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REVIEW OF ROAD SAFETY IN URBAN AREAS

by A Downing, G Jacobs, A Aeron-Thomas, J Sharples (TRL)
D Silcock, C van Lottum, R Walker, A Ross (Ross Silcock)

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6 REVIEW OF URBAN ROAD SAFETY PRACTICE IN DEVELOPING COUNTRIES...
1 EXECUTIVE SUMMARY

The object of this paper is to present a status report on the nature of the urban road safety problem. (It should be noted that the definition of 'urban' varies from country to country. In most it refers to towns above a given population say 50,000 whilst in many developing countries the police classify an accident as 'urban' if it takes place on a road 'owned' by town and city corporation. In other countries 'urban' is defined as a road having a given speed limit - 40 miles/hour or less in the UK for example) and the policies and interventions that have been tried in areas throughout the world. The research was restricted to a desk study and the findings are based on a review of the literature and an exchange of views of the experienced research team. It should be borne in mind that very little first hand information on urban road safety was available from developing countries and also there was very limited opportunity to discuss lessons learned and policy matters with decision makers in the development agencies. Nevertheless the paper makes a serious attempt to identify good practice which can be used in urban areas to reduce the number and severity of urban road crashes taking place in the developing world. This includes government policy towards urban road crashes, financing of remedials measures, institutional framework, physical characteristics of the road, traffic control and calming measures, road safety education and enforcement issues. The paper concludes with the authors' list of opportunities for road safety interventions in urban transport projects. The main findings and recommendations are as follows.

1.1 The urban safety problem

- 750-880,000 people died prematurely in road traffic crashes in 1999. Some 85% of these occurred in developing countries and urban road networks contribute to a significant proportion of countries’ national road traffic crash (RTC) problem. Between 35 and 70 per cent of all crashes occur in urban areas.
- Vulnerable road users dominate, with pedestrians being the most vulnerable group in the poorer countries. The majority of the victims come from the underprivileged sectors of society.
- Urban RTCs involve a high proportion of buses and commercial vehicles. They occur predominately on links rather than at junctions highlighting the dangers of the current emphasis on capacity expansion often at the expense of vulnerable road users.
- No clear link was found between urbanisation and the proportion of accidents occurring in urban areas but this is compounded by the lack of transport in the rural areas of the poorest countries. Data from three countries indicates that at least a third of rural RTCs occur where highways pass through villages or small towns.
- Urbanisation in the developing world continues apace, thus the relative importance of urban road crashes in the future will increase.

1.2 The socio-economic impact

- It is estimated that the current cost of road accidents for the developing world is US$ 65 billion, which is more than the total official development aid which they receive from the richer OECD countries. Urban RTCs tend to be less serious overall than rural RTCs but because of their greater number it is likely that they account for almost half the costs.
• Hospital studies and community surveys highlight the excessive involvement of economically active males in RTCs. This is likely to place severe economic burdens on the poor and considerable stress on women who carry the responsibility for caring for the victims. More research is needed to examine and quantify these impacts.

1.3 Best practice in developed countries
• Considerable progress has been made in improving the road safety of urban areas in developed countries with a focus on reducing vehicle speeds by traffic calming and enforcement and providing safer environments for vulnerable road users. Education has also played an important role in the holistic approach to road safety, for example in the safer routes to school initiative.
• Much emphasis has also been placed on managing a multi-sectoral approach at local levels in towns and cities with strong links to urban planning and development strategies and providing sufficient opportunities for community participation.
• Towns and cities in developed countries typically have transport plans with clear safety targets, strong institutions and adequate resources to achieve these targets.

1.4 Developing country practice
• There have been few projects focused only on urban road safety improvements. Projects aimed at national road safety improvements or strengthening national road authorities have occasionally included components targeted at pedestrians which places a focus on urban problems.
• Road safety activities, including road safety engineering, should not be assumed to be the same as traffic engineering. More recently, an urban transport project in Dhaka has recognised this point by including institutional strengthening components specifically for road safety engineering and traffic police operations.
• To date there is little data on the effectiveness of urban safety improvements in developing countries but there are some promising results from pilot studies of junction improvements, segregated lanes for non-motorised vehicles and pedestrians and traffic calming.
• It seems likely that the slow uptake of urban safety improvements is not so much due to a lack of know how but more to a lack of commitment, institutional capacity and resources. The problem is compounded by the fact that the urban road safety problem requires a multi-sectoral approach involving engineers, police, medical personnel etc. The need is for a coordinated approach, a fact often overlooked in many developing countries. Where projects have included technology transfer, the institutional strengthening inputs have been often been too short and focused on outputs such as designs of improvements rather than leaving behind a sustainable urban safety unit.
• There are some indications, especially in India, that public private partnerships have considerable potential for introducing safety improvements in urban areas.

Traditionally the approach adopted in the developing world has been that of ‘top down’ with central government taking the lead. However it is now accepted that local communities and non-governmental organisations can play an important role thus providing a simultaneous ‘bottom-up’ approach. In the future, greater effort should be directed towards this process.
1.5 The way forward

- Urban safety improvements should be separately identified even if for practical reasons they are treated as components of national or urban development projects.
- Road safety should be managed effectively as part of cities’ overall development strategies and transport plans i.e. in line with the planners’ vision for the cities. All urban and transport policies have a potential for safety impact and safety should always be considered.
- The management approach is critical to the success of plans and implementation. It should be multi-sectoral and include strong involvement of the stakeholders and community participation.
- Successful implementation of road safety strategies will depend upon public and political commitment, the strength of the implementing agencies and the resources available and a coordinated multi-sectoral approach. Development projects should devote sufficient resources to these aspects and, in particular, focus on establishing a sustainable road safety unit in large cities.
- A safety culture within the road authority should be developed with other units such as maintenance departments and planning, learning how they can contribute to the reduction of crashes. Road-user safety should be the responsibility of the road authority as a whole, and all units, not just that of traffic/safety engineering.
- Road safety management will also require the cooperation of a variety of local government sectors and NGOs and private businesses. A strong coordinating body or lead agency will be necessary to ensure implementation. It is not possible to recommend a specific model for such coordination but it is clear that the organisation must be capable of planning road safety projects, securing a budget, implementing the projects and monitoring their effectiveness.
- Whilst multi-sectoral coordination is an ideal, it is better that one agency leads and acts in the short term in preference to ineffective attempts at a coordinated approach.
- Some element of road user charges should be devoted to the improvement of urban roads and their safety with a rational approach to proportioning funds.
- Public-private partnerships could have considerable potential particularly where the private sector has a commitment to the development of their city. The partnerships should not replace government led safety organisations but provide the necessary impetus in the interim to generate resources and speed up implementation.
- Road safety measures should be focused on improving the safety of the vulnerable that will in the main come from the poorest sectors of urban society. Likely measures will include better facilities for pedestrians and two-wheelers reduced vehicle speeds, traffic calming and safer public transport. Changes need to be introduced through an understanding of the needs of target groups and not by top down approaches alone. Measures should be integrated and their implementation preceded by consultation and publicity.
- Road safety programmes need to be based on good crash information. Medical databases and secondary indicators should be considered as well as improved police systems essential for both planning and monitoring purposes.
- Research is needed to develop new approaches to road safety particularly to change the behaviour of vulnerable communities and the drivers of public service vehicles. Evaluation of approaches is vital, as is dissemination of the lessons.
learned. The Global Road Safety Partnership (GRSP) is a key focal point for accessing road safety information and disseminating recommendations.

2 INTRODUCTION

2.1 Background
The World Bank is currently undertaking an Urban Transport Strategy Review that will be the first detailed examination of the subject for almost fifteen years. This review is supported by a number of position papers, which collate experience and best practice in different topics relating to urban transport.

One of these position papers concerns urban road safety. The UK Department for International Development (DFID) commissioned TRL and Ross Silcock to prepare the road safety paper, which is presented here. The object of this paper is to present a status report on the nature of the problem, and the policies and interventions that have been tried in areas throughout the world. From this, the paper identifies good practice which can be used in urban areas to reduce the number and severity of urban road crashes taking place in the developing world. This includes government policy towards urban road crashes, institutional framework, physical characteristics of the road, traffic control and calming measures, road safety education and enforcement issues.

The paper briefly considers how 'urban areas' are actually defined in different countries and covers urban centres ranging from 'villages' to large cities. The review does not deal exclusively with the experience of large cities, although there is generally more information and practical experience available from them.

2.2 Scope of the paper
The paper reviews available information from as many developing countries as possible, that describes the magnitude and nature of urban road crashes, examining patterns, trends and, wherever possible, causes. The review also examines the socio-economic impact of road crashes on the urban community, looking in particular at the cost of road crashes, the impact on the community of these crashes and the drain that they have on the (already limited) health facilities. The impact on low-income communities receives particular attention.

An examination is made of the effectiveness of different interventions in urban areas of both developed and developing countries. This draws heavily on the experience of the World Bank in setting up projects that deal (usually in part) with the urban road safety problem. Institutional requirements and capability for designing and implementing urban road safety improvements receive particular attention.

A review is presented of good practice in urban areas of both developed and developing countries, identifying the effectiveness of interventions that have been developed to deal with the urban problem. The effectiveness of various measures from more general research and experience which covers the national situation (i.e. not only the urban problem) is also examined including safety plans, crash reduction measures, enforcement techniques.

The report itself follows the above format. Chapter 2 deals with crash patterns, chapter 3 covers socio-economic issues, Chapter 4 good practice in the developed world and
Chapter 5 reviews road safety practice in developing countries. An overall summary and conclusion are presented in Chapter 6.

3 URBAN ROAD TRAFFIC CRASHES

3.1 Introduction

This chapter reviews the urban road safety situation in developing countries, as reported in official statistics. It begins by putting the data obtained into context. Official databases are incomplete, due to under-reporting, and the quality of the data recorded also varies according to the priority given to accurate reporting by the police. The urban share of road crashes and related casualties is discussed and the characteristics of reported crashes and the consequent casualties in urban situations are summarised.

Whilst this paper relates to urban areas, the definition of "urban" varies from country to country. In general, the common definition is based on the population size of the locality, i.e. towns of 5,000 population or greater. For road safety purposes, urban/rural is sometimes identified on the police crash reporting forms, with urban being defined as within a municipal boundary, or by local street conditions. For example, in the UK, urban road traffic crashes (RTCs) are those which occur on roads with speed limits of 40 mph or less. In the case of RTC data from developing countries most police forces use 'urban' for roads 'owned' by town and city corporations. There is a concern that restricting "urban" to municipalities or towns will exclude those crashes occurring on highways passing through small towns and villages, which may be reported as rural RTCs. There are a few countries where the police use an additional classification for villages and this is commented on below (see villages).

3.2 Data Collection and analysis

3.2.1 Data Weaknesses

The analysis of official data as used here is limited to those RTCs which are reported to the police. Two acknowledged and common problems with such data are the quantity of data collected due to under-reporting and also the quality of the data, i.e. the omission or mis-reporting of specific items of information. These problems are not restricted to developing countries, but errors and omissions are generally greater in the less motorised countries.

Under-reporting

Whilst virtually all countries, less developed countries (LDC) included, have mandatory requirements for the public to report RTCs which involve personal injury to the police, under-reporting is still a serious problem worldwide. Early TRL research in Colombo, Sri Lanka found less than one fourth of hospital-reported RTC injuries matched with police records (Sayer and Hitchcock, 1984).

DFID has recently funded further research into urban RTC casualty under-reporting, based on studies in Bangalore, Hanoi, Dhaka, and Harare. Table 3.1 summarises some of the results from this study (urban findings shown after national estimates) which indicates the extent of under-reporting in the developing world. The problem is believed to be worse in developing countries with poorly developed institutions, less well trained police, police corruption which results in pressure not to report an RTC, and those countries with weak insurance systems where many compensation claims are settled privately. In addition to under-estimating the extent of the problem, there is also the concern that police data may be systematically biased, with RTCs involving certain
road user groups being less well reported than others. Early research in Colombo found children to have the lowest match between hospital and police injury reporting rate - just 6% (Sayer and Hitchcock, 1984). Hospital surveys in Hanoi and Harare showed a larger share of RTC casualties to be female and children than police data indicated (although this was not the case for Dhaka or Bangalore) (Aeron-Thomas, 2000).

**Data quality**

In addition to many RTCs not being reported to the police, there are also problems with the quality of the data that is recorded. Data fields such as lighting condition, weather, pedestrian movement/action, and road surface condition, often appear not to be accurately or comprehensively recorded. Missing data are frequent, especially with such fields as age of casualty as the police focus on driver information for prosecution purposes.

Location data are typically the most difficult data to collect. Whilst collision sketches are generally included in case files for prosecution purposes, location diagrams on crash report forms are often imprecise. With limited mobility in most areas, not all crash sites will be visited and the location referencing systems used may not be standardised or precise. Geographic Information Systems (GIS) or national grid referencing systems are rarely used with RTC reporting. This problem was encountered on a recent DFID-funded study of Pedestrian Accidents and Vulnerability in Developing Countries (WS Atkins, 1998). The exact location was difficult to establish; two of the case studies (Bangalore and Harare) used a link/node referencing system whereas another (Colombo) only reported road name.

3.2.2 Data sources
Data have been collected from several African and Asian countries and specific cities (see Table 3.2). To obtain a more representative picture, RTC data was collected for a multiple year period from these urban areas.

Table 3.2: Urban RTC data (cities in italics)

<table>
<thead>
<tr>
<th>Country/City</th>
<th>RTC data</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Asia</strong></td>
<td></td>
</tr>
<tr>
<td>Dhaka</td>
<td>1998</td>
</tr>
<tr>
<td>Fiji</td>
<td>1994-1995</td>
</tr>
<tr>
<td>Indonesia</td>
<td>1995</td>
</tr>
<tr>
<td>Kuala Lumpur</td>
<td>1993-1995</td>
</tr>
<tr>
<td>Malaysia</td>
<td>1993-1995</td>
</tr>
<tr>
<td>Papua New Guinea</td>
<td>1982-1994</td>
</tr>
<tr>
<td><strong>Africa</strong></td>
<td></td>
</tr>
<tr>
<td>Addis Ababa</td>
<td>1997/98</td>
</tr>
<tr>
<td>Botswana</td>
<td>1994-1998</td>
</tr>
<tr>
<td>Dar es Salam</td>
<td>1995-1996</td>
</tr>
<tr>
<td>Kumasi</td>
<td>1988-1989</td>
</tr>
<tr>
<td>Zimbabwe</td>
<td>1997-1998</td>
</tr>
</tbody>
</table>

No RTC database was obtained for a Latin American country/city and so analysis here is limited to published data which are shown separately in Table 3.4.

3.2.3 Background references

Accurate RTC data are seen as the cornerstone of all road safety activity, which professionals in the field argue strongly should be data-lead. Improving crash databases has thus often been the starting point of road safety programmes. Almost all the data discussed here came from the use of TRL’s Microcomputer Accident Analysis Package (MAAP) databases which have been set up as part of national projects or collaborative research exercises. Addis Ababa is one exception, where although much data is collected on crashes taking place, individual records are not computerised and analysis is limited to the 30 standardised tables produced quarterly.

Information was also obtained from several recent DFID-funded reports, including the Pedestrian Study mentioned earlier. World Bank studies were also reviewed, including the Pedestrian Action Plan (Zimbabwe/Burkino Faso), a recent Road Safety Study in Bogota, and the Dhaka Road Safety Plan Report.

Data on the urban RTC situation in Great Britain (used for comparative purposes) was obtained from the most recent annual publication by the UK Department of Environment, Transport and the Regions (DETR), “Road Accidents Great Britain: 1998, The Casualty Report”.

3.2.4 Data analysis

Data are presented on urban areas and cities of various sizes, stages of development and for different time periods. Accordingly, the analysis refers to relative percentages rather than base figures. Cumulative figures such as fatal and total injury RTCs and casualties are also provided for each table.
3.3 Magnitude of the Urban RTC Problem

In the six developing countries analysed, the urban population share ranged from between 16 and 79 percent whilst urban crashes accounted for between 36 and 69 per cent of the national road crash total (See Table 3.3). Two of the three countries with the lowest urbanisation levels (Ethiopia and Zimbabwe) reported the highest proportion of urban road crashes. Whilst almost half the population lives in urban areas, Botswana reported the lowest share of urban RTCs. In Great Britain, three-quarters of all personal injury RTCs occur in urban areas, where 89 per cent of the population live.

Table 3.3: RTC distribution in Africa and Asia/Pacific regions

<table>
<thead>
<tr>
<th>Country</th>
<th>Years</th>
<th>Population in urban areas (1997)</th>
<th>National</th>
<th>Urban</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(1997)</td>
<td>Fatal crashes</td>
<td>All casualty crashes</td>
</tr>
<tr>
<td>Botswana</td>
<td>1994-98</td>
<td>48%</td>
<td>1,540</td>
<td>53,545</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>1997/98</td>
<td>16%</td>
<td>1,313</td>
<td>5,519</td>
</tr>
<tr>
<td>Zimbabwe</td>
<td>1997-98</td>
<td>31%</td>
<td>2,097</td>
<td>22,505</td>
</tr>
<tr>
<td>Fiji</td>
<td>1994-95</td>
<td>41%</td>
<td>49</td>
<td>2,085</td>
</tr>
<tr>
<td>Malaysia</td>
<td>1993-95</td>
<td>79%</td>
<td>10,593</td>
<td>229,518</td>
</tr>
<tr>
<td>PNG</td>
<td>1982-94</td>
<td>16%</td>
<td>2,011</td>
<td>34,154</td>
</tr>
<tr>
<td>GB</td>
<td>1998</td>
<td>89%</td>
<td>3,137</td>
<td>238,923</td>
</tr>
</tbody>
</table>

Sources: national MAAP databases, Ethiopian Police and DETR (1999)

As expected with lower operating speeds, the urban share of national crash totals was greater for non fatal than fatal crashes in urban areas. Urban fatal RTCs accounted for between 20 and 40 per cent of all fatal crashes in the African and Asian countries shown, with Ethiopia and Zimbabwe again reporting the highest share.

From the limited data available, there does not appear to be any direct correlation between the proportion of crashes in urban areas and the extent of urbanisation. The less urbanised countries, i.e. Ethiopia and Zimbabwe, report a greater share of urban RTCs and casualties, including fatalities, than do either Malaysia or Botswana. However, this could be due to the stage of development with the majority of motor vehicles concentrated in the urban areas in the less developed nations (particularly in the capital cities) or it could be due to better reporting procedures in urban areas. This is probably particularly so for damage only crashes, for example relatively few are reported outside urban areas in Ethiopia or Zimbabwe.

The relative share of road fatalities and injuries in urban areas of the Latin America and the Caribbean are shown in Table 3.4. Barbados was the only country which reported a higher share of urban casualties than the urban population. The high percentage of all crashes reported in urban areas is believed to be due to the inclusion of damage only crashes in these data.

Table 3.4: Latin America and the Caribbean Urban Road Safety Situation

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>Urban percentage of total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Population (1997)</td>
</tr>
<tr>
<td>Barbados</td>
<td>1996</td>
<td>47%</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------</td>
<td>---------</td>
</tr>
<tr>
<td>Bolivia</td>
<td>1995/96</td>
<td>76%</td>
</tr>
<tr>
<td>Chile</td>
<td>1996</td>
<td>62%</td>
</tr>
<tr>
<td>Ecuador</td>
<td>1997</td>
<td>49%</td>
</tr>
<tr>
<td>Honduras</td>
<td>1997</td>
<td>61%</td>
</tr>
<tr>
<td>Peru</td>
<td>1996</td>
<td>71%</td>
</tr>
</tbody>
</table>

Source: Inter-American Development Bank (1998)

**Villages**

Crash reporting systems of most countries simply differentiate between urban and rural areas, however Botswana, Malaysia and PNG also monitor the number of crashes occurring in village areas. These have been included in the rural share, with crashes in villages accounting for 33 and 40 per cent of all rural crashes in Botswana and Malaysia respectively, whereas virtually all of PNG’s non-urban RTCs were reported as occurring in villages. The contribution of crashes on highways passing through villages appears to be highly significant.

**Casualty rates**

Data on eleven cities and urban areas in developing countries and also for Great Britain are shown in Table 3.5. The average number of casualties in an urban injury RTC ranges from 1.1 (Dhaka and Kuala Lumpur) to 1.9 (Kumasi). Based on the limited data available, it appears that urban RTCs in Africa tend to have a higher casualty rate than they do in Asia or Great Britain.

**Table 3.5: Urban RTC and casualty data**

<table>
<thead>
<tr>
<th>Country</th>
<th>Years</th>
<th>Urban Crashes</th>
<th>Urban Casualties</th>
<th>Average no. of casualties per urban RTC</th>
<th>Average no. urban injuries per fatality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Addis Ababa</td>
<td>1997/98</td>
<td>283</td>
<td>2,287</td>
<td>1.6</td>
<td>12</td>
</tr>
<tr>
<td>Botswana</td>
<td>1994-98</td>
<td>1,081</td>
<td>11,899</td>
<td>1.7</td>
<td>16</td>
</tr>
<tr>
<td>Kumasi</td>
<td>1995</td>
<td>486</td>
<td>3,886</td>
<td>1.9</td>
<td>13</td>
</tr>
<tr>
<td>Zimbabwe</td>
<td>1997-98</td>
<td>1,126</td>
<td>21,113</td>
<td>1.4</td>
<td>22</td>
</tr>
<tr>
<td>Bangalore</td>
<td>1993-95</td>
<td>1,786</td>
<td>17,565</td>
<td>1.2</td>
<td>10</td>
</tr>
<tr>
<td>Dhaka</td>
<td>1998</td>
<td>299</td>
<td>1,056</td>
<td>1.1</td>
<td>3</td>
</tr>
<tr>
<td>Fiji</td>
<td>1994-95</td>
<td>10</td>
<td>231</td>
<td>1.2</td>
<td>21</td>
</tr>
<tr>
<td>Indonesia</td>
<td>1995</td>
<td>667</td>
<td>1,491</td>
<td>1.8</td>
<td>3</td>
</tr>
<tr>
<td>Kuala Lumpur</td>
<td>1995</td>
<td>309</td>
<td>5,164</td>
<td>1.1</td>
<td>18</td>
</tr>
<tr>
<td>Malaysia</td>
<td>1993-95</td>
<td>3,827</td>
<td>39,121</td>
<td>1.2</td>
<td>12</td>
</tr>
<tr>
<td>PNG</td>
<td>1982-94</td>
<td>495</td>
<td>4,873</td>
<td>1.5</td>
<td>13</td>
</tr>
<tr>
<td>GB</td>
<td>1998</td>
<td>1,338</td>
<td>174,414</td>
<td>1.3</td>
<td>160</td>
</tr>
</tbody>
</table>

* Sources: national MAAP databases, Ethiopian Police and DETR (2000)

The number of urban injuries reported for every fatality varied between 3 (Indonesia and Dhaka) to 22 (Zimbabwe), much lower than that reported in Great Britain (160). This provides a clear indication of considerable under-reporting of non-fatal injuries occurring in developing countries. Buenos Aires reported over 50 injuries for every road fatality in 1998 and in a recent survey in Dhaka, there were 45 hospital reported injuries for every police reported road fatality (Aeron-Thomas, 2000).

The priority given to the reporting of slight injuries varies widely and will contribute to the low number of injuries being reported per fatality in some countries. Dhaka is seen
in Table 3.1 to have a serious injury under-reporting problem. The level of medical facilities available and the overall health of the population will also contribute to the injury: fatality ratio. Slight injuries are defined as requiring medical treatment but not hospitalisation and will often be treated in clinics or by local healers instead of hospitals. The lack of emergency medical assistance is likely to lead to more deaths resulting from serious injuries.

3.4 Key Characteristics of urban RTCs
3.4.1 Vulnerable groups
A wide range of urban casualties by class of road user is shown in Table 3.6. Pedestrians dominated the casualties in Addis Ababa (85%) but account for less than one out of every eight urban casualties in Malaysia. Pedestrians dominated all casualties in Addis Ababa and urban Zimbabwe, whilst passenger casualties dominated in another three countries (Botswana, Kumasi and PNG). Zimbabwe reported very few passengers injured in urban RTCs (1%).

Drivers dominate the urban casualties in Malaysia (75%) and in the capital city Kuala Lumpur (71%) and were also a main casualty group in Zimbabwe (46%). The rest reported much lower driver casualty involvement, especially Addis Ababa (3%). In PNG, passenger casualties (46%) were close to twice that of driver casualties (23%) while Dhaka and Fiji reported fairly even shares of pedestrian, passenger and driver casualties.

An examination of the fatality data compared with casualty data shows a large swing towards the pedestrian problem except in Kuala Lumpur and Addis Ababa (where the problem is for all severity levels). Clearly the survivability of pedestrians in crashes is a major concern.
When road casualties are analysed by type of vehicle involved (See Table 3.7), a more consistent pattern emerges with most urban areas reporting a high involvement of vulnerable road users (VRUs), although there was a wide range found in both Africa and Asia.

Pedestrians predominate in Africa, whereas in a number of Asian countries, motorcycle casualties feature. Compared with Britain, all countries, excluding Malaysia, reported more serious pedestrian casualty problems in urban areas.

Table 3.7: Urban RTC casualty distribution by class of road user and vehicle type

<table>
<thead>
<tr>
<th>Vulnerable road users (%)</th>
<th>4 wheel motor vehicle occupants (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedestrian</td>
<td>NMV</td>
</tr>
<tr>
<td>Botswana</td>
<td>23</td>
</tr>
<tr>
<td>Kumasi</td>
<td>34</td>
</tr>
<tr>
<td>Zimbabwe</td>
<td>41</td>
</tr>
<tr>
<td>Dhaka</td>
<td>36</td>
</tr>
<tr>
<td>Fiji</td>
<td>38</td>
</tr>
<tr>
<td>Bandung</td>
<td>41</td>
</tr>
<tr>
<td>Indonesia</td>
<td>25</td>
</tr>
<tr>
<td>K. Lumpur</td>
<td>21</td>
</tr>
<tr>
<td>Malaysia</td>
<td>12</td>
</tr>
<tr>
<td>PNG</td>
<td>33</td>
</tr>
<tr>
<td>GB</td>
<td>19</td>
</tr>
</tbody>
</table>

*includes LGVs  Sources: national MAAP databases and DETR (2000)  NMV = Non-motorised vehicles

Note: Discrepancy between Table 4 and Table 5 re pedestrian share is due to larger sample size with vehicle fields completed than casualty class.

Motorcyclists were by far the largest casualty group in Kuala Lumpur and Malaysia. There were very few motorcycle casualties in Dhaka (3%) but there were many people injured in three wheeled motorised vehicles (17% in baby taxis and 5% in the larger size tempos with designated routes).
The lowest VRU share was found in Botswana and PNG where the size of the country and the low population density contribute to a higher motor vehicle casualty involvement. Car occupants accounted for a maximum of 29 per cent in Fiji and as low as 2 and 3 per cent in Indonesia and Bandung. Four wheel motor vehicle occupants accounted for three of every four road casualties in Botswana and 64 per cent in Papua New Guinea. In Botswana, the largest number of urban road casualties involve pick-up trucks which are used as public transport vehicles.

**Casualty age and sex**

Overall, males accounted for between two-thirds and three-quarters of urban casualties, with highs of 85 per cent in Malaysia and Zimbabwe. Females represented only one out of every seven casualties in urban Zimbabwe and this low rate was recently confirmed by Harare hospital surveys (Aeron-Thomas, 2000). One reason for this low proportion may be reduced levels of hospital attendance by low wage-earners, including women. In the developing countries for which data were available, the highest urban female casualty involvement rate was one-third for Botswana and Kumasi. In contrast, females account for 44 per cent of all road casualties in Great Britain.

Such differences suggest that it is likely that changes in female work and mobility patterns will lead to increases in female casualties worldwide, due to women being increasingly exposed to risk in traffic. Women play a considerable role in caring for their family members injured in RTCs and this burden of care will add considerable strain to the livelihoods of poor families.

**Table 3.8** RTC casualty distribution by age

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>Total urban Fatalities</th>
<th>Children (%) Fatalities</th>
<th>16-50 yrs (%) Fatalities</th>
<th>Over 50 yrs (%) Fatalities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Add Ababa</td>
<td>1997/98</td>
<td>300</td>
<td>15</td>
<td>69</td>
<td>15</td>
</tr>
<tr>
<td>Botswana</td>
<td>1994-98</td>
<td>1,291</td>
<td>19</td>
<td>68</td>
<td>13</td>
</tr>
<tr>
<td>Kumasi</td>
<td>1995</td>
<td>575</td>
<td>31</td>
<td>50</td>
<td>19</td>
</tr>
<tr>
<td>Zimbabwe</td>
<td>1997-98</td>
<td>1,099</td>
<td>10</td>
<td>74</td>
<td>16</td>
</tr>
<tr>
<td>Dhaka</td>
<td>1998</td>
<td>420</td>
<td>21</td>
<td>71</td>
<td>8</td>
</tr>
<tr>
<td>Fiji</td>
<td>1994-95</td>
<td>13</td>
<td>42</td>
<td>58</td>
<td>0</td>
</tr>
<tr>
<td>Indonesia</td>
<td>1995</td>
<td>824</td>
<td>8</td>
<td>78</td>
<td>15</td>
</tr>
<tr>
<td>KL</td>
<td>1995</td>
<td>332</td>
<td>6</td>
<td>80</td>
<td>14</td>
</tr>
<tr>
<td>Malaysia</td>
<td>1993-95</td>
<td>4,100</td>
<td>9</td>
<td>71</td>
<td>20</td>
</tr>
<tr>
<td>PNG</td>
<td>1982-94</td>
<td>563</td>
<td>27</td>
<td>69</td>
<td>5</td>
</tr>
<tr>
<td>GB</td>
<td>1998</td>
<td>1,392</td>
<td>8</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Sources: national MAAP databases, Ethiopian Police and DETR (2000)

Road crashes are known to affect those of working age the most and this pattern holds for urban casualties (See Table 3.8). Road casualties aged between 16 and 50 accounted for three-quarters or more of all urban casualties, with 17-34 years of age the dominant age group in each country. Not only does this age group represent the most active economic age cohort but it is also that of maximum family dependency, with most casualties being male heads of households. These high proportions are probably a combination of much greater exposure to risk, because the economically active travel more, but also because of the reporting bias in police data, referred to earlier.
Children under the age of 16 represented between 7 and 21 per cent of urban road casualties. The reported child fatality share in both Fiji and PNG are very high, over twice that of the other locations. In Addis Ababa, Botswana as well as Fiji and PNG, young children (under 11 years) were reported having a much higher casualty involvement rate than older children (11-16 years).

Only in Bangladesh, Indonesia and Malaysia did those aged over 50 account for as much as 10 per cent of urban road casualties. As could be expected, the older age group had a higher fatality involvement rate, especially Kuala Lumpur and urban Malaysia overall. Children too appeared more vulnerable to fatalities in several urban areas. It is difficult to comment on the relative risk without population distribution data and exposure data, i.e. number of daily trips.

Pedestrians
When only pedestrian casualties are considered, the traditionally vulnerable age groups, i.e. children and the elderly, are seen to have a much higher casualty involvement rate (See Table 3.9).

Table 3.9: Pedestrian casualty age and sex distribution

<table>
<thead>
<tr>
<th>Year</th>
<th>Pedestrian casualty</th>
<th>Male (%)</th>
<th>Children (%)</th>
<th>16-50yrs (%)</th>
<th>Over 50yrs (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Add Ababa</td>
<td>1997/98</td>
<td>258</td>
<td>2238</td>
<td>75</td>
<td>17</td>
</tr>
<tr>
<td>Botswana</td>
<td>1994-98</td>
<td>503</td>
<td>4563</td>
<td>67</td>
<td>33</td>
</tr>
<tr>
<td>Kumasi</td>
<td>1997</td>
<td>332</td>
<td>2434</td>
<td>63</td>
<td>40</td>
</tr>
<tr>
<td>Zimbabwe</td>
<td>1997-98</td>
<td>656</td>
<td>11518</td>
<td>80</td>
<td>16</td>
</tr>
<tr>
<td>KL</td>
<td>1995</td>
<td>212</td>
<td>4014</td>
<td>55</td>
<td>19</td>
</tr>
<tr>
<td>Malaysia</td>
<td>1993-95</td>
<td>781</td>
<td>5981</td>
<td>65</td>
<td>22</td>
</tr>
<tr>
<td>PNG</td>
<td>1982-94</td>
<td>281</td>
<td>2272</td>
<td>74</td>
<td>40</td>
</tr>
</tbody>
</table>

Sources: national MAAP databases, Ethiopian Police and DETR (2000)

In countries as disparate as Botswana and Malaysia, children accounted for over a third of all pedestrian casualties and even more in Fiji and PNG (43%) (See Fig. 3.1).

Figure 3.1: Children’s involvement in pedestrian casualties
Those over the age of 60 account for a relatively small share of all casualties, with only Dhaka having more than one of every six pedestrians injured aged 60 or over.

Over half, and often as many as two thirds, of pedestrians injured were hurt while crossing the road. Only PNG reported more pedestrian injuries taking place while the pedestrians walked along the road, i.e. parallel to the road, and this is suspected to be not accurately reported.

All the above must be seen in the context of much higher levels of pedestrian activity in less motorised countries, although there are virtually no data available to quantify this. Indeed exposure (to the risk of a RTC) data of all kinds are generally lacking.

**Location type**

Much of the focus in traffic engineering is on junctions where congestion occurs, where the number of potential conflicts increases with the possible range of vehicle movements, and hence where vehicle to vehicle road crashes concentrate. In the more orderly road environment of developed cities, pedestrians are channeled to cross roads at junctions. Thus the majority of urban RTCs in Great Britain occur at junctions but as shown in Figure 3.2, most urban crashes in LDCs were reported to occur mid-link.

A comparison of relative risk cannot be undertaken without the relevant exposure data, i.e. traffic count data for different road geometry for vehicle crashes, and pedestrian activity levels. The Indonesian Highway Capacity Manual is one of the few African or Asia sources providing data on urban junctions and also comparisons of RTC involvement rates. However the data also suffers from serious under-reporting.

Overall it is not surprising to find a greater emphasis given to road crashes on links in developing countries. There is an emphasis on vehicle crashes, and the safety features and facilities for pedestrians and other vulnerable road users have not kept pace with those in motorised countries. Furthermore, unrestricted access to main roads due to poor or non-existent development control increases the risk of a collision. However such findings must be treated with caution as it is possible that crashes at minor junctions are not being properly classified as such by the police.

Figure 3.2: Percentage of urban crashes occurring on links

```
<table>
<thead>
<tr>
<th>Location</th>
<th>Total Injury Crashes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Botswana</td>
<td>81%</td>
</tr>
<tr>
<td>Kumasi</td>
<td>64%</td>
</tr>
<tr>
<td>Dhaka</td>
<td>64%</td>
</tr>
<tr>
<td>Fiji</td>
<td>52%</td>
</tr>
<tr>
<td>Kuala Lumpur</td>
<td>60%</td>
</tr>
<tr>
<td>Malaysia</td>
<td>63%</td>
</tr>
<tr>
<td>PNG</td>
<td>67%</td>
</tr>
<tr>
<td>Indonesia</td>
<td>79%</td>
</tr>
<tr>
<td>Great Britain</td>
<td>30%</td>
</tr>
</tbody>
</table>
```

**Collision type**
Pedestrian crashes were the dominant collision type in almost all locations (except for Malaysia), ranging from 13 per cent of all crashes in Malaysia to over 90 per cent in Addis Ababa (See Table 3.10). There was no consistent pattern for vehicle to vehicle collisions with most places reporting a mixture of collision types. Dhaka was the only city where a single vehicle to vehicle collision type dominated with 30 per cent rear end injury RTCs. Rear end collisions also were significant in Kuala Lumpur and Malaysia whereas right angle collisions were more common in Botswana and Indonesia.

Table 3.10 Urban RTC collision type distribution (Percentage)

<table>
<thead>
<tr>
<th>Location</th>
<th>All injury</th>
<th>Pedestrian</th>
<th>Rear end</th>
<th>Head on</th>
<th>Right angle</th>
<th>Sideswipe</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Addis Ababa</td>
<td>2,287</td>
<td>91</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Botswana</td>
<td>11,899</td>
<td>34</td>
<td>9</td>
<td>5</td>
<td>15</td>
<td>n/a</td>
<td>37</td>
</tr>
<tr>
<td>Kumasi</td>
<td>3,913</td>
<td>55</td>
<td>8</td>
<td>7</td>
<td>5</td>
<td>5</td>
<td>19</td>
</tr>
<tr>
<td>Zimbabwe</td>
<td>21,113</td>
<td>62</td>
<td>9</td>
<td>5</td>
<td>5</td>
<td>n/a</td>
<td>20</td>
</tr>
<tr>
<td>Dhaka</td>
<td>1056</td>
<td>47</td>
<td>30</td>
<td>7</td>
<td>1</td>
<td>5</td>
<td>11</td>
</tr>
<tr>
<td>Fiji</td>
<td>231</td>
<td>39</td>
<td>6</td>
<td>12</td>
<td>10</td>
<td>9</td>
<td>25</td>
</tr>
<tr>
<td>Indonesia</td>
<td>1,832</td>
<td>29</td>
<td>13</td>
<td>17</td>
<td>20</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td>KL</td>
<td>5,164</td>
<td>21</td>
<td>17</td>
<td>6</td>
<td>7</td>
<td>12</td>
<td>36</td>
</tr>
<tr>
<td>Malaysia</td>
<td>39,121</td>
<td>13</td>
<td>15</td>
<td>9</td>
<td>16</td>
<td>13</td>
<td>34</td>
</tr>
<tr>
<td>PNG</td>
<td>4,873</td>
<td>41</td>
<td>4</td>
<td>9</td>
<td>8</td>
<td>n/a</td>
<td>38</td>
</tr>
</tbody>
</table>

As expected from the prevalence of mid-link incidents and the heavy involvement of pedestrians, Table 3.11 shows that the most common vehicle manoeuvre reported is that of going straight ahead. Kuala Lumpur reported a large number of “other” vehicle manoeuvres which could have involved merges or stationary vehicles.

Table 3.11: Urban RTC Vehicle manoeuvres (percentage)

<table>
<thead>
<tr>
<th>Location</th>
<th>Straight</th>
<th>Overtake</th>
<th>Right</th>
<th>Left</th>
<th>U-turn</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Botswana</td>
<td>86</td>
<td>2</td>
<td>6</td>
<td>1</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Kumasi</td>
<td>86</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Zimbabwe</td>
<td>83</td>
<td>n/a</td>
<td>4</td>
<td>10</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Dhaka</td>
<td>87</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Fiji</td>
<td>69</td>
<td>4</td>
<td>9</td>
<td>3</td>
<td>1</td>
<td>14</td>
</tr>
<tr>
<td>Indonesia</td>
<td>74</td>
<td>7</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>14</td>
</tr>
<tr>
<td>KL</td>
<td>37</td>
<td>2</td>
<td>15</td>
<td>3</td>
<td>3</td>
<td>39</td>
</tr>
<tr>
<td>Malaysia</td>
<td>64</td>
<td>3</td>
<td>1</td>
<td>15</td>
<td>2</td>
<td>14</td>
</tr>
<tr>
<td>PNG</td>
<td>70</td>
<td>3</td>
<td>9</td>
<td>3</td>
<td>1</td>
<td>13</td>
</tr>
</tbody>
</table>

Time of occurrence
Urban injury crashes are spread out fairly consistently from the time of morning rush hour through early evening. Injury RTCs had an earlier peak (4-6 p.m.) than did fatal RTCs (6-8 p.m.) but both of these peaks were slight.

3.4.2 Summary
The analysis was limited to the police data available, but it should be noted that clear evidence exists to show a serious crash and casualty under-reporting problem in developing countries. Thus the scale of the urban road safety problem is undoubtedly greater than is indicated by the official statistics. However it is not possible to say
whether there is any difference between the under-reporting bias of urban and rural RTCs.

In addition, there are limited data available describing the exposure to risk of different road users and it is acknowledged that there is greater under-reporting of crashes involving the most vulnerable groups of road users.

Subject to these caveats, the findings from this review of the data available are:

- Urban crashes are a serious problem in developing countries. They represent more than 50% of the injury RTCs in 2 of the 6 countries studied in Asia and Africa and 2 of the 5 countries in Latin America and the Caribbean.

- Between 36-69% of all injury crashes occurred in urban areas but there is no clear link to urbanisation. Indeed two of the least urbanised countries have been reported having the highest percentage of urban crashes.

- The classification of urban and rural crashes used by the police is not always clear, with the likelihood that many RTCs on highways in built-up areas are classified as rural. Data from three countries indicate that at least a third of rural crashes actually occur in villages.

- The average casualty rate for an urban injury crash ranges from 1.1 to 1.9 casualties per crash. This is lower than the national rates due to the lower impact speeds and greater share of pedestrian casualties in urban areas.

- The number of injuries per fatality reported varies between 3 (Dhaka and Indonesia) and 22 (Zimbabwe). This is much less than the ratios in motorised countries - eg around 90 in Great Britain and provides an clear indication of the under-reporting of less serious crashes.

- Vulnerable road user casualties (pedestrians and two-wheeled vehicle riders) dominate the urban situation, except for the less populated countries of Fiji, Botswana and Papua New Guinea where 4 wheel motor vehicle casualties are higher.

- Apart from the two wealthiest countries in the data set, Malaysia and Botswana, about a third or more of the casualties were pedestrians.

- Two thirds of urban casualties are motorcycle riders/passengers in Kuala Lumpur and urban Malaysia, whereas in Dhaka, three-wheel motor vehicles accounted for 22 per cent of those injured. Such figures reflect the different traffic mix.

- Four wheel motor vehicles account for three-quarters of all urban casualties reported in Botswana and between 15-64 per cent elsewhere.
Approximately two-thirds to three-quarters of all urban casualties are male. The lowest female casualty involvement rate is in Malaysia (16%) whereas the highest is in Kumasi (30%).

Three-quarters of all urban casualties were aged between 16-50 with the largest number between 17-34 years. Thus most of the victims are breadwinners for their families.

Two-thirds or more of reported urban crashes involving injuries occur on links in the road network, i.e. away from junctions. Few occur where there are any traffic controls, including traffic police.

Crashes involving pedestrians dominate the collision types in the large majority of countries.

Cars are the most common vehicle type involved in urban crashes in Africa and the Pacific whereas motorcycles dominate in Malaysia and Kuala Lumpur. Bus involvement ranges from 5 (Kuala Lumpur) to 32 per cent (Dhaka), whereas truck involvement is lower with 4 (Kuala Lumpur) to 17 percent (Zimbabwe). Zimbabwe also reports the highest non-motorised vehicle involvement rate (17%). Comparisons of this kind reflect, at least in part, the relative mix of traffic in the countries listed.

The most common vehicle manoeuvre involved in a crash appears to be the simplest, travelling straight ahead.

A preliminary study of pedestrian crashes has highlighted the over-representation of the poor in pedestrian casualties. Therefore the poor can be assumed to be a prime victim of urban road crashes in developing countries.

The findings of the analysis reported here have confirmed previous understandings rather than offered any major surprises. Although most urban casualties are male and of prime working age, the vehicle types involved (and thus the drivers) vary widely. Regardless of the vehicle type involved, most urban crashes are reported to occur away from junctions. However it is at junctions that the traffic control facilities, i.e. signs, signals and police, are concentrated. This leaves the concern that traditional traffic engineering measures and police enforcement strategies which tend to focus on junctions, may well be of somewhat limited relevance in reducing casualties in villages, towns and cities in developing countries.

4 THE SOCIO-ECONOMIC IMPACT OF ROAD CRASHES

4.1 Introduction

This section of the paper examines the social and economic impact that road crashes have in urban areas of developing countries. Unfortunately, even at the national level, only limited information is available on the social impact of road crashes and even less is specifically directed towards the urban situation. Limited information was available from the DFID-funded research carried out at hospitals in a number of Third World cities or from interviews undertaken at houses in these cities. A limited picture can be
built up, therefore, of the type of people receiving treatment in hospital following a road crash and whether or not low income people are particularly disadvantaged.

Major studies carried out by the World Health Organisation provide information on road crashes as a health burden, indicating their importance as a cause of death, disability and also in terms of years of life lost. It should be borne in mind, however, that these do not relate specifically to the urban situation.

Studies in a number of developing countries have attempted to provide an estimate of the annual cost of road crashes but only one of these has attempted to provide a breakdown of urban and rural costs. Information obtained from studies in the developed world is used to put the costs of crashes in urban areas into perspective.

4.2 Crash Costs In Urban Areas

4.2.1 Introduction

Detailed studies undertaken in the UK and elsewhere in the developed world indicate the high rates of return that can be obtained from the application of low-cost traffic management techniques at sites where significant numbers of crashes take place. Results from studies in Malaysia and elsewhere in the developing world are now showing similar results (Baguley 1995). Thus, apart from the essential task of reducing road deaths and injuries in developing countries, a sound case can be made for reducing road crashes on economic grounds alone.

As part of a recent project undertaken on behalf of the Global Road Safety Partnership (GRSP) (Jacobs, Aeron-Thomas and Astrop, 2000), it was estimated that the global cost of road crashes in 1999 was in excess of US $500 billion and the cost in the developing world was estimated to be about US $65 billion. Road crashes, with a significant proportion occurring in urban areas, are therefore costing developing and transitional countries huge sums each year that they can ill afford to lose. It is conceivable that maybe half of the above cost relates to crashes taking place in urban areas - assuming that a significant proportion of all crashes involving personal injury and the large majority of all damage-only crashes take place in urban areas (see table 3.3).

4.2.2 Resource Allocation

A recent (not yet published) report undertaken by Ross Silcock and TRL for DFID reviews how the methodology used for costing road crashes in developing countries can be improved. The report makes the point that, even within the transport sector alone, hard decisions have to be taken on the resources that a country can devote to road safety. In order that this decision-making process has a rational basis, it is important that a consistent and soundly based method be used to determine the cost of road crashes and the value of preventing them.

Thus the first need for cost figures is at the level of national resource planning to ensure that adequate investment in road safety takes place in a given country. It helps at the national planning level to provide decision makers with an estimate of the annual cost of road crashes. For example, in a study undertaken by TRL in the early 1990's (unpublished) the annual cost of crashes in Mauritius was calculated to be (the equivalent of) £20 million. A series of recommendations were outlined at a total cost of £100,000 spread over a five year period which could reduce crashes (and hence
costs) by 5 per cent p.a. (i.e. saving £1 million p.a.). Thus the average first year rate of return on investment was estimated to be 1000 per cent. High rates of returns such as these are in fact, fairly common in road safety appraisals, and indicate clearly the value to be obtained in crash-reducing measures.

Conversely a review of road safety in Ethiopia by a joint TRL - Ross Silcock team estimated that the annual cost of road crashes was about (the equivalent of) £40 million p.a. Thus it is reasonable to suggest that at least 10 per cent of this sum be spent on a crash reduction programme each year. However a suggestion that 2 per cent of a newly established Road Fund, (equivalent to £400,000) be spent on a comprehensive crash reduction programme each year was rejected by government, whereas an annual investment of say £4 million would not have been unreasonable.

If decision makers reject greater investment in road safety, then by allocating costs to road crashes, the implications of that decision can be clearly spelt out.

A second need for crash cost figures is to ensure that the best use is made of any investment and that the most appropriate improvements are introduced in terms of their cost-effectiveness. If specific costs and benefits are not applied to crashes taking place then widely different criteria in the choice of measures, the assessment of projects and the allocation of resources will result. As a consequence there will be an imbalance in the ways in which funds available for safety projects are allocated and also an overall under-investment in road safety. This is likely to apply specifically to investment in urban areas (see below).

4.2.3 Investment In The Urban Sector
It is without doubt the drama of the high-speed crash or multiple pile-up which attracts widespread publicity and makes the greatest impact on the general public. Concern is often expressed to the politician with a possible over-investment in efforts to reduce these crashes, usually on inter-urban highways. In terms of hard facts, in many countries, the greater problem associated with road crashes lies in urban areas where traffic speeds are relatively low. For example, in the UK, 75 per cent of all injury crashes reported occur on roads with a 30 or 40 miles per hour speed limit. It is vital therefore to examine under what circumstances these incidents occur and how the problems can be alleviated.

As outlined in Section 3 of this report, a very significant proportion of persons killed and injured in road crashes in Third World cities are pedestrians or users of public transport. Additionally in the major cities of South East Asia, a high proportion of those killed and seriously injured are riders of two wheel motor vehicles i.e. scooters, mopeds and motor cycles. Crashes involving pedestrians or motorcyclists in particular are unlikely to be dramatic yet their impact from an economic point of view can be very significant indeed. The actual cost per crash may be low, particularly for slight or damage-only crashes but the numbers taking place clearly far exceed the numbers involving a fatality or seriously injured road user. In the UK, for example, a fatal crash is now costed at over £1 million whilst the cost of an average damage-only crash is just over £1,200 i.e. more than 80 times less. However the number of damage-only crashes taking place more than makes up for this. Thus in the UK damage-only crashes were costed in 1998 to be £4.5 billion out of a total national cost of all crashes of £14.8 billion and the cost of damage-only crashes exceeded that of fatal crashes.
By ensuring that cost procedures are applied to the less severe crash which is likely to occur in urban areas, and that realistic estimates are made of the numbers taking place, then lower speed crashes will not be ignored when national crash-reduction programmes are established.

4.2.4 Crash Costing Procedures

Details of how road crashes can be costed in developing countries (together with associated problems) are given in the report to DFID referred to earlier. Basically it is important that crashes are costed by degree of severity (i.e. fatal, serious, slight and damage-only) and that the Human Capital approach is used with sums included to reflect the pain, grief and suffering of those involved and also their loved-ones. The report to DFID explains the difficulties associated with the costing procedure, particularly the difficulties in obtaining accurate information on lost output and property (mainly vehicle) damage and also assessing a realistic value for pain, grief and suffering. (Another critical factor, discussed in Section 3 of this report, is the under-reporting of road crashes, particularly those not involving a fatality).

It should be emphasised that, even in Western Europe, there is relatively little uniformity in the way in which road crashes are costed (Alfaro et al, 1994). This, coupled with the difficulties associated with the data collection process, means that values derived must be regarded more or less as broad estimates of cost. Thus any refinements of the costing process may be introducing spurious accuracy into the process. That said, it is possible to cost road crashes taking place in urban and rural areas separately and this in fact is done in the UK. (The other broad sub-division of costs in the UK is to provide separate values of crashes taking place in the hours of daylight and darkness).

Table 4.1 shows the cost breakdown for crashes in the UK for the year 1997.

<table>
<thead>
<tr>
<th>Severity</th>
<th>Road Class</th>
<th>Urban</th>
<th>Rural</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatal</td>
<td>977,510</td>
<td>1,081,660</td>
<td></td>
</tr>
<tr>
<td>Serious</td>
<td>117,420</td>
<td>138,090</td>
<td></td>
</tr>
<tr>
<td>Slight</td>
<td>11,690</td>
<td>14,190</td>
<td></td>
</tr>
<tr>
<td>Damage-Only</td>
<td>1,140</td>
<td>1,680</td>
<td></td>
</tr>
</tbody>
</table>

1. Defined as roads with a speed limit of 40 miles / hour or less.

From table 4.1 it can be seen that, in the UK, costs of crashes in urban and rural areas clearly differ, with costs consistently greater in rural areas. Thus rural crashes involving a fatality are about 11 per cent higher, for seriously injured 18 per cent higher, for crashes involving a slightly injured person about 20 per cent higher and for damage-only crashes (inevitably at greater collision speeds in rural areas) almost 50 per cent higher.

Such a refinement is rarely used in those developing countries where attempts have been made to cost road crashes. Until costing procedures are improved it is suggested that average costs be produced for urban and rural areas combined.
4.3 Social Impact

4.3.1 Trip Patterns

From a social perspective there are significant differences in vehicle ownership patterns in developed and developing countries. Thus in the West, the more affluent families usually choose to live in suburban or rural areas and are usually dependent on one or two cars per family for personal mobility. In developing countries however higher income people tend to live close to city centres and even if they own personal transport they still make use of local public transport systems (Fouracre and Maunder, 1987). Another interesting aspect of car ownership in many Third World cities is that a high percentage of all cars and motorcycles owned in the country in question are based in the capital city. Thus, in Thailand for example, about 75 per cent of all cars are based in Bangkok (but only 10 per cent of the country's population) and in Iran and Kenya, the capital cities of Teheran and Nairobi contain over 50 per cent of the nation's cars (Jacobs and Fouracre, 1987 (unpublished note)). For these reasons, road users are probably more exposed to the possibility of a road injury than they are in rural areas.

Similarly the average number of journeys that people make may also be a factor. Thus studies have shown that in rural areas (Hine, 1992, Airey and Cundill, 1998) of Ghana and Malawi, the number of motorised 'out of village' trips per person per year ranges from 1 to 100 per annum. Conversely, in Indian cities for example (Fouracre and Maunder, 1987) trip rates depend on both income levels and proximity to the centre but range from 1 to 2 trips per person per day. Inevitably, therefore, exposure to traffic is much greater in urban than in rural areas.

However counterbalancing this is the fact that vehicle speeds are generally low in Third World cities but relatively high on inter-urban roads. Thus whilst most crashes probably occur in urban areas they are of less severity than those taking place in rural areas.

The work in Indian cities also highlighted the dependence of both low and high income people on walk and public transport modes. Thus for all income levels for trips of about 1 kilometre, 80 per cent are made by walk mode and about 50 per cent are still made by walking for trips of up to 2.5 kilometres. After that walk modes decline significantly so that for journeys of 5 kilometres only about 2 per cent are by walking. For longer journeys trips by public transport dominate so that after 10 kilometres about 80 per cent of low income trips are by public transport and even 50 per cent of similar length trips by high income people are by public transport. Inevitably, therefore, pedestrian and public transport casualties will be particularly high in urban areas of Third World cities.

4.3.2 Hospital Studies

Very little work has been undertaken on the socio-economic status of victims of road crashes in developing countries and virtually nothing is known of the impact of road crashes on the lives (and lifestyle) of victims and their families. However a relatively small study, funded by DFID, was undertaken by Ross Silcock and TRL (Ghee et al, 1997), where road crash victims were interviewed in a number of hospitals in Bangladesh, Fiji, Ghana, Indonesia, Peru, Swaziland and Zimbabwe. The choice of hospital(s) was dictated by local interest and support, and was not intended to be a representative selection. Resource constraints precluded statistically-based selection criteria, and no claims are made that the hospitals selected are representative of
conditions throughout the country concerned. It is probable that, because most of the hospitals involved are based in large cities, the road crash victims are biased towards urban conditions.

The main advantage of a hospital-based survey is that it offers a concentration of crash victims, thus offering low-cost data capture. However, the result is a non-representative sample of crash victims as a whole; fatalities are obviously excluded, and minor injuries are not generally treated in hospital. Also it seems likely that the poor in particular have limited access to modern medical facilities and that they are more likely to resort to traditional medicine or have no proper treatment at all.

The study compared the national population profile, by age and gender, with the age and gender of the crash victims who were interviewed. The most striking feature was the over-representation amongst the crash victims of males in the economically active age range of 16-45. This is evident in all seven countries, with some also showing a similar peak, if smaller, amongst females.

Analyses of national road crash data (Ghee et al, 1997) suggest that perhaps 15 per cent of fatalities in developing countries are children under 15. This study showed a smaller proportion of crash victims in the hospitals surveyed are in this age band - typically below 10 per cent. There are many possible reasons for this. For example, if it is assumed that the proportion of crash victims who die is independent of age (it is actually the frail and elderly who are most at risk), then one possible conclusion is that injured children (i.e. non-earners), are less likely to be taken to hospital than those in the economically active age ranges. It is also true that children figure strongly in pedestrian casualties, and the risk of death is greater for a pedestrian than a vehicle occupant. Thus it is likely that a greater proportion of child road crash victims die, rather than being treated in hospital.

The study investigated the mode of travel of the victims surveyed, and the other types of vehicle involved in the crash. The proportion of victims who were pedestrians ranged from 30 per cent in Fiji to 65 per cent in Swaziland. Travelling in the back of a lorry, or pick-up (i.e. manual workers, the poorer members of society), appears to be particularly risky in Fiji. The respective range for the proportion of victims using public transport is from 2 per cent in Swaziland to 44 per cent in Peru. Since the hospitals were based in major urban centres, the likelihood is that the majority of those interviewed were injured in urban crashes.

Many crash victims have dependants. Absence from work and/or the family can have far reaching effects, well beyond the immediate costs of the treatment needed and other monetary costs of the crash. The study determined the numbers of dependants of the crash victim interviewed, as a cumulative percentage of interviewees. It was found that the highest levels of dependency were observed in Bangladesh, the lowest in Indonesia. In Bangladesh 83 per cent of victims had family members wholly dependent upon them and 78 per cent in Zimbabwe. The impact of the crash on family life was therefore very significant.

It is acknowledged that interviewees are often reluctant to report incomes, however a reasonable degree of success in this respect was achieved during the hospital surveys. In all cases the median income of road crash victims was above the national average.
All male victims' median incomes were well above the national average, and although only limited data are available for female victims' incomes there is some evidence that the female median is also above the national average income. The surveys were largely based in the national capitals, where above average incomes may be expected. A more realistic scenario may well be that the poorer victims do not present themselves at hospital - which they cannot afford - and more research is needed to investigate this further.

4.3.3 Studies of Casualties
In a DFID-funded study of pedestrian road crash victims in Third World cities undertaken by W S Atkins (1998, in preparation), with TRL support, interviews were conducted of pedestrians involved in road crashes. Surveys were carried out in Sri Lanka, Ghana, Zimbabwe, PNG and India. These interviews were of randomly selected people who may not have been hospitalised as a result of the crash. A limited number of interviews of relatives of people killed were conducted as were interviews of control samples (i.e. of people not involved in the crash).

Information was obtained on the following socio-economic parameters:
1. Age (by gender and age group)
2. Occupation (defined as unskilled, skilled, managerial, miscellaneous, unemployed, housewives, students and other).
3. Personal earnings (usually based on a weekly sum).
4. Household income (for combined family)

Most interviews took place in cities and results relate predominantly to people living in urban areas. Statistical analyses were undertaken to determine whether or not differences exist between crash and control data. In Sri Lanka, PNG, Ghana and India (but not Zimbabwe) it was found that people without formal employment or those from low income households in Sri Lanka, Ghana, Zimbabwe and India were more frequently represented in the pedestrian crash group (statistically significant difference) than the in normal population (control).

From this study there is clear evidence that poorer sectors of the community were much more likely to be involved in road crashes as pedestrians than those who are better educated and with higher personal or household incomes. Clearly more work is required to investigate further the involvement of low income communities in road crashes. It is also important that further research is conducted into what actually happens to poor people (or even children in fact) when involved in road crashes.

4.4 Health Burden
4.4.1 Road Crashes As A Cause Of Death
In recent years there have been two major studies of causes of death world-wide which have been published by the WHO, the 'Global Burden of Disease' (1996, World Health Organisation, World Bank and Havard University) and the 'World Health Report - Making a Difference (WHO, 1999). The World Disaster Report from the Red Cross (International Federation of Red Cross and Red Crescent Societies, 1998) also makes similar points.

These publications show that, in 1990, road crashes as a cause of death or disability were by no means insignificant, lying in ninth place out of a total of over 100 separately
identified causes. However by the year 2020 WHO forecasts suggest that as a cause of death, road crashes will move up to sixth place and in terms of years of life lost (YLL) and ‘disability adjusted life years’ (DALY’s) will be in second and third place respectively. Table 4.2 summarises the results obtained.

Table 4.2 Changes in rank order of death for leading causes 1990 - 2020

<table>
<thead>
<tr>
<th>Year</th>
<th>Deaths</th>
<th>Years of life lost</th>
<th>Disability adjusted life years*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>9</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>2020</td>
<td>6</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

* DALY’s express years of life lost to premature death and also years lived with a disability, adjusted for the severity of the disability.

These results related to global patterns but additional information indicates that for developing countries only, the equivalent values for the year 2020 are road deaths in 5th place as a cause of death and in second place for DALY’s (a value for year of life lost was not presented). Thus as a cause of death in the future, road crashes may well be even more of a health problem, both globally and in the developing world than they are today.

Understandably no sub-division is available for urban and rural areas but findings should apply equally to both areas. Clearly the actual values for each country will depend on the population distribution (urban and rural) which exists in each country. Population distribution varies widely in different countries throughout the developing world. In Latin America the majority of countries have mainly an urban population with, for example in Argentina, Chile, Peru and Venezuela about 80 per cent of the total population is urban. In Asia and Africa distributions vary widely with South Africa, Morocco and Botswana having about 50 per cent urban-based but in Ethiopia, Malawi and Uganda the urban population is 20 per cent or lower. Large hospitals which are generally the locations where data are collected are inevitably city-based, but serve both urban populations and people living in surrounding areas.

4.4.2 Road Deaths and Medical Care

The higher levels of fatality rates in developing countries are usually attributed to lack of investment in road safety factors such as driver training and testing, road layout and design, vehicle conditions etc but it is also likely that a lack of medical facilities contribute to high fatality levels. If medical attention can be given to crash victims promptly then the chance of survival is increased. Unfortunately, with very limited emergency services and a general lack of qualified medical personnel, the chance of a road crash victim receiving prompt medical attention in most developing countries is low. The link between chances of being killed in a crash and level of medical services was first identified by Jacobs and Cutting (1986) who noted a (statistically significant) relationship between Fatality Index and doctors per head of population.

The Fatality Index is usually defined as the percentage of all persons injured who actually die.

\[
i.e. \text{ Fatality Index} = \frac{\text{Fatalities}}{\text{Total Casualties}} \times 100\%\]

24
Fatality Indices, as measured in developing countries, have been found consistently to be greater than in Western countries. For example, in OECD countries the FI is usually in the range 1.5 to 2.0 whilst (reliable) values for a number of African and Asian countries usually range from 10 to 20. Fatality Indices are now viewed by practitioners with caution because of the significant degree of under-reporting of the less serious injury (thus inflating FI values).

However in a study by Ghee et al (1997) Fatality Indices for a number of developed and developing countries were regressed against:

- hospital beds per 1,000 population
- doctors per 1,000 population
- nurses per 1,000 population

This analysis showed that there was a significant relationship between FI and hospital beds and nurses per 1,000 population i.e. in countries where medical facilities are poor, the Fatality Index is high. Consequently, if medical facilities are improved then the number of people injured in road crashes who subsequently die can be minimised. Clearly road victims in both urban and rural areas stand a much greater chance of survival if attention from ambulance crews, especially trained paramedics, can be provided promptly. Needless to say, in poor countries such facilities are rarely available.

In some countries the problem is compounded by the fact that injured people must demonstrate that they can afford medical treatment. Thus in Addis Ababa for example, an injured person taken to hospital (probably by a helpful witness to the incident) will only be admitted if he or she can show that they have sufficient funds to pay for treatment. More research is needed on the impact of emergency services and the many peripheral factors involved on fatality rates. In the case of the impact of medical services, it is likely that the impact of lack of ambulances, para-medics and hospital services is more severe in rural areas than in towns and cities.

4.4.3 Emergency Services
About half of all road traffic deaths occur within 15 minutes of the crash taking place, commonly as a result of injuries to the brain, heart and large blood vessels. As stated in Section 3 of this report, a high percentage of road deaths and injuries in developing countries involve pedestrians who are a particularly vulnerable group of road users. Inevitably the majority of pedestrian deaths take place in urban areas. The time between injury and stabilisation is the single most important factor in patient survival with the first 30-60 minutes (often described as the 'golden hour') being the most important.

Ambulance services are clearly less frequent or effective in developing countries (they may in fact be non-existent) and a more flexible approach is often required due to:

- a lack of communications network;
- public unwillingness to give ambulances priority; and
- a lack of data that prevents the need for emergency services from being identified.
One particular problem in Third World cities is the congested nature of the streets which prevents those ambulances which do exist from reaching the scene of the crash quickly, and also inhibits the speedy transfer to hospital. Due to a lack of ambulances many Third World cities make use of passers-by to take the injured people to hospital. Whilst praise-worthy in a moral sense, this often means that treatment is not given at the scene of the crash and no resuscitation measures are used. Indeed well-meant movement of the victim can worsen some injuries. This situation can be improved if more people have basic understanding of first-aid procedures and a clear understanding of what not to do.

In Third World cities, emergency services can be improved at modest cost by the following.

- The provision of an emergency telephone number;
- the establishment of a control centre;
- the setting up of an Emergency Medical Services Committee;
- provision of first-aid training;
- provide a mechanism (from insurance companies) to cover costs of minor expenses incurred in bringing the injured person to hospital; and
- upgrade hospital emergency departments.

4.5 Summary
A summary of findings from this section is as follows.

- WHO and Red Cross studies compared deaths and disability from over 100 separate causes and found that road crashes as a cause of death or disability in 1990 were already important and likely to become even more so by the year 2020.

- In order to ensure that scarce financial resources are allocated as efficiently as possible, it is important that road crashes are costed, at least at the national level. The method used should be consistent and the Human Capital approach is recommended, with sums added to reflect the pain, grief, and suffering of those involved and also those closest to them.

- Whilst the severity of road crashes which take place in urban areas is generally less than those occurring on major inter-urban roads, due to their greater numbers, the overall cost of crashes taking place in urban areas is likely to be just as significant.

- Results from a study of hospital casualties in a number of hospitals in Third World cities indicate the over-representation as patients of economically active males. In order to identify why children, females and poorer sections of the community appear not to receive hospital treatment needs further investigation.

- A home-interview study of people involved in road crashes in five cities showed that people without formal employment or those from low-income households were more likely to be injured (as pedestrians) in a road crash than those from wealthier households.
5 BEST PRACTICE IN DEVELOPED COUNTRIES

5.1 Introduction
The substantial increase in car ownership in industrialised countries following the second world war resulted in growing traffic volumes and higher numbers of road crashes. The need to develop ways of improving safety as well as accommodating many more vehicles was recognised. As a result, a large amount of basic research was carried out, modern traffic flow theory was developed and general highway design standards were drawn up. Motorways (Expressways) were constructed to accommodate inter-city traffic. Traffic movements in urban areas were regulated and controlled with the increasing application of traffic signal technology. Traffic laws and regulations were developed and strengthened, and traffic law enforcement became an important strand of police activity.

The forerunner of comprehensive road safety management in urban areas can be considered to be the imposition of blanket speed limits in towns and cities. In the UK, the 30 miles per hour (mph) urban limit was introduced in 1934. Subsequently restrictions on through traffic have gradually been introduced in the central areas of towns and cities, pedestrianisation treatment and the segregation of different types of vehicle has evolved, and one-way systems are now widespread. In addition there has been the wide scale introduction of waiting restrictions to control parked vehicles, which also improved sight lines and reduced conflicts at junctions.

In aggregate, these measures contributed to the steady reduction in road crashes in most European countries, particularly as regards pedestrian casualties in urban areas. Whilst most of the measures were introduced primarily for traffic management reasons, it is generally accepted that orderly and regulated traffic flow conditions provides a safer road environment for all road users.

Road safety practitioners have built on this, both in terms of crash reduction and crash prevention. Reduction activities target known problems, typically at a ‘blackspot’ location where crashes occur on a regular and explainable basis; prevention targets problem groups of road users, (such as drunk drivers) or uses systematic approaches to highway design, such as introducing a formal road safety audit procedure into the design process.

5.2 Road Safety Plans
It is now common practice for road safety to be approached in a comprehensive way, from a national strategy setting goals (such as Sweden's Vision Zero goal of no deaths from road crashes, or the UK government's casualty reduction targets). These national strategies are operationalised at local levels by local authorities, or on certain types of road by a highway authority. Central to both a national strategy and a local action plan is the recognition that achieving reductions in road crashes and the consequent casualties depends on concerted actions across several sectors.

Coordination of activity by central and local government under the traditional headings of the three Es - Engineering, Enforcement and Education - is essential to achieve cost-effective results. As these activities are almost always the responsibilities of different authorities, under different ministries and with separate budgets, it is much easier to say than it is to do, even in relatively mature countries with well developed institutions.
Ownership by stakeholders and community participation is also recognised as important for successful implementation of measures and some examples of good practice are given in the box below.
5.3 Engineering Measures

5.3.1 Blackspot programmes

In addition to general traffic management measures, the process of crash investigation and prevention (AIP) has evolved. Based on detailed analysis of crash data to establish patterns and common features, a variety of crash remedial measures have been developed for treating specific sites and route sections with concentrations of crashes that have similar characteristics. These measures often deal with crashes that involve only motorised vehicles, where in most cases there is either no significant displacement of traffic, or minor re-routing is accommodated as part of the scheme design. Methods for tackling concentrations of crashes (blackspots) have been successfully applied in the UK and elsewhere for many years, with the early experience contributing to the publication of the Accident Investigation Manual in 1974 by the then Department of Transport, and subsequent updates. It is often the case that blackspots can be treated at relatively low cost, and very high economic returns can be achieved from such treatments.

Blackspot programmes remain a well-tried and effective means of improving road safety. However they depend on a comprehensive and accurate database describing the nature and location of crashes. In addition, monitoring the effects of different measures has provided a body of professional experience and knowledge in the field. As a result

1 Community Road Safety

1.1 New Zealand

For the past decade, New Zealand has been financing a Community Road Safety Programme under its Land Transport Safety Authority (LTSA). Community Road Safety Projects are designed by the local community and are tailored to local needs and at-risk groups. In 1999-2000, there were 300 community projects with an average LTSA funding of NZ$4,500. LTSA also hires community coordinators and much support (both financial and in-kind) has come from community groups and other organisations. Funding is determined not only by crash cost per capita but also by the per capita income and the population density. Examples of local projects include: Community Alcohol Action Projects, After ball parties in Otago, Pedestrians in Christchurch, Safe with Age, Intersections in Hamilton. Process rather than outcome evaluation is used for the Community Road Safety Programme.

1.2 USA

Started by the National Highway Traffic Safety Administration (NHTSA) and now spread to all Department of Transportation agencies, the Safe Communities approach integrates transport and health issues with the help of the local community. The development as well as the implementation of a project is a two way process with local priorities determining the objectives and the initiatives. Safe communities have four main themes:

1. injury data analysis and linkage
2. expanded partnerships, especially with health care providers and businesses
3. citizen involvement and input
4. comprehensive injury control system

While there are over 900 local Safe Communities projects, the full scale Safe Communities Model is currently being piloted in four US cities (Anchorage, Dallas, Greenville, and Providence) over a three year period. The first year is dedicated to planning with data analysis, coalition forming, prioritising injury problems and selecting countermeasures. The program is implemented in the next two years with a complete evaluation at the end of the third year.

(Traffic Safety, July/August 1999)
concentrations of crashes at particular locations are now much less common in developed towns and cities.

5.3.2 Traffic calming
As the worst blackspots are treated over time, a greater proportion of crashes tend not to be concentrated but scattered, and less amenable to site-specific treatment. In particular, pedestrian and cyclist casualties tend not to be clustered. Accordingly there arose the need for area-wide treatment, particularly in urban areas, which eventually became known as ‘traffic calming’. This popular expression is descriptive of the process which seeks to control motor vehicles in a number of ways, often in order to improve amenity as well as safety.

Denmark, the Netherlands and West Germany were the first countries in Europe to develop traffic calming schemes, in the 1970's. In the Netherlands, schemes were introduced in conjunction with maintenance programmes relating to the country’s low-lying topography. These involved comprehensive reconstruction to produce a residential precinct (Woonerf) which was designed to slow down traffic. In these Woonerven there is also a lower speed of 30 kph, coupled with the various engineering measures, which include ‘space sharing’ between pedestrians and vehicles. Over the course of years the accumulation of schemes can lead to almost the whole of a town being covered by these schemes, but generally this has been as an evolutionary process rather than as part of an overall plan.

There is a large body of evidence from evaluations of traffic calming schemes in many countries which show substantial reductions in crashes (e.g. Blanke, 1994, for Germany; Mackie and Webster, 1995 and 1996, for the UK; Brindle, 1996 in Australia; Gadd, 1996 for New Zealand).

2 Speed reduction

In 1992, Graz Council decided to establish a 30 kph (18 mph) speed limit on 75 per cent of its roads (all except for the main roads which would remain at 50 kph). The proposal was widely consulted involved strict enforcement and measures to promote walking, cycling and public transport. The city also reduced vehicle access to the city, increased parking charges and in cases of conflict, non-motorised traffic and public transport were given priority over private motorised vehicles. Both casualties (24% decrease in serious injuries) and actual speeds (on the 30 and 50 kph) decreased with the greatest fall in the very high speeds.

At the time it was introduced, the programme had less than 50 per cent approval but now 8 out of 10 residents support the reduced speed initiative, including 2/3 of car drivers (Pilkington, April 2000).

Quoting from an article in the Guardian, “For fewer deaths and less pollution, reduce speed now”, August 18, 1999 Rogers B.

5.3.3 Area-wide schemes
In the UK, it was recognised that traffic displacement/re-routing is a major consideration for area wide schemes. Many areas included other land-uses besides housing and account needs to be taken of conditions on the major roads which often bisect residential areas.
Following large-scale trials in a number of towns and cities across England, the extensive ‘Guidelines for Urban Safety Management’ [Institution of Highways and Transportation] were published in 1990. These guidelines argued that a strategic approach was required in order to cover large urban areas. Accordingly the term ‘urban safety management’ is now used to reflect the fact that it is a management oriented rather than a pure design process (see below).

5.4 Traffic law enforcement

It is generally accepted that efficient and safe traffic movements depend upon high levels of adherence to the prevailing traffic laws. This, in turn, requires high profile law enforcement, as many people do not regard traffic offences such as speeding or making an illegal turn as a criminal offence.

In urban areas, high vehicle speeds are acknowledged as a major threat to safety, particularly for vulnerable road users. Research at TRL has established relationships between traffic speeds and crashes which suggests that crash frequencies increase as the proportion of drivers exceeding the speed limit increases (Taylor et al, 2000). Increasingly 30 kph (20 mph in the UK) speed limits are being imposed over quite large urban areas in order to offer safety benefits, particularly to pedestrians and cyclists.

There is a growing use of automatic equipment and cameras to detect and record traffic offences, particularly speeding, red light running and infringements of traffic regulations such as illegal use of bus lanes. This reduces the manpower needed for traffic law enforcement, and because road users see them as effective, cameras have a major impact on drivers’ behaviour.

3 Red light cameras

Red light cameras are a new and effective means of reducing ‘red light running’, which is a leading cause of urban crashes in the US. There are currently 70 red light programs in the US (only 1 was operating 5 years ago), including one program in Washington DC with 40 cameras. Not only is red light running reduced at intersections with cameras, it is also reduced at nearby intersections without cameras. Whereas speed cameras can encounter much public opposition, there has been much public support for red light cameras (Insurance Institute for Highway Safety, March 2000)

5.5 Education and publicity

Education and publicity programmes are commonly important parts of road safety activities in developed countries, although their nature and linkage with other measures makes them difficult to evaluate in terms of impact on crash rates.

Publicity campaigns are used effectively to target unsafe behaviours, for example drinking and driving and speeding, although they are also used to inform drivers of new legislation. However this type of mass media initiative is more commonly carried out as part of a wider campaign, including enforcement, rather than as publicity alone. Developing and evaluating effective road safety campaigns is now a more refined process, note the OECD reports on 'social marketing' and 'influencing the driver'.
Road safety education in schools is believed to be most effective when road safety topics are incorporated into other aspects of the curriculum, rather than as a series of separate visits by outsiders. It is also recognised that RSE needs to be progressive, child centered and practical. A number of 'Good Practice Guidelines' have been produced (for example, DETR in the UK) that cover the role of other agencies than the schools themselves. However, as with many aspects of road safety education and publicity, it is difficult to link these activities with any changes in crash rates. More recently additional programmes have been linked to the development of safer routes to school in the UK. Integration of education with local engineering initiatives and a focus on local problems would appear to have significant potential for safety benefits.

5.6 Urban Road Safety Management

Current best practice centres on the concept of urban safety management, adopting an area wide, comprehensive approach, such as described in the extensive ‘Guidelines for Urban Safety Management’ (Institution of Highways and Transportation, 1990). These state that urban safety management is a structured method to crash prevention and casualty reduction on urban roads, which takes account of other policies that influence road safety and involves all the agencies which can have an influence on road safety. It recognises that it is important to help people feel safer as well as reducing death, injury and damage caused by crashes. There are a number of stages to the process, which include the development of objectives, setting aims for the scheme design, and implementation and monitoring. It involves the cooperation of a number of agencies, and public consultation is a vital part of the whole process.

The basic methodology is to identify the current road hierarchy and assess its performance in terms of the various activities that the different types of road have to support. This includes consideration of the needs of different road user groups and the frontage properties, crashes and numbers of pedestrians and vehicles, including traffic speeds. Each part of the road network is then examined to determine if it is adequate. Where this is not the case, specific improvements need to be introduced, or its role in the hierarchy needs to be changed. This requires the consideration of the redistribution of traffic and road space for all users. The process has to be based on defined areas to which the process can be applied, and the definition of a functional road hierarchy is a vital requirement.

Wyatt (1996) describes the Safe Town Initiative of the UK government, which aims to investigate the scope for reducing crashes by implementing a coherent range of actions for road safety according to a well defined strategy. The study is essentially the full application of the Guidelines for Urban Safety Management. It is a five-year project with extensive funding, to support comprehensive casualty reduction measures throughout the whole of a freestanding town, in this case Gloucester. Although the initiative emphasises traffic calming, it aims to bring together all the activities of the local authority with the cooperation of a range of other organisations. The project is now in its final year, and illustrates the complexity of the task involved.

There are many elements in an urban safety strategy, as illustrated in the figure below taken from the DUMAS project research report (European Commission, 2000). Bringing together the different bodies and professional skills needed is a substantial management task.
The DUMAS (Developing Urban Management and Safety) Project is a large European Union collaboration of research teams in nine countries, the objective of which is to produce a framework for the design and evaluation of urban safety initiatives (European Commission, 2000). The research phase has been completed, which has resulted in the formulation of a design framework for urban safety management schemes and an assessment framework for evaluation purposes. These will be used for scheme design in a number of town studies which are intended to provide guidance on how to manage projects successfully and provide further development of the frameworks. DUMAS has summarised the process to be undertaken in tabular form, as shown below.
1. **THE PRELIMINARIES**

1.1 Are you sure? If not, stop here

1.2 Have you got sufficient support?
   Support is needed from:
   - Politicians – local and central Government
   - The public – local residents are most important
   - Technical staff in the local Authorities
   - Transport operators
   - Network operators
   - Police

1.3 Have you got finance? if not; give up now and seek funds

1.4 Are there legal barriers? Check out before starting project

2. **STARTING THE PROJECT**

2.1 Set up structures
   - management structure
   - communications channels

2.2 Launch
   Have a big press announcement to get the project launched

2.3 Set objectives
   Have clear high-level objectives for the Project e.g. casualty reductions of X% by year Y.

3. **RUNNING THE USM PROJECT**

3.1 Analysis phase
   - What are the safety and mobility problems?
   - Where do the crashes occur? to whom? at what time of day? etc.
   - Understand the problems in the town/city – safety, environmental and mobility.
   - Listen to everyone’s complaints.

3.2 Strategy phase
   - Given the high-level Objective and the Problems; how do we go about fixing the Problems to achieve the Objective?
   - Break the town/city down into sub-areas and produce a safety strategy for each.
   - Check these strategies with everyone – get commitment.

3.3 Planning stage
   - Plan to tackle problems in order, usually starting with the biggest.
   - Use as many approaches as possible to deal with problems.
   - Check the consequences of solutions proposed.
   - Have timescales that are reasonable, with some contingency.
   - Check these solutions with everyone to get support.

3.4 Design stage
   - For the solutions proposed, design measures.
   - Make designs acceptable to as many people as possible.
   - Check costs do not exceed finance limits.
   - Check resources are available to design and implement each measure proposed.
   - Check designs are supported by everyone.

3.5 Implementation stage
   - Implement measures in stages, starting with a ‘quick fix’ to a large problem – you need a success to start with.
   - An individual initiative might follow these stages:
     - Consultation
     - Detail design – involve as many as possible
     - Implementation
     - Flow/speed changes – getting used to it.
     - Assessment
     - Note: the full benefits may not be realised until all the measures are in place.

3.6 Assessment stage
   - Measure crashes, casualties and flows etc. Check against objectives – where objectives not achieved, reconsider and possibly introduce additional measures.
   - Make sure everybody knows about successes and failures during the Project with regular press releases and announcements.
   - Report back on achievement of objectives.

The DUMAS research to date has shown that, although knowledge of urban safety management has existed for some ten years, few broadly based, management schemes
have been implemented. This is attributed by the authors to a number of reasons. It was generally concluded that urban safety management is a complex process, it is costly and is politically difficult to deal with. The technical knowledge and capability exists, but it is the non technical factors that have caused the lack of much implementation, so far, in all of the countries involved in the DUMAS study.

5.7 Summary
The main findings from a review of best practice in developed countries are:

- Overall, road crashes and rates have been reducing in most industrialised countries over a number of years, due to the cumulative effect of a range of interventions. This reduction comprises a large decrease in vulnerable road user casualties, coupled with a decrease in vehicle occupant casualties.

- A comprehensive approach, based on a road safety plan for the town or municipal area, is needed. Such a road safety plan often stems from a national strategy with clearly defined casualty reduction targets; the local plan is a means of delivering to the target at a local level.

- The comprehensive approach involves the various authorities with responsibilities for the different aspects of road safety activity, primarily: highway and traffic engineers; traffic police; those with responsibility for education and publicity; health authorities and emergency services; and the local communities.

- Site specific remedial treatment is effective in dealing with clusters of vehicle/vehicle crashes and some crashes involving pedestrians. Pedestrian and pedal cycle crashes tend to be more dispersed and so require an area-wide approach for effective treatment. The need for a more comprehensive approach has grown as successful blackspot programmes have reduced the proportion of crashes concentrated at single locations.

- There is a strong relationship between traffic speeds, crashes and injury severity. Thus speed enforcement and area-wide speed limits are effective in reducing crashes. For zones with a speed limit lower that the standard, the casualty savings are even greater, particularly for pedestrians.

- Some countries have introduced special legislation to reduce the priority of motorised vehicles over other road users in residential areas (such as Woonerven), in addition to applying lower speed limits.

- Traffic calming schemes, which reduce traffic speeds and generally provide facilities for pedestrians and other vulnerable road users, have been proven effective in reducing crashes in many industrialised countries.

- There is a consensus in developed counties that the next step to achieve even greater urban road safety is a management process which addresses the whole of the road network in a defined urban area. It is a strategic approach which needs to be integrated into other urban planning and development strategies. Whilst this has
been accepted at a technical level for some years, for largely political and financial reasons, the implementation of area-wide approaches are, so far, few in number.

6 REVIEW OF URBAN ROAD SAFETY PRACTICE IN DEVELOPING COUNTRIES

6.1 Introduction
This section of the paper draws heavily from experience of World Bank projects and evaluation reports because road safety activities in developing countries is mostly the result of interventions by external funding agencies. Whilst there have been some projects which focus on road safety, these are exclusively national projects. It is much more common to find road safety components as a small part of larger highway or urban projects as opposed to the entire project being road safety specific.

Typically the executing agency for the road safety component of a national project is a national roads authority which usually has little, or no, jurisdiction or responsibility in urban areas. In cases where there is a road safety component of an urban transport project, there is commonly substantial overlap with traffic engineering components, which generally claim road safety benefits as part of their justification. Examples of urban road safety activity which can be disentangled from other aspects of the project are rare. This may well dilute the effort devoted to the road safety issues, and makes evaluation of road safety investment more difficult.

In an urban context, Talvitie, Reja & Ebrahimi (undated) state in their report of a World Bank seminar on urban transport, that traffic management has achieved less success than infrastructure improvement. Three reasons are noted:
- low absorptive capacity of the borrowing country;
- weak legal system; and
- little government commitment to the measures.

By implication, these concerns can also be attributed to road safety activities in urban areas.

Talvitie et al cite a number of examples. In the Jamaica Urban Transport Project, the traffic management component was not implemented for lack of government interest. In Cote d’Ivoire computer controlled traffic signals were installed in Abidjan under the Urban Development Project, however insufficient funds and technical knowledge were available to maintain them. Often project designs fail to consider the legal implications of a scheme correctly. In the case of Abidjan, even when operating, the traffic signals were of limited use, as they were poorly enforced. In contrast, in Brazilian cities, strong police enforcement provided greater success. Traffic management measures require strong rule of law to be effective.

This general failing in the sustainability of traffic management activities is also identified in a performance audit report covering a number of projects in Indonesia (World Bank report 18099). Whilst the direct linkage is rarely made explicitly in the evaluation reports, experience suggests that this negative conclusion can be extended into road safety engineering measures, which often are seen as a component of a traffic management project.

That is not to say that site specific, blackspot improvement measures are ineffective in developing countries. If they are well designed and correctly implemented then
impressive reductions in crashes at the treated sites are achieved. Examples can be cited from projects known to the authors. Some projects have focussed on junction crash problems (eg. Reddi, 1993, Legassick, 1997) whereas others have concentrated on improving safety for vulnerable road users. Jones (1999) reports a saving of 22 per cent in pedestrian crashes following a Kathmandu safety scheme and Hills and Thompson (1990) report crash reductions of 26 per cent and 52 per cent following pedestrian footbridge and central refuge installations. Sayer and Baguley (1994) carried out an analysis of raised pedestrian crossing trials in Karachi and reported a First Year Rate of Return of about 230 per cent. In some countries road safety units have been established within the road authority or the police with the aim of a continuing programme of blackspot identification and treatment (eg: in the national road authority in Vietnam and in the City Mayor’s office in Bogota).

The remainder of this section first summarises a number of reports which have reviewed road safety investment in developing countries. It then outlines the content of a number of road safety manuals which have been prepared specifically for use in developing countries or as part of projects in a particular country. Section 6 discusses the strengths and weaknesses of current practice, as exemplified by recent road safety projects, and finally a summary of the current ‘state of the art’ is set out.

6.2 Summary of key reports
There have been four reviews of World Bank experience with investments in road safety (Mason, 1981; Willoughby, 1986; Ross and Mwiraria, 1992; and Amundsen, 1995). These reviews were based primarily on Staff Appraisal Reports (SAR) and they attempted to identify the nature and success of road safety projects and road safety components within (primarily highway) projects. Little reference is made in any of the reviews to road safety in urban areas as a specific topic, although there is a trend towards more emphasis being given to non-motorised traffic. Amundsen focusses specifically on this aspect.

Ross and Mwiraria (1992) reviewed 107 Bank projects from the period 1970-89. Of these, 36 were projects where improving road safety was a specific objective; in the remainder it was an indirect objective. In terms of success of the traffic safety component, 32% were judged to be successful and the same percentage unsuccessful. 24% were partially successful with the balance being ‘too early to judge’. They state that it is very important to create an enabling environment if substantial advances in traffic safety are to be made. Ross and Mwiraria advocate designing projects in phases, based on increasing levels of awareness in the borrowing country. They felt that most interventions should be implemented as part of one of the following: road safety programmes; infrastructure improvements; and traffic system management initiatives.

Amundsen (1995) compares the numbers of road safety elements in the projects considered in the previous reviews and concludes that the latest, 1995, review has more safety elements; an average of 3.3 elements per project compared with 1.4 in 1981. Amundsen states that physical engineering elements (28% of the total) are the most common, with institutional strengthening being second most used, 17% of components in the latest review. He does not, however, make any judgements as to their effectiveness.
In order to assess the impact of the growth in road safety components Amundsen used a questionnaire survey of Bank Task Managers. Less than half the questionnaires were returned, but Amundsen reports that there was general agreement that the Bank had been fairly successful in boosting the technical abilities of Bank staff. There was less agreement about whether there was increased ‘awareness (of road safety) in the transport sector’ and whether there had been an increase with respect to ‘promote and incorporate road safety into Bank activities’.

In 1989 the World Bank undertook a study in cooperation with the Swedish Road and Traffic Research Institute (Carlson and Hedman, 1990). The main purpose was to formulate a systematic approach to tackling the problem of road crashes. It draws from the work of the Institute of Traffic Economics in Norway (Lauridsen and Muskaug, 1995) in the SADCC-countries (Angola, Botswana, Lesotho, Malawi, Mozambique, Swaziland, Tanzania, Zambia, Zimbabwe). A working group argued that long term success depended upon a basic structure comprising the following elements:

- traffic legislation;
- road safety organisation at the national level;
- qualified workforce; and
- traffic crash data.

A range of guidelines and ‘state of the art’ documents has been produced and are being used in a number of projects. Evaluations of their effectiveness are yet to be carried out.

Midgeley (1994) reviews urban transport problems in Asia and refers specifically to road safety issues. He states that traffic crashes are one of the major causes of mortality and hospitalisation in developing countries in Asia. Contributory factors are: traffic growth; undisciplined behaviour; poorly maintained vehicles; inadequate traffic control and engineering. The statistical base for crashes is fragmented and unreliable, with under reporting and incomplete records. The situation is generally worse than reported. In Dhaka, Bangladesh, estimates identify that police statistics include only 50% of fatalities recorded in hospitals.

Crash rates are well above those of developed countries, and urban areas are worse affected. In Bangladesh, Dhaka accounts for 40% of national motorised vehicles and 50% of all crashes. In Shanghai there were 3,400 fatalities in the five years between 1984 and 1988, ten times that of Tokyo, due to the high proportion of pedestrians and cyclists, and the problem is exacerbated by delays in providing emergency aid to victims.

Midgeley goes on to say that in India over 40,000 road crash fatalities are reported annually. 11% of fatal and 29% total occur in the 12 largest cities. One third of urban fatalities are pedestrians. Fatal crash rates in metropolitan cities range from 13.7 to 28.7 per 100,000 veh, compared with 2.1 in Japan and 3.8 in Australia. Many cities have seen alarming increases in crashes: Bangkok, 14,000 in 1985 to 31,000 in 1988; Delhi 700 fatal in 1977 to 1270 fatal in 1985; Shanghai, 12.5% annual increase between 1985 and 1987; fatal crashes at 9% each year. In an early study (Fouracre and Jacobs, 1977) estimated annual economic losses from road crashes were estimated to be about 1% GNP in developing countries. It is now thought that this might well be an under-estimate of annual costs. Over 1985-1987 material losses in Shanghai increased by 33% per year, amounting to US$ 2.6 million in 1987.
Midgeley notes that traffic crashes are rising at a high rate in low and middle income Asian countries. The reasons for this are given as:

- urbanisation brings new urban residents unfamiliar with urban traffic conditions;
- congestion causes impatience and lack of driver discipline;
- networks were not designed for the volume and speed of traffic; and
- provision for increased volumes of motorised traffic has reduced facilities for NMV’s and pedestrians.

Agencies have recognised the need to reduce crashes, yet between 1968 and 1985 crash deaths rose by 170% in Asian developing countries, compared to a 25% decrease in developed countries. Simple low cost solutions are available (Midgeley cites ‘Towards Safer Roads in Developing Countries’ Ross Silcock and TRL, 1991)) and suggests that the following are needed:

- bring safety to the attention of planners and engineers and highlight important safety details;
- introduce policy makers and aid agencies to the issues of planning and design that effect crashes and their mitigation;
- bring together the experience of developing countries, guidelines, standards and designs to inform professionals;
- provide a source of ideas for countermeasures; and
- stimulate education and research.

Midgeley argues that programmes should be drawn up involving: police, engineers and educators and that the importance of adequate funding should be recognised. He lists the Components of an Urban Road Safety Programme as:

1. crash data collection and analysis
2. traffic engineering and control at crash locations
3. vehicle testing and inspection
4. driver training and testing
5. traffic education for children
6. publicity and marketing
7. traffic police enforcement
8. road safety monitoring and research
9. traffic and road safety design standards
10. emergency services and first aid
11. road safety legislation and penalties

Midgeley identifies that pedestrians are the most vulnerable group of road users (see section 3). They lack space and safe facilities especially for the young, elderly and infirm. Facilities for pedestrians are often looked upon as luxuries, or overlooked altogether. They are often poorly designed, not respected by drivers or enforced by the police. Midgeley states that suitable examples of safe facilities are common in developed countries.

In Indonesia, the World Bank (1995 - completion report no. 15245) funded a Regional Cities Urban Transport project in four cities (Bandung, Medan, Semarang and Surabaya). The project focussed on corridor improvements and traffic engineering,
with claims of safety benefits. In addition a data base was introduced in Bandung and training programmes, including road safety issues, were implemented.

Also in Indonesia the Jabotek Urban Development project (World Bank completion report 17116) included the improvement of pedestrian access and safety amongst its objectives. As with many essentially traffic engineering projects the outcome seems to be that traffic growth outstripped the development of the network, leading to congestion on the improved roads.

A project completion report on the Taegu Urban Transport project in Korea (World Bank report 14711, 1995) states that the project was completed successfully, with reductions in delays and crashes, but no statistical details are given.

The Seoul Urban Transport project (World Bank completion report 12152, 1993) included the implementation of 200 blackspot improvement projects. The project was successful in meeting its traffic management objectives, although the benefits were probably short lived as a result of rapid traffic growth. Lack of experience and confidence resulted in less radical schemes than anticipated, with emphasis on physical measures rather than operations and strategic planning.

In a review of non-motorised vehicles in Asian cities, Replogle (1992) points out the under-reporting of crashes involving NMVs. He suggests that the bias towards motorisation lead to road safety being measured by rates per registered vehicle; this results in countries with low levels of motorisation having the worst crash rates. This picture is changed if we examine traffic deaths by population. Similar differences are found by mode when examining rates by distance travelled, time travelled and by trip. Pedestrians are often worse off in these terms than cyclists. Cycle deaths in Delhi are only one third of those of pedestrians. A study of 14 other developing countries found cyclists at far less risk than pedestrians. He goes on to state that comprehensive segregated NMV networks have significant benefits for safety in mixed traffic situations. The introduction of a comprehensive network can lead to 20% decrease of cyclist crash involvement, 32% decrease of chance of injury and 12% mobility increase. This appears to be based on evidence from China. Road safety needs more attention for NMVs and pedestrians are at increasing risk through the increase in motorisation. (See section 3).

Draft guidelines on planning and improving facilities for pedestrians and cyclists have been prepared for the Sub-Saharan Africa development programme by de Langen (1999). He notes a number of conditions which apply in urban areas of Africa with respect to urban transportation and mobility, many of which lead to unsafe conditions for vulnerable road users. Based on pilot projects in four cities (Dar es Salaam and Morogoro in Tanzania; Nairobi and Eldoret in Kenya) the guidelines claim that “serious urban pedestrian and bicycle traffic crashes can almost be eliminated by a suitable programme of road (and intersection) re-design and traffic calming.” De Langen’s report goes on to say that the “...main price that has to be paid for safe roads is psychological: preparedness to grant priority to another road user.” The only solution which works is stated as being physical, not legal - in other words engineering measures to traffic calm the roads, not enforcement or education programmes. This finding mirrors experience in industrialised countries where the concept of ‘self-
enforcing’ traffic calming is accepted as much more effective than changes to the law, without the back up of engineering new road layouts.

There have been a substantial number of road safety studies in eastern and central Europe in recent years. Much of this work has been based on cooperative efforts by the EU and the World Bank, funded under the EU PHARE programme. The studies analysed the problems in the various countries and put forward a Regional Road Safety Plan as well as action programmes for each individual country. The components of the typical national action plan are similar to those advocated in other action plans, referred to in section 6 below.

The general message that the implementation of traffic management (and by implication low-cost road safety measures) requires management skills and political commitment as much as technical knowledge is powerfully made in the World Bank Performance Audit report on the Bangkok Traffic Management Project (Report 7068, 1987). At audit, the traffic management in the city was not seen as any better than at appraisal. The report suggested that the project had raised unreasonable expectations at the outset, which exacerbated the problem.

There is evidence of the potential effectiveness of blackspot measures. For example the Amman Transport and Municipal Development Project (World Bank completion report 13300, 1994) notes that three corridor improvements improved social conditions and safety. Substantial crash reductions were achieved at two major intersections (98% between 1984-1990). However only two of the planned 15 junction improvements were implemented and only 18% of the planned expenditure on traffic management was achieved. The report concluded that government ownership of such projects has to be cultivated through dialogue.

6.3 Road Safety Manuals
Since (by definition) all countries of the developing world suffer from a lack of financial resources, it is essential that the scarce resources which are available, are not wasted. Many countries also suffer from a lack of technical resources and experience to ensure that roads are built as safely as possible and remain so. Very often too few trained professionals are available to safeguard the safety of roads with gaps in their knowledge and an unfamiliarity with recent developments and techniques. Consequently there is a need to distil collective knowledge gained either from developed or developing countries to create easily accessible sources of reference. These can be topic based and also produced on a regional or even national basis, they must indicate how to deal with existing problems and how to anticipate those road safety problems that may need to be faced in the future.

This is best done by the production of easy-to-understand manuals or guidelines and a number have been produced in recent years to assist engineers and planners dealing with road safety in the developing world. Amongst the most important of these are the following.

6.3.1 Towards Safer Roads in Developing Countries
This was prepared by TRL and Ross Silcock with ODA (now DFID) funding in 1991. Copies were distributed widely by DFID to planners and engineers in the developing world and it has been used as the basis for road safety activities in many countries in
recent years. The document outlines the different stages involved in planning and
designing road networks and introduces safety-conscious design principles so that
professionals and decision makers in developing countries are given guidance on how
to make their road networks safer. Separate and specific guidance is given on
"Accident Prevention" (i.e. planning, designing and building road with safety in mind)
and "Accident Reduction" which deals with the introduction of low cost engineering
improvements at hazardous locations.

The manual was originally produced in English and was intended for use throughout the
developing world. Since 1991, a Spanish version has been produced for use throughout
Latin America. With World Bank support similar manuals have been produced
specifically for use in India, based in turn on problems and issues that relate
particularly to India (Manual for Safety in Road Design, Ross Silcock Limited with
TRL, 1998).

6.3.2 Road Safety Engineering Manuals
A manual on identifying, prioritising and treating hazardous locations on roads in
Malaysia has been published by the Institut Kerja Raya Malaysia (IKRAM) under the
direction of the Director General of Public Works Malaysia (1995). This covers
investigation diagnosis, implementation and evaluation at dangerous sites in urban and
rural roads in Malaysia. Similar manuals have been developed in other countries
including Indonesia, Bangladesh and Kenya.

6.3.3 Road Safety Guidelines for the Asian and Pacific Region.
This manual was produced by Ross Silcock with TRL support, funded by the Asian
Development Bank (ADB). It formed part of a major study of road safety problems in
the Asia-Pacific region. Support for the manual came from 112 representatives from 23
countries in the region who attended a conference organised by the United Nations
Economic and Social Commission for Asia and the Pacific (ESCAP) held in Bangkok
in 1966.

The guidelines are intended to assist decision makers in the region on developing
policies for road safety.

The guidelines firstly introduce the problem of road safety in the region and then
indicates how action plans and programmes can be established. Road safety
interventions are dealt with in 14 separate sectors which cover virtually all aspects of
the problem. A smaller and separate manual was also produced specifically on the
problem of vulnerable road users and how they can be assisted.

6.3.4 Guidelines on road safety action plans and programmes

These international guidelines were produced by Ross Silcock with TRL support and
were funded by the United Nations Economic and Social Commission for Asia and the
Pacific (ESCAP). The guidelines offer advice and practical guidance on the
preparation of road safety action Plans and Programmes. They also indicate the
policies and initiatives necessary to improve activities in each sector affecting road
safety. They are part of a series of reports on road safety produced for ESCAP by Ross
Silcock with TRL support.

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6.3.5 **TRL Publications**

Apart from producing research reports on a wide range of issues dealing with transport in developing countries, TRL also produces a series of manuals of guidelines on different topics within its ‘Road Note’ series. To date, a number have been produced which deal either wholly or in part with road safety issues and these include:

- **ORN5** A Guide to Project Appraisal
- **ORN6** A Guide to Geometric Design
- **ORN10** Costing Road Accidents in Developing Countries
- **ORN17** Road Safety Education in Developing Countries Guidelines for Good Practice

Outside the ORN series TRL have also produced:

- A Manual on Road Lighting in Developing Countries
- A Guide for Drivers of Heavy Goods Vehicles in Africa (French and English version)
- A Manual on the use of the Microcomputer Accident Analysis Package (MAAP)

6.3.6 **Others**

Apart from those listed above, various developing countries have produced manuals and guidelines for use primarily in their own countries. Examples include the following:

- The CSIR in South Africa have produced a range of safety-related manuals which no doubt have relevance for other countries in the region. This includes a Pedestrian Facility Manual to plan, design and maintain safe pedestrian facilities and also a Traffic calming Manual for the promotion of pedestrian safety in urban areas in South Africa.
- An easy to use manual on traffic calming in villages has been recently introduced in Bangladesh together with guidelines on road safety audits.
- Another good example is the 'Botswana Driver Training Handbook' which was produced with the support of the Swedish government.
- In Indonesia TRL produced Interim Guidelines on Road Accident Problems and Countermeasures (Baguley, 1998) for the Road Research Development Project. This manual proposed a range of solutions for key accident types for urban links and junctions as well as rural locations. It gave a crude cost rating and an estimated percentage accident reduction for each treatment.
Extract from Indonesia Guidelines
2.1 Accident types on Urban Links - Motorcycles and NMVs

Marking for shared cycle-pedestrian way LOW COST

Segregated motorcycle lane along major highway in Malaysia HIGH COST

<table>
<thead>
<tr>
<th>Countermeasure</th>
<th>Cost Band</th>
<th>Accident reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edge lines</td>
<td>LOW</td>
<td>0 -19%</td>
</tr>
<tr>
<td>Change 4 lane road to 2 lane</td>
<td>LOW</td>
<td>~36%</td>
</tr>
<tr>
<td>Cycle schemes</td>
<td>HIGH</td>
<td>56%</td>
</tr>
<tr>
<td>Segregated cycle lane</td>
<td>HIGH</td>
<td>40%</td>
</tr>
<tr>
<td>Widen shoulder</td>
<td>HIGH</td>
<td>10 - 40%</td>
</tr>
<tr>
<td>Lane widening</td>
<td>HIGH</td>
<td>2 - 47%</td>
</tr>
</tbody>
</table>
The above list is by no means inclusive but it demonstrates that significant progress has been made in the production of guidelines which are useful for urban safety. However, the recommendations remain largely unadopted because of the institutional constraints and lack of human resources at the urban level.

6.4 Current practice
6.4.1 Road Safety Plans
Road safety plans and/or action programmes have been prepared in many countries, usually by external consultants piggy-backed on other projects. Examination of a number of local, national and regional road safety plans identifies a number of common trends. Despite their independent preparation, and consideration of specific local conditions, consistent themes emerge across both national and local plans. Road Safety plans were examined from: the PHARE countries of Eastern Europe: Albania, Bosnia and Hertzegovenia, Bulgaria, the Czech Republic, Estonia, the Former Yugoslavian Republic of Macedonia, Hungary, Latvia, Lithuania, Poland, Romania, the Slovak Republic, Slovenia; The city of Lahore, India; Sri Lanka; Zambia; and regional studies of the Asia/Pacific Region and the Latin America/Caribbean Region.

Apart from those few prepared for cities, these plans do not refer explicitly to urban conditions. Also, it must be remembered that they are plans and sometimes programmes for action, not evaluations of interventions which have proven to be effective. Many of them refer to Towards Safer Roads in Developing Countries (see section 6).

6.4.2 Common Measures
A number of common measures were identified from those plans examined. No measures were found to be common to all plans, however at least 60% of plans included the following:
- the need for a national coordinating body for road safety activities;
- improved mechanisms for road safety funding;
- monitoring and evaluation of the plan for further development;
- RTC data collection;
- engineering improvements and traffic management schemes;
- a requirement for further research into local conditions and appropriate mitigation measures;
- provision of new legislation to target problem areas identified by research;
- researched based publicity and education campaigns;
- equipment for the police, to allow them to improve the enforcement of existing traffic regulations;
- training for professionals such as the police, engineers and teachers in road safety techniques; and
- improvements to the driver training system.

It should be noted that a large number of these items are also those targeted in developed countries, on a continuous basis, to improve road safety.

6.4.3 Important Omissions
The level of detail afforded in the plans examined varied tremendously. It was evident that some were merely a list of suggestions and that little thought had been given to the
realities of implementation. Some had been prepared over a matter of days and others, weeks or months.

The most common omission was the impact on the legal system and changes required if measures from the road safety plan were to be enforceable. These plans are most often led by road safety professionals with only limited input from the local enforcement and legal authorities. As with any important scheme, stakeholder ownership is as important at a political level as a user level. Only 32 % of plans made reference to the need for lobbying and information at a political level to gain support for road safety (an essential requirement). It should be noted that lack of political support is often the reason behind the failure of traffic management measures and their enforcement, as identified in the World Bank project completion and audit reports discussed earlier in this chapter.

Considering that 50 per cent of plans made no reference to identifying the causes of the current road safety situation, and that three factors contribute most to crashes: human behaviour, vehicle condition and prevailing highway conditions; it is surprising to note:

- 40 per cent of plans made no reference to driver training improvements;
- 30 per cent of plans made no reference to the publicity of safety issues;
- 60 per cent of plans made no reference to vehicle inspection; and
- 75 per cent of plans failed to identify design standards as an important issue.

75 per cent of plans omitted the needs of the emergency rescue services, and the importance of their life saving role in road safety. Improvement of paramedic and ambulance services will reduce the mortality rate of traffic crash victims. It is recognised in the developed world that the quicker a patient is given medical care the higher their chances of survival.

37 per cent of plans made no mention of the importance of continued monitoring and evaluation. Without this the effectiveness of the individual aspects of a plan cannot be assessed, funding cannot be allocated, and improvements cannot be identified.

### 6.5 Current situation in a sample of cities

Table 6.1 briefly summarises road safety activities in a number of cities known to the authors. These cities are not necessarily representative of their continents, but give a sketch of current circumstances and actions in various parts of the world.

#### 6.5.1 Road safety management

Just as with the national level, there is a need at the urban level for a senior level body to coordinate the different organisations with powers and responsibilities over road safety. Only a few locations eg Hanoi and Bangalore in Table 6.1, were found to benefit from city level coordination. Botswana has district level road safety committees that provide local guidance. On a more informal basis, traffic police, engineers and the local road authority administration in Addis Ababa are reported to meet on a weekly basis to discuss traffic control and signing needs.

Despite being located in the capital, national organisations such as National Road Safety Councils generally will not be focused specifically on the urban situation and usually are engaged with national strategic and policy issues, such as education and publicity campaigns. They may also tend to focus on the highway situation where the
majority of road fatalities (including the larger scale crashes) and most road investment will occur.

The few city-related road safety plans identified were developed by foreign specialists on technical assistance inputs rather than local officials, save for Bangalore. Both the police and medical community in Bangalore have been active in raising safety awareness for many years and have produced a Bangalore Road Safety Agenda. National plans are not a substitute for city plans as many of the actions, including pilot projects, were focused outside urban areas on highways and little role will be specified for the municipality, one of the lead players in urban road safety.

Only in Vietnam was reference found to dedicated road safety funding (from traffic fines) at the local level. Most cities appear to pay for any safety measures out of departmental budgets and these are usually very limited. Road funds have become popular in recent years in Africa as means of paying for road maintenance and rehabilitation improvements but the potential for safety financing from these sources remains unclear. The Road Fund Proclamation in Ethiopia is the only one known to specify safety measures, along with road maintenance activities. This has made little difference to road safety as the only safety measure financed so far has been the upgrading of traffic signs in Addis Ababa. With 91 per cent of injury crashes in Addis Ababa involving pedestrians, the provision of new traffic signs, as opposed to pedestrian crossing facilities, is not expected to reduce road crashes.

Private sector sponsorship has been obtained in several of the urban areas surveyed, with substantial investment in Harare for the installation of pedestrian footbridges. The Global Road Safety Partnership (GRSP) is working closely with the Bangalore Agenda Task Force (BATF) to develop a road safety programme with substantial private sector support and already a number of schemes have been agreed for the city. These include the issuing of a signs manual in line with Indian Standards and which make special provision for sponsorship logos so that a high proportion of road signs can be financed by the private sector. Private sector support is, however, likely to be sporadic and should be viewed as a complement and not a replacement for routine public sector investment.
THE BANGALORE AGENDA

The Bangalore Agenda is born of a vision to make Bangalore the best city in India and at par with the best cities of the world by 2004-2005. This will be done as a partnership between all the stakeholders of the city: the civic bodies, corporates, and citizens.

The following will be the focus of the Bangalore Agenda: (reproduced from the Chief Minister's letter to Nandan Nilekani, appointing him Chairman of the BATF, vide CM-3098-DEP-99, dated November 20, 1999, Bangalore)

- Upgrade information systems relevant to decision-making, particularly in the areas of information technology, Geographical Information Systems (GIS) and Enterprise Resource Planning (ERP)
- Stimulate corporate and industry involvement in the city by funding maintenance of civic assets and important programmes
- Help create a massive infrastructure plan and benchmark this with the leading cities of the world in development of fly-overs, grade separators, markets, plazas, water bodies, and roads. It will also pay special attention to the requirements of the under-privileged and the socially deprived in slums and congested areas
- Help develop internal capacity of the agencies by enhancing skills, attitudes, and planning.

The BATF (Bangalore Agenda Task Force) aims to be a facilitator in this process, creating forums for cohesive and positive interaction between the stakeholders. It also intends to create mechanisms for driving transparency and accountability through the process.

This web site is one of the pillars of this transparency. It needs your involvement to realise its potential in shaping the Bangalore of tomorrow.

(from www.blrforward.org.html)

6.5.2 Data and Traffic Police/Law Enforcement

Crash data are traditionally of better quality in urban areas where police reporting is easier and computerisation more advanced. Technical assistance for crash data has also tended to start with pilot projects in urban areas where closer supervision was possible. Yet the crash data in urban areas still appear to suffer from two main problems: under-reporting and lack of application.

Although the police in Dhaka has computerised crash data for the past few years, crash data sharing with the road engineers has yet to be formalised. In Addis Ababa, Hanoi and Harare, the engineers receive standardised print-outs of crash data but do not have the data or relevant software for analysis. Road engineers in Lusaka do not yet receive any crash data from the police on a regular basis.

Traffic law enforcement is influenced by political and public pressure, which sees traffic congestion as a more immediate problem than road crashes. Traffic police resources are usually targeted at junctions and the efficient movement of motorised vehicles, with little priority given safety needs. Traffic signals do not free traffic police for other duties with many signalised junctions still under the control of traffic police. It
is rare for Traffic Police to attend to pedestrians’ needs, even at junctions. While the lack of mobility will encourage stationary duties, traffic police could be assigned mid-link pedestrian crossings instead of junctions.

Indian cities have been particularly resourceful, for example in Delhi, the police have introduced 'interceptors' in partnership with an NGO, the Institute of Road Traffic Education (IRTE) and Maruti (Suzuki) who have provided the vehicles. These vehicles are equipped with video cameras and they have proved very effective in enforcing moving violations on the spot.

6.5.3 Road safety engineering
Most cities have highway engineering units and some have staff with traffic engineering and road safety responsibilities. Lusaka is an exception where the local road engineers are not required to monitor or address the local road safety situation. Dhaka, with over 7 million people, has only recently established a traffic engineering unit and assumed responsibility for road safety. Even where traffic engineering units exist, without crash data, appropriate training in analysis and prevention, and a specifically allocated budget, the abilities of road engineers to address blackspots will be limited. In Bangalore, the City Corporation relies on the police to organise traffic management and safety improvements. In Indonesia a number of safety improvement schemes were developed for Bandung, Surabaya and Semarang under the Road Research Development Project with support from the Institute of Road Engineering and TRL. Most of the schemes were never implemented and this is a fairly common story. Inadequate ownership, institutional weakness and a lack of understanding of the budgeting and implementation process are the major problems.

Whereas several cities are noted for having introduced one-way systems in recent years, this is for traffic flow purposes rather than safety. Indeed it is probable that the increased operating speeds will increase the risk and severity of pedestrian injuries. Developing cities do not benefit from well-defined road hierarchies and urban speed limits are rarely enforced, as traffic police rarely have the means or the incentive to enforce speed limits.

Again in India, cities have obtained good private sector support for road signing and in Delhi, advertising agencies pay for installing road signs by receiving advertising revenue from the reverse side of the signs.

6.5.4 Education and publicity
Urban road safety education and publicity programmes have tended to follow the national policy, and there are rarely additional programmes specifically for urban areas. However, Addis Ababa does have traffic clubs established in almost all schools. Traffic clubs are organised by the traffic police and traffic volunteers assigned to assist at pedestrian crossings. It should be noted there is no traffic safety lessons for school children in the regional school curriculum. More publicity efforts did occur at the urban level as campaigns are often too small for national exposure. Hanoi was the only city identified which conducted separate publicity campaigns from those organised by the national road safety committee.

Harare had a small pilot project ongoing where the students of the first two grades of the schools with the worst crash record were given reflective jackets to wear. This
The institute of road traffic education (IRTE) has been active in Delhi for a number of years working in close cooperation with the Delhi traffic police, the transport department of the government of Delhi, several private sector sponsors, 39 schools in the region and parents of school children.

**Institute of Road Traffic Education (IRTE) Delhi**

Fulfils an essential role:

- Advising parents, schools and the State on their joint responsibilities and advising on how road safety education can be improved.
- Advising on improved training of school bus drivers and supervisors.
- Advising on how to make roads and the environment safer for children.
- Making recommendations for improved safety of school buses including vehicle licensing, safety and design.
- Organising workshops on the safe transport of school children and also on the improved safety of auto rickshaw and cycle rickshaws.
- Introduction of the Student Volunteers Scholarship Scheme (with support from private sector). Students receive a stipend for assisting the traffic police with traffic and safety activities and form a role model for their peers.

Many cities in developing countries have constructed off-road "traffic gardens." Apart from a few locations where they are properly staffed with full time safety instructors (eg Singapore), there is no evidence from developing countries that they have any positive effect on children's knowledge or behaviour on real roads and they are often underutilised or fail to reach the children in most need. In some cases they become playgrounds and give a potentially dangerous message to very young children that roads are places where they can play safely. However they can demonstrate a commitment on the part of city government and can help raise awareness and concern for children in traffic.

6.5.5 Community participation

The press contains many examples of violent reactions from communities when their members are injured or killed in road crashes. Examples of their involvement or participation in the development of improvements are rare but there are many instances of communities building their own speed barriers to slow down traffic. This motivation needs to be tapped and built into more rational and objective formal improvement programmes.

There also needs to be more investigation of community issues.
Thus surveys carried out by the Bangalore Agenda Task Force (BATF) indicate a concern with roads, public transport and safety and a perception that the civic authorities service is inadequate (see figure 6.1 and 6.2 below from BATF Web site).

**Figure 6.1**

<table>
<thead>
<tr>
<th>Citizen concerns</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bangalore City Corp.</strong></td>
</tr>
<tr>
<td>• Road conditions</td>
</tr>
<tr>
<td>• Garbage</td>
</tr>
<tr>
<td>• Storm water drainage</td>
</tr>
<tr>
<td>• Increase in mosquitoes</td>
</tr>
<tr>
<td>• No public toilets</td>
</tr>
<tr>
<td>• Increase in pollution</td>
</tr>
<tr>
<td>• Irregular water supply</td>
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<tr>
<td>• Poor water quality</td>
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<tr>
<td>• Stray dogs</td>
</tr>
</tbody>
</table>

*in descending order of importance*
Figure 6.2

Civic bodies - Citizen interface: Perceptions

- Bribes to lower levels clerks: 39%
- Where & whom to complain: 60%
- Long time to meet officers: 74%
- Bribe to higher level officers: 84%
- No care & concern for public: 91%

If these issues addressed, at least 1 of top 3 problems will be addressed for 91% of the citizens.
## TABLE 6.1 Urban Road Safety: Comparison of Cities

<table>
<thead>
<tr>
<th>City</th>
<th>Basic Stats</th>
<th>Road safety management</th>
<th>Action plan</th>
<th>Road safety Funding</th>
<th>Data and Traffic Police</th>
<th>Road safety engineering</th>
<th>Education and publicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dhaka, Bangladesh</td>
<td>7 m pop 533 fatalities and 1023 injuries in 1998 Pedestrian problem</td>
<td>a) No b) NRSC and some District RS Committee but not in Dhaka City</td>
<td>a) No, but draft plan produced by foreign specialist but limited local input and not yet approved b) National plan approved but little implemented</td>
<td>a) No dedicated city safety budget b) Data not transferred to city traffic safety/eng unit c) Serious under-reporting</td>
<td>a) Yes, MAAP since 6/95 b) Data not transferred to city traffic safety/eng unit</td>
<td>a) Yes, newly formed and only one staff trained</td>
<td>a) No, but proposals have been made for several junctions, b) DUTP to safety audit junction improvement schemes</td>
</tr>
<tr>
<td>Bogota, Columbia</td>
<td>7 m pop, 1073 fatalities &amp; 10,454 injuries in 1996, 71% pedestrian deaths</td>
<td>a) National road safety org. exists b) Some coordination provided by Accident Investigation Unit</td>
<td>a) Draft 5 year Plan w/focus on eng. and data</td>
<td>a) Yes, data exists for many years a) MAAP for Windows since 1999 and GIS based system</td>
<td>a) No</td>
<td>a) Yes, established in 1999</td>
<td>a) Not known for the city No</td>
</tr>
<tr>
<td>Addis Ababa, Ethiopia</td>
<td>a) 300 fatalities &amp; 3340 injuries in 1997/98 b) 91%</td>
<td>a) No, but police and engineers meet regularly to discuss traffic control and signing. No national</td>
<td>a) No b) Draft national plan proposed</td>
<td>a) Road Fund provides for RS remedial measures</td>
<td>a) Published RTC data regularly shared, but location data not monitored</td>
<td>a) No, TP assigned junction control and students help with pedestrian</td>
<td>a) Yes, but no training in RTC analysis a) City requested upgrade of traffic signs upgrade nothing specific for</td>
</tr>
</tbody>
</table>

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53
<table>
<thead>
<tr>
<th>City</th>
<th>Basic Stats</th>
<th>Road safety Coordinating Organisation</th>
<th>Action plan</th>
<th>Road safety Funding</th>
<th>Data and Traffic Police</th>
<th>Road safety engineering</th>
<th>Education and publicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harare, Zimbabwe</td>
<td>a) 2 mil pop b)</td>
<td>a) not for city b) Zimbabwe Traffic Safety Board (ZTSB) exists a) no b) no national plan but annual ZTSB works programme a) No dedicated safety budget b) Private sector sponsorship of pedestrian bridges Good RTC database Link/node coordinate but moving to x/y coordinates Some TP at pedestrian crossings, target illegal bus stops, license and speed checks Traffic engineering unit active and report on RTC situation a) 60 kph urban limit b) one-ways introduced in recent years a) undertake remedial measures a) Yes b) ZTSB active in promoting traffic safety education for children</td>
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<tr>
<td>Bangkok, Thailand</td>
<td>a) 10 mil pop b) 400 fatal c) 1500 inj</td>
<td>a)Yes b) NRSC sub-committee is chaired by MOTC Deputy Minister a) Yes a) No dedicated city budget b) 5 year National Plan estimated to cost US$250 million a) Data is computerised by the police dept. a) Yes, topics inc. safety belt, drug/drink-driving, motorcycle helmet a) Safety engineering unit in Metropolitan Authority and Police Dept. a) None except 50-80 km/hr on expressways b) hierarchy with bus &amp; contraflow lanes, express highway, and restricted zones a) not known a) yes, concentrate on traffic rules and risk of children on road safety</td>
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<tr>
<td>Yerevan, Armenia</td>
<td>a) 1 mil pop b) 26% fat, 40% inj, 44% pia,</td>
<td>a) No, only at discussion stage b) proposed NRSC yet to be established c) both existing during Soviet time a)Not specific to Yerevan b) National Plan exists little is being implemented a)not for city b) upcoming US$5 million WB load is primarily for highway improvements a) Police still using Soviet report form with minimal equipment but main focus is on checking a) Few speed checks undertaken with minimal equipment but main focus is on checking a) No separate unit with responsibility b) 40 kph but not well signed,little compliance a) Life skills programme (inc. road safety) to be statutory but only at pilot stage now. a) No campaigns b) Traffic police occasionally write articles in newspapers</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>City</td>
<td>Basic Stats</td>
<td>Road safety Coordinating Organisation</td>
<td>Action plan</td>
<td>Road safety Funding</td>
<td>Data and Traffic Police</td>
<td>Road safety engineering</td>
<td>Education and publicity</td>
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<tr>
<td>Hanoi, Vietnam</td>
<td>National Traffic Safety Council with provincial committees</td>
<td>National Plan exists but no local plan for City</td>
<td>Yes, from traffic fines</td>
<td>Data base exists in police, but not readily available</td>
<td>Traffic police enforce regulations</td>
<td>Yes</td>
<td>Speed limits not clear; little enforcement</td>
</tr>
<tr>
<td>Bangalore, India</td>
<td>National, State and City Councils exist</td>
<td>No regular city road safety plan but police active with remedial measures including road improvements</td>
<td>No specific funding but public private partnerships established</td>
<td>MAAP covers Bangalore city</td>
<td>Enforcement activity high but more needed on moving violations</td>
<td>No</td>
<td>Mixed end use and multiple access on Aerials. Day time truck ban under consideration</td>
</tr>
<tr>
<td>Lusaka, Zambia</td>
<td>a) pop b) NRSC exists but no urban equivalent or focus</td>
<td>a) not for urban b) 2 year National Plan exists</td>
<td>a) no safety funding from city b) Road Fund could finance road safety c) WB national ROADSSIP programme d) Govt funds NRSC</td>
<td>a) new MAAP form introduced in Jan 2000. b) MAAP to be installed</td>
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6.6 Summary
Current urban safety practice in developing countries was reviewed by examining the limited reports and manuals available and by pooling the authors’ experience. The key points arising were:

- Few road safety projects have focussed on urban problems or solutions but there has been an increasing emphasis on vulnerable road users, particularly those in large cities.
- There is little evidence of crash reductions from urban improvements in developing countries but there are a few promising results from junction improvements, the construction of segregated lanes for non-motorised vehicles and the introduction of speed breakers (road humps or traffic calming devices).
- The recommendations for urban road safety management are similar to those at the national level but with increased stress on the involvement of local communities and a need to link safety to the overall development of cities and the access needs of citizens.
- The introduction of urban road safety improvements has been slow and implementation is not primarily constrained by lack of knowledge but by lack of commitment and inadequate institutional capacity and funding. Forming and strengthening within institutions with a safety responsibility is essential with technical assistance being required over a long period if sustainable achievements are to be achieved.
- Partnerships for whom safety initiatives have been successful in several countries but particularly in India and these need to be built on and lessons learned disseminated through the GRSP.

7 CONCLUSIONS
This paper has focused on the urban road safety situation in developing countries, in the context of a review of urban transport policy. Most road safety reviews which have been carried out previously for the World Bank were at national levels and more multi-sectoral in their approach. This paper was limited to a desk exercise and the availability of relevant reports and data was a constraint. In the urban transport context, road safety is usually seen as a component or subset of traffic engineering. At the national level actions are often piggybacked on a highway project.

In summary, the following issues should be considered in the context of urban transport policy:

- How important is the urban road safety situation in developing countries?
- What are the particular features of urban road safety?
- How useful are the lessons from overseas?
- How appropriate is the national road safety approach to the urban situation?
- What should be done now and who should be responsible?

7.1 Importance of urban road safety situation in developing countries
A recent study undertaken by TRL for the GRSP (Jacobs and Aeron-Thomas, 2000) found that, in 1999, between 750,000 and 880,000 people died in road crashes, worldwide. Between 23 and 34 million were injured. Of these totals about 85% occurred in the developing world.
This review of the crash data from several African and Asia countries found between 36 and 69 per cent of all crashes involving injuries to occur in urban areas. When damage only crashes are included, urban areas account for an even greater share, as seen by Latin America where 58-95 per cent of all road crashes occur in urban areas.

The overall problem is even worse than the official statistics indicate. Recent research has found under-reporting to be extensive in many cities and there is a risk that women and children may be the least well reported of all road casualties. It is also probable that the urban poor bear a disproportionate burden of the consequences.

The GRSP review also showed that, over the last 15 years or so, road deaths have continued to increase in the developing world: in Asia by almost 80% and in Latin America and Africa by 40%. Conversely, industrialised countries show a decrease of about 20% over the same period.

These facts and trends are not new, but it is depressing that so little appears to have been done to deal with the problem. A number of reasons can be postulated for the relative lack of action and investment in road safety in general, and urban road safety in particular, in the developing world. Whilst there is a general understanding of the scale of the problem, it is not one of the priority areas of most government departments. Furthermore, road safety crosses many traditional departmental boundaries; coordination is difficult and investment by one department to achieve savings for another is rare. In other words road safety remedial measures often 'fall through the cracks'. Another reason may be that problems involving human behaviour (as does road safety) are more difficult to tackle and there may be a reluctance to invest in measures which are not perceived as offering benefits by the general public - particularly if the actions are seen as imposing restraints, for example through strict enforcement of traffic laws. It is also true that road safety projects are not seen as offering prestige to decision makers in the same way as infrastructure projects.

In an urban context these problems can be compounded by the presence of another layer of local government, often with limited resources to address the many problems facing its rapidly expanding population.

7.2 **Particular features of urban road safety**

Vulnerable road users (pedestrians and two-wheeled vehicle riders) dominate the urban situation. Apart from the wealthier countries (Malaysia and Botswana in the data considered here), about a third or more of the casualties were pedestrians. The majority of these will come from the poorest communities in the city.

Two thirds of urban casualties are motorcycle riders/passengers in Kuala Lumpur and urban Malaysia, whereas three-wheel motor vehicles injured 22 per cent in Dhaka. Such figures reflect the different traffic mix. Four wheel motor vehicles account for three-quarters of all urban casualties reported in Botswana and between 15-64 per cent in other countries for which data are available.

Approximately two-thirds to three-quarters of all urban road crash casualties are male. The lowest female casualty involvement rate is in Malaysia (16%) whereas the highest is in Kumasi, Ghana (30%). Three-quarters of all urban RTC casualties were aged between 16-50 with the largest number between 17-34 years. Thus most of the victims
are breadwinners for their families and road crashes have a disproportionate impact on family livelihoods.

Two-thirds or more of reported urban crashes involving injuries occur on links in the road network, i.e., away from junctions, a markedly different situation than in western Europe. Relatively few crash locations are those where there are any traffic controls, including traffic police. Crashes involving pedestrians dominate the collision types in the large majority of countries.

The findings of the analysis reported here have confirmed previous understandings rather than offered any major surprises. Although most urban casualties are male and of prime working age, the vehicle types involved (and thus the drivers) vary widely. Regardless of the vehicle type involved, most urban crashes are reported to occur away from junctions where the traffic control facilities, i.e., signs, signals and police, are concentrated. This leaves the concern that traditional traffic engineering measures and police enforcement strategies which tend to focus on junctions, may well be of somewhat limited relevance to reducing casualties from road crashes in villages, towns and cities in developing countries.

7.3 Lessons learned from developed countries
Overall, road deaths and serious injuries, and hence fatality rates have been reducing in most industrialised countries over a number of years, due to the cumulative effect of a range of interventions. This reduction comprises a large decrease in vulnerable road user casualties, coupled with a decrease in vehicle occupant casualties.

A comprehensive approach, based on a road safety plan for the town or municipal area, is needed. Such a road safety plan often stems from a national strategy with clearly defined casualty reduction targets; the local plan is a means of delivering to the target at a local level.

The comprehensive approach involves the close cooperation of various authorities with responsibilities for the different aspects of road safety activity, primarily: highway and traffic engineers; traffic police; those with responsibility for education and publicity; health authorities and emergency services; and the local communities. Given the complex nature of road safety, involving the interactions of diverse human behaviours with a wide range of road environments and vehicle characteristics, it is essential that a comprehensive and coordinated approach be adopted.

Site specific remedial treatment is effective in dealing with clusters of vehicle/vehicle crashes and some crashes involving pedestrians. Pedestrian and pedal cycle crashes tend to be more dispersed and so require an area-wide approach for effective treatment. In the West the need for a more comprehensive approach has grown, as successful blackspot programmes have reduced the proportion of crashes concentrated at single locations. There is a strong relationship between traffic speeds, crashes and injury severity. Thus speed enforcement and area-wide speed limits are effective in reducing crashes. For zones with a speed limit lower that the standard, the casualty savings are even greater, particularly for pedestrians.
Some countries have introduced special legislation to reduce the priority of motorised vehicles over other road users in residential areas (such as Woonerven), in addition to applying lower speed limits.

Traffic calming schemes, which reduce traffic speeds and generally provide facilities for pedestrians and other vulnerable road users, have been proven effective in reducing crashes in many industrialised countries.

There is a consensus in developed counties that the next step needed to achieve even greater urban road safety is a management process which addresses the whole of the road network in a defined urban area. It is a strategic approach that needs to be integrated into other urban planning and development strategies. Whilst this has been accepted at a technical level for some years, for largely political and financial reasons, the implementation of area-wide approaches are, so far, few in number.

Road safety in the West has been advanced with the help of defining road hierarchies. These seek to match the use and operating speed of roads to the surrounding land uses. The situation is often quite different in developing countries where road space is much more scarce and land pressures often much greater. Also, there is a greater recognition of the need for a balance between mobility and safety, particularly in the allocation of road space to non-motorised users. In developing countries, by and large, growing motorisation and catering for vehicle growth is paramount.

It should also be remembered that the responsibility for improving road safety has been made a mandatory duty for local authorities in most industrialised countries. This happened in 1974 in the UK. Like road engineers in LDCs today, many engineers in the West had to be pushed into accepting this additional role and this statutory duty proved a major step forward in developing remedial measures programmes.

Community pressure and its involvement in pressing for road safety improvements is more highly developed in the West. In developing countries, crash data reveal the vulnerability of the poor to road crashes. But not only is their risk much higher, but they will also be less likely to organise any protest or campaign. With resources tending to go to those who press hardest, special effort will need to be made to avoid overlooking the road safety needs of the poor.

More recently public and private partnerships for urban development have come to the fore. The Global Road Safety Partnership (GRSP) initiated by the World Bank Group has started a number of demonstration projects involving business partners. Bangalore provides an excellent example of a strong city development programme involving local industries.

7.4 Relevance of National Approach
The standard approach to improving road safety in a country is first to target the national level. National bodies (for example a National Road Safety Council) are established to develop action plans and strategic programmes and oversee their implementation. Much of the work appears to be targeted at the policy or regulatory level. Despite national coordinating bodies being located in the capital, there appeared to be little emphasis or appreciation of the local safety needs. As a result little attention is given to urban problems, particularly outside of the capital city.
Furthermore, much of the early road safety work in developing countries is associated with technical assistance inputs on highway rehabilitation projects that are concerned with the national and regional highways, and not areas under municipal control. Indeed, even where national routes pass through cities, those sections often are ignored as they fall under a local authority’s jurisdiction rather than the national road authority.

A review of national safety plans found little focus on the urban situation. As with the national coordination organisation, the priority was on establishing appropriate procedures and policies at the over-riding national level. Pilot projects were located in both urban and rural areas. While any improvements to the crash data system are usually begun in the capital where monitoring can be undertaken, the urban situation seems to have benefited little from this. There is still a widespread problem with the local road safety/traffic-engineering unit not receiving crash data (including location details) on a regular basis. In other words, little cooperation actually takes place between the police (who are responsible for collecting crash data) and the local engineering unit who need to use the data to meet their responsibility for identifying and treating dangerous locations.

A separate but related issue is the extent to which road safety is already being addressed in urban transport projects. Based on limited information, it appears that road safety is not being systematically addressed and that many of the problems which were identified many years ago (e.g., lack of crash location data, no targeted enforcement campaigns, lack of accountability at both municipal level and within the roads section) remain concerns.

It seems that the historic concentration on national policies and programmes has not served the urban areas at all well.

7.5 Summary: The Way Forward
Comprehensive urban road safety management remains an ideal and even in Europe there are few examples yet of successful implementation on a town or city-wide basis. Experience has shown there is a risk of multi-sectoral plans remaining as good ideas, but not being properly, or even partially, implemented. With this lesson in mind, the focus here is on getting the responsibility for urban road safety integrated into urban transport programmes. If coordination and comprehensive action remains the ideal, in the short term it is better that at least one body acts, rather than none.

Political will to do so is essential, and this must stem from increased public awareness of the scale of the problem. Community participation is needed not only to influence political decisions, but as few laws are self-enforcing, voluntary compliance has to be the aim. Community participation should be sought, not only in the implementation of remedial measures, but also in the identification of local priorities and the choice of interventions.

In parallel with efforts to raise political and public awareness, progress can be made at a professional level. Many road safety activities have been initiated by the donor agencies that have supplied technical assistance. Given the wide-ranging needs, inputs have tended to be short and often limited to the introductory appraisal stage. Some projects have included training courses but it is not just the lack of local technical skills
that needs correction. The objective should be the development of institutions that value and apply the technical skills of crash analysis and prevention. This may well require long term support to achieve, recognising that trained local staff become valuable assets who often change jobs and move away from their original responsibilities.

Road authorities (within municipalities) should assume the lead responsibility for road safety. Well-designed local road safety engineering schemes are known to be effective and are often relatively low cost.

Road safety engineering should not be assumed to be the same as traffic engineering. Whilst both stem from the same root, maximising safety for all road users is not the same as maximising road capacity for motorised traffic. Ultimately politicians must choose how to allocate scarce resources between what may be two competing aims, but the decision should be an informed one. Professional advice on each should be available from specialist unit(s) in local government.

The traffic/safety-engineering unit will need to monitor the crash situation on their roads and they will require crash data, especially location details. Joint training of police and road engineers in crash analysis is believed to improve working relationships.

As important as official police data are in establishing location patterns, it will only include a fraction of road crash casualties. Road casualty data should also be collected from the main hospitals. A simple computerised medical records system should be introduced and maintained in the key hospitals with casualty departments. The burden needs to be measured explicitly, in terms of hospitalisation, bed patient days, or operations required.

A safety culture within the road authority should be developed with other units such as maintenance and planning learning how they can contribute to the reduction of crashes. Road-user safety should be the responsibility of the road authority as a whole, and all units, not just that of traffic/safety engineering.

Most local government agencies are desperately short of funds. Road user charges are used in some countries to raise funds for maintenance and road safety activities. Such mechanisms are usually national in scope and do not necessarily benefit the urban authorities. Mechanisms need to be identified which can collect and channel local road user charges back to the areas from which they are derived in order to invest in road safety improvements.

Some countries, particularly India have been innovative in creating partnerships between government, NGO and private sector organisations to implement urban safety projects in engineering, enforcement and education. Such approaches are being promoted through the GRSP and the lessons learned need to be disseminated widely to facilitate take up worldwide.

Road safety measures themselves should be focused on improving the safety of the vulnerable who will largely come from the poorest sectors of the community. This will invariably mean improving the provision of road facilities for pedestrians and two-wheelers, reducing speeds of motor vehicles and improving the safety of bus and
paratransit operations. Changes in knowledge and behaviour need to be addressed through the needs of the target groups and not by top down approaches alone.

Urban road safety improvements can be initiated ahead of national development but the focus should be on improving the safety of high risk groups or locations using an integrated approach with stakeholder participation. Ideally the safety initiatives should also be integrated within the development policy of cities. The vision for the city and its development and transport plans, including integrated transport policies, should all consider traffic safety. Thus the building of ring roads and mass transit systems, the development of integrated transport systems and the legislation of day light restrictions on truck movements are likely to have major safety benefits for city road transport networks. They will also allow the space for the introduction of traffic calming and provide greater freedom of movement for the vulnerable road users. In addition the improved provision of the key facilities required by the urban poor closer to their communities will not only make access easier but also reduce their exposure to the risk of being involved in road crashes.

Above all there is a need for research and development to determine how the above recommendations can be brought together in an effective and appropriate management approach and to find ways of improving road user behaviour through community involvement. Road safety innovations should be evaluated and the success and failures documented and disseminated so that many benefit from the lessons learned by a few.

Finally, we list below opportunities for road safety interventions which could be used within urban transport projects. We stress that these are mostly based on the authors opinions rather than on proven effectiveness. Whilst some have been tried, few have been monitored sufficiently to establish their benefits.

**Urban Land Use Planning**

- Land use planning aims to reduce the number of motorised trips and also trip length
  - Segregate functions of access and movement to create safer road networks
  - Ensure good local planning of parking and circulation and design to be as self enforcing as possible
  - Have local plans checked for road safety implications and impacts
  - Introduce and strictly enforce access control procedures
  - Introduce and strictly enforce development control procedures
  - Train engineers and planners in safety conscious planning of road networks and land use
  - Establish Consultation procedures so that traffic safety engineers have opportunity to comment on any proposed development accessing onto a public road.

**Infrastructure improvements**

- Carry out a safety review of existing road networks to identify deficiencies and potential hazards
♦ Introduce a formal Safety Audit of proposed new roads to maximise safety for all road users.
♦ Establish a road safety unit with a brief to identify and improve hazardous locations.

Traffic Management

♦ Establish road hierarchy to minimise conflicts between access and movement needs and between types of road user
♦ Provide safe routes, networks and areas for pedestrians, cyclists and NMVs
♦ Introduce crash prevention activities (safety audit, access control, road user education)
♦ Introduce crash reduction activities at hazardous locations (accident blackspots, route action plans, area-wide action plans, mass action plans)
♦ In major cities where good enforcement capacity and prosecution systems may already exist consider new technology such as red light cameras and speed cameras

Transport operations

- Public Transport -
  - special defensive driver training courses for drivers based on needs assessment
  - safety checking of bus stops and pedestrian routes to bus stops
  - increased enforcement of overloading regulations
  - regulation of public transport driver hours
  - recording of violations and crashes against the operator/owner and removal of operator licence if persistent offender.
  - introduce a rewards system for safe drivers
  - regular road-worthiness checks
  - provide safer transport to school
- Heavy Goods Vehicles
  - special defensive driver training courses for drivers based on needs assessment
  - safety checking of loading methods and hazardous goods
  - increased enforcement of overloading regulations
  - regulation of HGV transport driver hours
  - recording of violations and crashes against the operator/owner and removal of operator licence if persistent offender.
  - regular road worthiness checks at least twice yearly
- Insurance
  - strengthen insurance regulations
  - use insurance premiums to promote safer practices

Institutional strengthening for road safety

- Establish municipal road safety committee (MRSC) under the Mayors office
- Establish small permanent secretariat to service the MRSC
• Establish a computerised crash data system at the Police HQ with copies of processed data being made available to road safety unit and the MRSC Secretariat.
• Introduce mobile traffic police patrols on motor cycles or in cars and focus on moving offences
• Where finances preclude mobile patrols, set up small task force to carry out frequent roadside law enforcement exercises at different locations on the major roads of the city.
• Establish and train a safety unit in the City Engineers office to oversee safe operation of the city road network
• Develop safety audit and access control procedures and train local staff as trainers and practitioners.
• Develop local versions of guidelines, such as *Towards Safer Roads in Developing Countries*, Safety Audit Manuals and other safety guidelines
• Develop sustainable capability to train road safety professionals

**Improve the Policy and Regulatory Environment**

• Legislate to give statutory responsibilities to City Roads authority to improve road safety and to report annually (with statistics) on trends and achievements
• Legislate to require roads authorities to exercise access and development control on their road networks and ensure enforcement powers are adequate
• Develop access and development control procedures requiring all connections to public roads to be submitted to roads department for safety and traffic checking
• Examine existing traffic laws, prosecution system and fines/penalties to ensure it is a sufficient deterrent. If ineffective, introduce the necessary changes to make it effective
• Seek innovative ways to finance improvements in traffic police staffing and operational budgets. Consider options to apply some of the traffic fines collected to fund more enforcement equipment or enforcement activities. Legislative changes may be required to permit this

**Education and publicity**

• Introduce road safety into schools curricula
• Establish capability to deliver road safety publicity campaigns within the urban areas
• Develop community education programmes

**Safe Communities**

• Introduce the concept of safe communities and develop model communities with a strong desire for a safe environment

**Partnerships**

• Encourage the involvement of businesses and civil society in road safety programmes for example:
- sponsorship of road signs, bus bays and road safety education and publicity
- emergency vehicles and improved visibility of vehicles
- sharing of training resources for drivers
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