(1990 DATA)

Cause	Middle Eastern Countries	Developing Countries	Developed Countries
Fire	1.0	2.0	3.0
Drowning	2.0	7.0	2.0
All other (violent causes)	26.0	20.0	26.0
Suicide	5.0	9.0	33.0
Homicide	10.0	26.0	3.0
Road traffic accidents	56.0	36.0	33.0
TOTAL	100%	100%	100%

4. USE OF THE 'SMEED' EQUATION

Smeed (1968) analyzed data on road accident fatalities, vehicles and population from 20

developed countries for the year 1938, and from his analysis derived the following relationship:

$$\frac{F}{V} = 0.0003 \left(\frac{V}{P} \right)^{-2/3}$$

where F = annual number of fatalities from road accidents
 V = number of vehicles in use
 P = population

This relationship can alternatively be expressed as a straight line:

$$\log \frac{F}{V} = -3.52 - 0.63 \log \frac{V}{P}$$

According to the Smeed relationship, the greater the per capita level of vehicle ownership, the lower the per vehicle fatality rate. Jacobs & Hards (1978) repeated this analysis for the same countries for the years 1950, 1960 and 1970, and discovered that the linearity remained over time (although the equation varied slightly).

Research has shown that in the developing world, whilst there is a linear relationship between the logarithm of vehicle ownership and the logarithm of fatality rates per vehicle, this relationship is different from that discovered in industrialised countries. The difference is in the slope of the regression equation. For example, Fouracre & Jacobs (1977) discovered the following relationship using 1956 data for a selection of more than 30 developing countries:

$$\log \frac{F}{V} = -3.30 - 0.43 \log \frac{V}{P}$$

For the purpose of this research the above analysis was repeated for Asian, African and South American countries using 1990 data; the results of this calculation are shown in the following equation, and the plot in Figure 3. The r^2 value for this regression line is 0.78.

$$\log \frac{F}{V} = -3.56 - 0.62 \log \frac{V}{P}$$

Data for a number of Middle Eastern countries are plotted on Figure 3 and it can be seen that almost all points lie above the regression line. This implies that these countries have high fatality rates relative to their levels of vehicle ownership. Putting known values for population and number of registered vehicles for the different countries into the above equation allows the number of fatalities to be predicted and compared with actual fatalities. This comparison give some indication of the proximity of a particular country to the regression line, and thus give some quantification of the relative road safety problem.

Figure 3
USE OF THE SMEED EQUATION

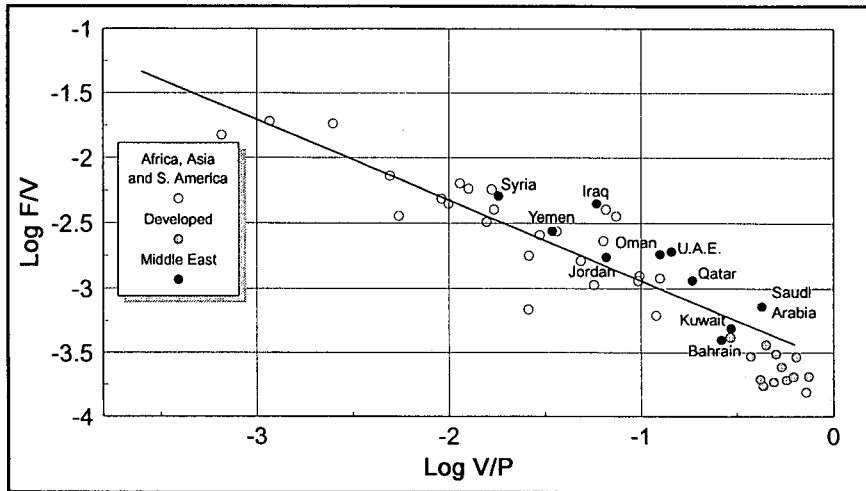
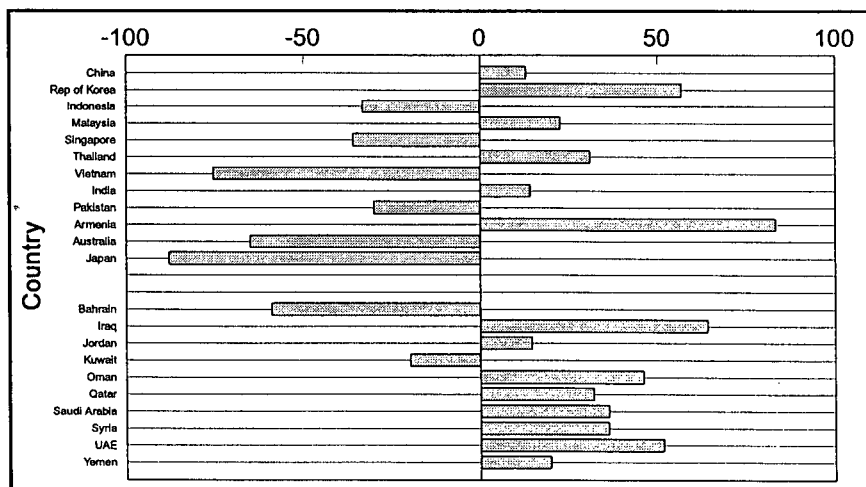


Figure 4 shows the percentage difference between actual and predicted fatalities for most of the countries used in this analysis. The percentage differences have been calculated using the following equation:

$$\text{Percentage Difference} = \frac{F_{\text{actual}} - F_{\text{predicted}}}{F_{\text{actual}}} * 100\%$$

Figure 4
PERCENTAGE DIFFERENCE BETWEEN ACTUAL FATALITIES AND FATALITIES PREDICTED BY SMEED EQUATION



From Figure 4 it can be seen that some countries (below the regression line) have death rates lower than that predicted by the equation whilst others (above the line) have death rates greater than that predicted by the equation. It is particularly interesting to note that almost all the emerging nations such as Korea and Malaysia in Asia and Kuwait, Oman, Qatar, Saudi Arabia and Yemen in the Middle East have actual fatality rates that are typically about 40-50 per cent greater than that predicted by the equation. The implication is that with relatively high vehicle ownership levels in these countries, fatality rates are higher than might be expected and much greater effort and investment is required in road safety activities in order to reduce road accidents.

5. COSTS OF ROAD ACCIDENTS

5.1 Global Economic Costs of Road Accidents

As well as the social costs such as pain, grief and suffering that arise as a result of road accidents, there are also economic costs which can place a severe financial strain on a country's resources. Fouracre & Jacobs (1976) calculated that for any country, the annual cost of road accidents is equivalent to approximately one per cent of its GNP. To gauge the economic cost of road accidents one per cent of GNP has been calculated by region for 1990 using statistics published by the World Bank (1992) (see Table 2).

Table 2
COST OF ROAD ACCIDENTS BY REGION IN 1990

Continent	1% of GNP (US\$ millions)
Europe	77,200
Africa	4,200
North America	71,900
South America	11,100
Asia and Middle East (including Japan)	60,000
Oceania	4,000
Total	228,400

From the above data, it was calculated that the global cost of road accidents may well be of the order of \$230 billion per year, with the cost to Asian and Middle Eastern countries being around \$60 billion. Therefore, in addition to the humanitarian aspect of reducing road accident fatalities, a strong case can be made for reducing road accident deaths on economic grounds, since accidents consume financial resources that countries can ill afford to lose.

5.2 Estimated Costs by Country

If one assumes that road accidents cost approximately one per cent of GNP in all countries, then a crude estimate can be derived of the annual costs of road accidents in emerging countries throughout the world (see Table 3).

On this assumption, it can be seen that in fairly large countries such as Korea, road accidents may well be costing almost \$3,400 million per annum. In wealthy countries such as Saudi Arabia costs may well be over \$1,000 million each year. In smaller countries such as Singapore and Bahrain, costs may well be between \$550 million and \$50 million. However wealthy a country may be, it can ill afford to incur such large costs to its economy each year as a result of road accidents.

Unfortunately, road safety is but one of the many problems demanding its share of funding and other resources in developing countries. Even within the boundaries of the transport and highway sector, difficult allocative decisions have to be taken regarding the resources that any government can devote to road safety. In order to assist in this decision making process it is essential that a method be devised to determine the cost of road accidents and thus the resources which perhaps ought to be invested in their prevention.

Indeed, the first need for cost figures is at the level of national resource planning to ensure that road safety is ranked equitably in terms of investment in its improvement. Fairly broad estimates are usually sufficient for this purpose, but they should be made on a basis which is comparable with other sectors competing for the scarce funds.

Substantial returns are available from investment in road safety. In a recent study carried out by TRL it was shown that a programme of investment in road safety engineering, education, training and traffic law enforcement, costing some £100,000 p.a., would reduce the national cost of road accidents by 5% each year. In a country with an estimated total cost of road accidents of £20 million p.a., this implies an annual saving of £1 million, for an investment of £100,000; a benefit:cost ratio of about 10:1.

Table 3
ROAD ACCIDENT COSTS PER ANNUM
EMERGING NATIONS (1993)

Country	1% OF GNP (US\$ millions)
Korea	3,380
Saudi Arabia	1,051
Malaysia	600
Singapore	554
U.A.E	387
Kuwait	340
Oman	96
Qatar	80
Jordan	50
Bahrain	43

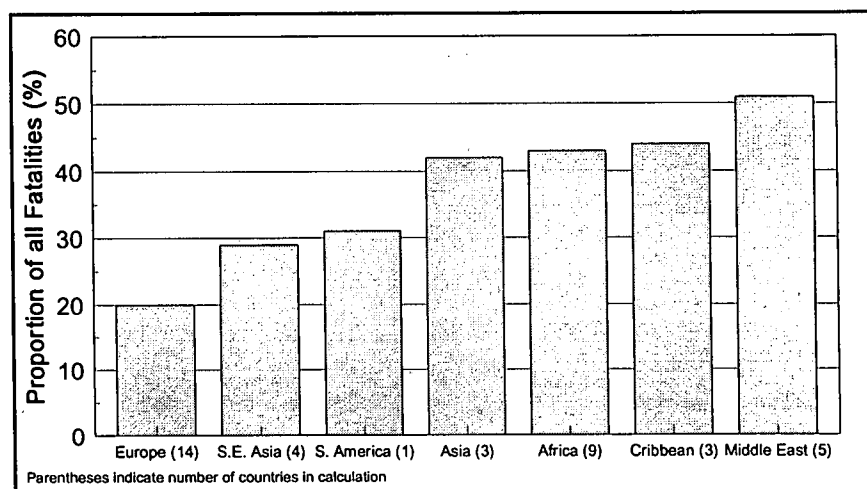
A second consideration when deriving the cost of road accidents is to ensure that the best use is made of any investment and that the best (and the most appropriate) safety improvements are introduced in terms of the benefits which they will generate relative to the costs of implementation. Failure to associate specific costs with road accidents 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. As a consequence it is unlikely that the pattern of expenditure on road safety will be in any sense optimal. In particular, if safety benefits are ignored in transport planning, then there will inevitably be an under-investment in road safety. Advice on costing road accidents is provided by TRL in Overseas Road Note No 10 (Transport Research Laboratory, 1995).

6. THE NATURE OF THE ACCIDENT PROBLEM

6.1 Accident Patterns

There are a number of accident characteristics which are common to a number of emerging countries and yet are somewhat different from those in developed countries. In any country it is inevitable that a significant proportion of persons killed and injured will be pedestrians, obviously the most vulnerable group of road users. However, statistics (see Figure 5) show that the percentage of all persons killed who are pedestrians is particularly high in Middle Eastern countries.

Figure 5
PEDESTRIAN FATALITIES AS A PERCENTAGE OF
ALL ROAD ACCIDENT FATALITIES



A significant proportion of those pedestrians are, in fact, young people (see Table 4). A recent study has shown that whereas in developed countries the percentage of all people killed who are aged under 15 is less than 6 per cent, the equivalent figure in developing countries is about 15 per cent. The figure for emerging nations is closer to that for developing countries at just of 12 per cent. This is obviously due in part to differences in the age

profiles of the total population between developed, developing and emerging countries but other important factors are also at play. For example, Asian countries provide instruction in road safety education and proportionately more children walk to school as opposed to being driven. These factors, together with the development of materials that can be used by primary school teachers in Africa, are currently the subject of detailed research by TRL. Reasons why emerging nations should have such a high percentage of fatalities involving young people are not clear and certainly merit further investigation.

Table 4
THE INVOLVEMENT OF CHILDREN UNDER 15 YEARS
OF AGE IN ROAD ACCIDENTS
(1993 or latest available year)

	Number of fatalities aged under 15 years	Total number of fatalities	Proportion of fatalities aged under 15 years
Developing (13 countries)	7,911	54,575	14.5%
Developed (13 countries)	4,951	84,440	5.9%
Emerging (5 countries)	3,956	31,252	12.7%

As might be expected, the types of accidents taking place and the vehicles involved depend considerably on local conditions. For example, in Papua New Guinea pick-up trucks are the most common form of public transport and in that country almost 40 per cent of all fatal accidents involve a pick-up. Accidents involving public service vehicles, ie buses or their equivalent, are much more common throughout Asia than, for example, in Western Europe. Thus, in Great Britain only 3 per cent of all accidents involve a bus. Conversely, in Pakistan, India and Sri Lanka the equivalent figure is about six to eight times higher.

Economic growth in virtually all countries is accompanied by increasing vehicle ownership. In countries such as Malaysia and Indonesia much of this growth is comprised of motorcycles (used perhaps as a stage towards the ownership of a car). Consequently a very high percentage of persons killed and injured are users of motorcycles, scooters and mopeds; in Malaysia over 60 percent of road accident casualties are users of motorcycles (or equivalent) and a detailed study of road accidents in Bandung, Indonesia showed almost 50 per cent of all casualties to be motorcycle users.

6.2 Factors Involved

In most countries accidents involving personal injury are reported by (or to) the police and their accident reports provide information on the factor or causes which contribute to the accident. In general the police are primarily concerned with traffic violation and their reports usually under-estimate the importance of road layout and design or vehicle condition. The emphasis of police investigations therefore will tend to be on determining human error and apportioning blame.

In the UK a detailed study was undertaken by TRL in the 1970's of injury accidents taking place in an area of South East England (Sabey & Staughton). This study showed the importance of the road user which was a factor in 95 per cent of accidents investigated. The study also demonstrated the strong link between road user error and deficiencies in the road environment, the latter being a contributory factor in about 28 per cent of accidents.

Constraints of funding have prevented TRL carrying out a similar study in Africa or Asia so police reports have been the only source of information (see Table 5).

Table 5
CAUSES OF ROAD ACCIDENTS AS DETERMINED BY THE POLICE
IN DEVELOPING COUNTRIES

Country	Main Causes 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
TRL on-the-spot study (1975)	95	8	28	

From this table it can be seen that, in general, the data highlights the importance of the road user in accidents in developing and emerging countries but gives little indication of any road environment factor (other than in the case of Iran). It seems likely that the road environment (in terms of road layout, design and surface condition) has been under-estimated by the police as a factor in accidents. The design and condition of the main roads is generally poorer in developing than in developed countries and the pace of introducing effective engineering improvements to reduce accidents is much slower. By speeding up this process the inevitable rise in accidents in many Asian and African countries could certainly be retarded. The best way to go about this is currently the subject of detailed research by the Overseas Resource Centre at TRL.

6.3 Road User Behaviour and Knowledge

Studies undertaken by TRL of road user behaviour in a number of Asian countries clearly show that road users were much less disciplined than in the UK (Jacobs et al., 1981; Downing, 1985). Although the relationships between differences in behaviour and accidents were not determined (not being the objective of these particular studies) the results suggest that road safety measures that 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 driver behaviour in some countries may be due to lack of knowledge about road safety regulations or to their general attitude towards driving. Studies by TRL indicated that there were only a few topics where a lack of knowledge was widespread. Although attitudes are notoriously difficult to change there would seem to be potential for improvement by introducing publicity and enforcement campaigns.

7. SUMMARY

Road accidents continue to be an important social and economic problem in the emerging countries of Asia and the Middle East. Fatality rates are high in comparison with developed countries, and the actual number of deaths show large increases over the last twenty years. Conversely deaths from road accidents in Europe and North America have declined by about 30 per cent despite large increases in vehicles on the roads of these countries.

Apart from the humanitarian aspect of the problem it must also be borne in mind that road accidents cost any nation, be it developed, developing or emerging, about 1 per cent of its GNP per annum. This suggests that in Korea the annual cost of accidents is in excess of US\$3,000 million and in Saudi Arabia over US\$1,900 million. Studies also indicate that from a social point of view - when compared with other causes of death - road accidents are of major concern.

Relative little can be done to deal with the safety problems in any country until the problems have been clearly defined in terms of factors involved, types of accident taking place, class of road user injured and the location of accidents. In order to assist developing countries to improve their accident databases and their accident investigation and diagnosis capability, TRL's Overseas Centre with ODA's support has developed its Microcomputer Accident Analysis Package (MAAP). This consists firstly of a model accident report form or booklet which can be modified to suit particular needs and is designed to be used by the police to collect data nationally and systematically, and secondly a set of software programs for data entry and analysis. The relatively low cost and availability of micro computers means that countries (or provinces, regions, police districts or cities within countries) can analyze their own data to help identify accident locations and the nature of the problem. In this way appropriate countermeasures can be introduced, their effectiveness assessed, all with increased efficiency and therefore, it is hoped, accuracy.

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