Chapter 16 Road Safety

16.1 Nature and Scale of Traffic Accident–Risks

About three quarters of traffic injury accidents and nearly half of fatal accidents occur in built–up areas, ie on roads subject to speed limits up to and including 40 miles/h (DOT, 1995). The complexity of the urban environment leads to many conflicts between road–users, especially at junctions, which account for more than two–thirds of all urban accidents.

Outside town centres, up to one half of all accidents occur on primary and district distributor roads and about one quarter each occur on local distributor and residential access roads. Accidents may form clusters, at particular places of conflict or be concentrated on some busy lengths of road but in many parts of the road network, especially on residential roads, they are more scattered.

The numbers of deaths, seriously injured and all casualties reported for different classes of road–users in 1995 are given in Table 16.1. These figures relate to injury–accidents reported to the police but many accidents go unreported. Comparisons of police data with reports from Accident and Emergency departments of hospitals (James, 1991) indicate that only 76% of seriously injured and 62% of all casualties are reported in the national statistics. Thus, the true figures for casualties in urban areas are likely to be of the order of 37,000 seriously injured and 350000 in total.

Pedestrians are the most vulnerable road–users, making up over half of the deaths in urban areas. A further quarter of deaths are amongst car–occupants. The position is reversed for injuries, with car–occupants making up over one–half and pedestrians one–fifth of casualties. The vehicles involved in the largest numbers (over three–quarters) are cars.

The risk of becoming a casualty, per kilometre travelled in urban areas, is highest for pedal cyclists and riders of two–wheeled motor vehicles (of the order of 645 and 750 per 100 million vehicle–km respectively) and next highest for pedestrians (410 per 100 million vehicle–km walked), compared with 73 per 100 million vehicle–km for car occupants (Ward et al, 1994).

Categories of reported accidents and casualties in the UK (1995)	**Built–up roads**			**Non–built–up roads**	**All roads**
	Fatal	**Serious**	**Total (all categories)**	**Total**	**Total**
Accidents	1,438	25,785	169,716	53,254	222,970
Vehicles involved	2,046	40,666	298,127	100,072	398,199
Casualties	1,497	28,430	214,970	83,667	298,637
Sub–division of casualties					
Pedestrians	797	10,537	44,972	1,939	46,911
Pedal cyclists	115	3,109	22,599	2,299	24,898
Two wheel motor vehicles	162	3,793	17,050	6,050	23,100
Car occupants	390	9,692	116,831	67,252	184,083
Bus or coach occupants	8	639	8,170	909	9,079
Light goods occupants	12	399	3,654	2,894	6,548
Heavy goods occupants	9	153	999	1,762	2,761
Others	4	108	693	562	1,257
Totals	1,497	28,430	214,970	83,667	298,637

Table 16.1: Numbers of Reported Accidents and Casualties in 1995. Source: DOT (1996a)

16.2 Factors Contributing to Accidents

Most accidents are due to a combination of factors relating to human failings, road deficiencies and vehicle defects. In depth multi–disciplinary studies have shown that human factors contribute in 95% of accidents in urban areas, road factors in about 20% and vehicle factors in one percent. The interaction between human failings and road features has important implications for applications of remedial measures to aid and influence road–users.

A comprehensive study in Leeds (Carsten *et al*, 1989) identified the main failings amongst drivers, which precipitated the accidents, as failure to give way, lack of anticipation, loss of control, wrong positioning and improper overtaking. The underlying reasons are, mainly, going too fast or following too close, perceptual errors (failing to look or see) and errors of judgement. These driver–errors are compounded by adverse features of road design, such as unsuitable layout or poor visibility, slippery roads and obstructions due to parked or stationary vehicles.

In accidents involving pedestrians, failures amongst both pedestrians and drivers are evident. A high proportion of pedestrians fail to give way, in circumstances where it is not possible for drivers to anticipate their actions. In other accidents, both drivers and pedestrians misjudge the situation or fail to see the other. Parked or stationary vehicles play an important part through obscuring inter–visibility between drivers and pedestrians.

16.3 Legislation and Obligations

The two most important statutory duties that are relevant are the Highways Act 1980 (HMG, 1980) [Sa] and the Road Traffic Act 1988 (HMG, 1988).

The Highways Act 1980, section 41(1) [NIa] [Sb], places a statutory duty–of–care on the Highway Authority towards road–users of all kinds:

- ❑ 'The authority who are for the time being the Highway Authority for a highway maintainable at public expense is under a duty, subject to subsections 2 and 4 below, to maintain the highway.'

The Road Traffic Act 1988, section 39(3) [NIb], makes provision for the Highway Authority to carry out studies into accidents and to take steps to both reduce and prevent accidents:

- ❑ '…each local authority must carry out studies into accidents arising out of the use of vehicles on roads or parts of roads, other than trunk roads, within their area';
- ❑ '...must, in the light of those studies, take such measures as appear to the authority to be appropriate to prevent such accidents...'; and
- ❑ '...constructing new roads, must take such measures as appear to the authority to be appropriate to reduce the possibilities of such accidents when the roads come into use.'

Recommended good practice is provided by three IHT Guidelines; namely, those on Accident Reduction and Prevention (IHT, 1990a), Urban Safety Management (IHT, 1990b) and Road Safety Audit (IHT, 1996), which are discussed in Sections 16.7, 16.8, and 16.11, respectively

The Highways Act 1980, section 58 [NIc] [Sc], provides the defence to a claim that a Highway Authority has taken such care as is reasonably required:

'In an action against a highway authority, in respect of damage resulting from their failure to maintain a highway maintainable at the public expense, it is a defence (without prejudice to any other defence or the application of the law relating to contributory negligence) to prove that the Authority had taken such care as in all the circumstances was reasonably required to secure that the part of the highway to which the action relates was not dangerous to traffic.'

It is likely, therefore, in a case against a highway authority, that the argument will be based on whether reasonable care has been taken by the Authority to protect road–users. In this respect, authorities could be judged on the basis of respected published advice.

16.4 Government Policy and Local Authorities' Code of Practice

Government policy

The main thrust of government policy in the 1990s has been the determination to achieve the target, set in 1987, of reducing accident casualties by a third by the year 2000, compared with the annual average for 1981–85 (DOT, 1987) [NId]. The first monitoring report set out the implications of the targets for particular groups, ie 40% reduction in deaths and serious injuries for pedestrians and child cyclists; 60% in deaths and 65% in serious injuries for motorcyclists; and 50% in drink–related deaths and serious injuries (DOT, 1989). These groups are particularly relevant in urban areas.

The strategy for achieving the casualty–reduction targets focuses on four key areas for improvements in

Situation	Remedial options	Potential savings in accidents
Wet Road		
❑ skidding or loss of control	anti–skid treatment to restore micro–macro texture	30% – 60% (80% on wet road)
❑ darkness	improving surface texture	no figures available
❑ spray obscuring visibility	restore macro texture	no figures available
❑ poor delineation	texture of markings to contrast with road surface	no figures available
*For details of road surface treatment benefits see County Surveyors' Society, Report 1/5 (CSS, 1988)		
Darkness		
❑ lit road poor luminance	improve quality; match surface texture with lighting	30% – 50% dark
❑ unlit road	instal lighting	30% – 50% dark
	or delineate with reflectorised lane and edge markings	50% – 70% dark
*For details of road surface treatment benefits see County Surveyors' Society, Report 1/9 (CSS, 1990)		
Running off road		
❑ cross carriageway		
or down slope	safety barriers	15% fatal or serious
❑ hitting rigid object	safety barriers or crash cushions	15% – 65% in severity
Junctions		
❑ excess conflicts	instal roundabout	30%–40% at small or mini
		40%–60% fatal or serious
	instal traffic signals: new turn facility, phasing	10%–50%
❑ turning traffic	traffic signals	30% – 50%
	waiting lanes or 'ghost islands'	20% – 30%
❑ overshoot from minor road	traffic islands in minor road	50% – 80%
❑ overshoot at roundabout	yellow bar markings	50%
❑ running red lights	camera detection	20% – 60% red light running
❑ restriction of sight	realign or relocate junction or remove obstruction	no figures available
*For details of roundabout or traffic signal benefits see County Surveyors' Society, Reports 1/4 and 1/6 (CSS, 1987 and 1989)		
Excessive Speed		
❑ too fast for conditions	camera detection	30% – 40%
	traffic calming (specific roads)	up to 70%
Vulnerable road–users		
❑ cyclists	cycle lanes or tracks	20% (30% pedestrians)
❑ pedestrians		
in road	controlled crossings	20%
stepping out	guard–rails	10%
obscured by parked vehicles	controls on parking	no figures available

Table 16.2: Accident situations and remedial options.

safety: vulnerable road–users; influencing drivers' behaviour; vehicular safety; and roads. The Road Safety Report 1995 (DOT, 1995) [NIe] identifies the range of measures being taken, or planned, to make roads safer and acknowledges the major contribution of organisations outside central government; namely, local authorities, the police, motoring organisations, the insurance industry, schools and colleges, the motor manufacturing industry, private sector firms and voluntary organisations.

By 1995, it became clear that it was time to review and to consider developing new targets, far beyond the year 2000, building on the limited success of the original target. An essential element of setting targets is the identification and quantification of measures which will have impact on reducing casualties to different groups of road–user in different road environments. Options for developing further targets were set out in a consultative conference Targets 2001: Where do we go from here? led by the Parliamentary Advisory Council for Transport Safety (PACTS, 1995).

Local Authority Associations' Road Safety Code of Good Practice

The role of local authorities in reducing road casualties is crucial. Those having highway powers are responsible for almost 96% of the total mileage in Great Britain. These roads carry nearly 70% of all traffic and account for 86% of all accidents. Local highway authorities have a prime responsibility for reducing death and injury on the roads. Those local authorities without such powers can also assist road safety, both directly through their various services and indirectly by influencing public opinion and attitudes.

The Code of Practice was developed by the Local Authority Associations in 1989 (LAA, 1989) to underline the considerable importance which they attach to road casualty reduction. This was against the background of support for the Government's casualty reduction target. The strategy recommends action by local authorities in seven key areas: road safety planning; information; engineering; road–user education and training; enforcement; encouragement; and co–ordination of resources. The essence of the Code is the provision of an integrated road safety service.

Revision of the Code (LAA, 1996) was made to allow for the changing level and nature of responsibilities, consequent on the reorganisation of local government, and the wide application of compulsory competitive tendering (CCT). It reinforces the Association's determination to continue to achieve a substantial improvement in road safety in the foreseeable future.

16.5 Collaboration between Agencies

The multi–disciplinary nature of road safety requires that there is strong collaboration across many boundaries of responsibility, both within local authorities and with outside organisations.

Each of the professional disciplines involved in engineering, education and enforcement should work together. The prime responsibility for promoting co–operation rests with the Local Highway Authority, to establish organisational arrangements and to ensure co–ordination between the various services involved in the road safety [NIf] strategy. Internally, this involves accident investigation, road safety engineering and road safety education staff. Externally, it involves liaison with local education authorities, teachers and the police. Voluntary workers also have an important part to play.

A new dimension to co–operation in road safety was added, in 1992, when the Department of Health announced its strategy for the Health of the Nation (DOH, 1992), with accidents being one of five key issues (DOH, 1993) [Wa]. Targets have been set for reducing deaths by the year 2005 for three age–groups: children (under 15 years); young people (15–24 years); and the elderly (65 and over). A major proportion of these deaths arise from motor vehicle accidents: 50% for children; 75% for young people; and 20% for the elderly. While acknowledging the need for 'healthy alliances', health organisations do not necessarily recognise the experience, expertise and application of successful measures within the highways and transportation fields. Thus, it is important that local highways authorities also take prime responsibility for involving health workers in their strategic plans.

16.6 Public Perception and Attitudes

Perception of risk

While risks of accidents and injuries can be quantified, to identify priority needs and remedial actions, it is the perception of risk as seen by individuals, rather than the actual risk, which frequently determines the acceptability or success of countermeasures. False perceptions of risk may hinder progress towards improving road safety.

Perceived risks are biased by the drama of the accident or by aggressive driver behaviour. The relatively rare occurrence of a multiple pile–up on a motorway or a multiple–fatality coach crash attracts more press publicity than the thousands of road–users killed in urban areas each year. Likewise, 'road rage' and 'joy–riding' make headlines, yet in–depth studies have shown that aggressiveness contributes to only about two per cent of accidents. In consequence, there is public demand for resources to be devoted to such problems at the expense of treatments in areas where returns are likely to be far greater.

It is important to keep the public informed of objective assessments of accident risk, the potential of different remedial measures and how priorities for action are determined. At the same time, a better understanding of road–users' perception of risk, risk–assessment and risk– taking behaviour can lead to more effective remedial measures, especially through education.

Attitudes to risk

Attitudes to risk and the expectation that road–users have of the safety of the road system are increasingly influential in determining the acceptability of proposed countermeasures. While the balancing of resource costs and potential benefits are important considerations in determining needs and priorities, it is attitude to risk, which is subjective and unpredictable, that can sway the balance in decision–taking one way or the other. Public participation in local road safety schemes is an essential part in promoting road safety, to explain the risks and the relevance of the proposed action, to identify any incidental consequences, to listen to their concerns and to allay their fears.

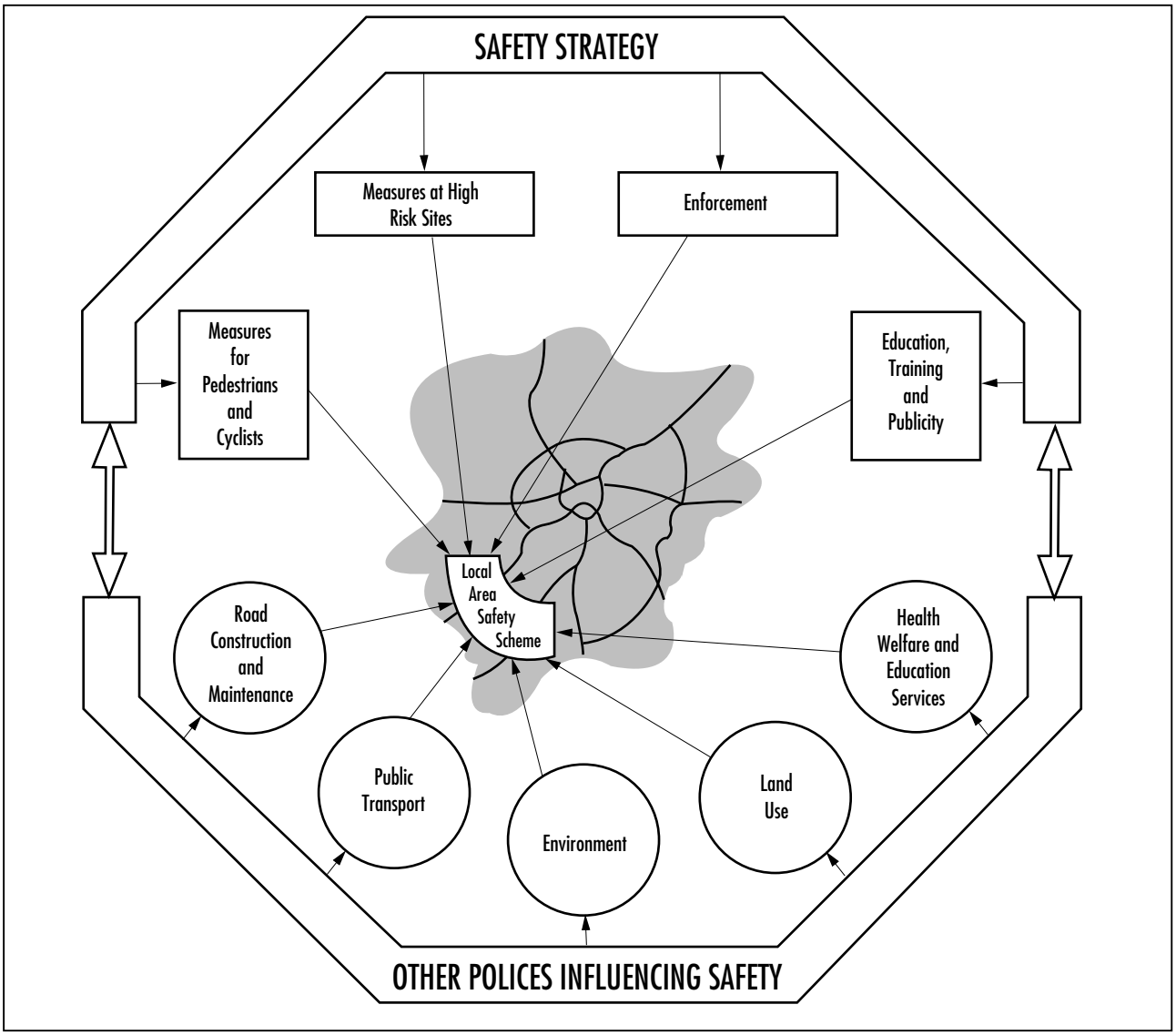

Figure 16.1: Strategy for urban safety management.

16.7 Urban Safety Management and Road Safety Plans

Urban safety management (USM) is the term used to describe a structured approach to accident prevention and casualty reduction. It can help authorities to develop road safety plans and to implement the LAA Road Safety Code of Good Practice (LAA, 1989 and 1996).

Urban Safety Management Strategy

A strategy for each urban area as a whole allows national, regional and local targets for accident reduction to be reflected in specific safety initiatives. These initiatives need to be related to wider policies for the area, balancing safety, traffic, environmental and land–use objectives. The strategy allows for consistent local safety objectives to be developed for each part of the area.

In terms of local area–wide safety schemes, the strategy approach is based on the Urban Safety Project carried out by the Transport Research Laboratory and two Universities, in collaboration with five local highway authorities (Mackie *et al*, 1990). This showed that, if a new approach to reducing accidents were adopted nationally in urban areas, about 15,000 injury–accidents could be avoided each year.

The IHT Guidelines on Urban Safety Management (IHT, 1990b) proposed that local highway authorities adopt a safety management strategy for each of their urban areas and they describe the use of modest highway and traffic engineering measures, akin to traffic calming (see Chapter 20), to improve road safety on an area–wide basis through local area safety schemes.

Safety Management within each Urban Area

Within each urban area, the aim should be integrate all activities affecting safety. Both the direct effects of safety programmes and the indirect effects on safety of other policies should be taken into account. Having developed an area strategy, more detailed studies are needed to develop safety objectives for each local area (see Section 16.10). The strategy is represented in Figure 16.1.

Principles of good safety management

The potential for reducing deaths, injuries and damage in accidents on urban roads and helping people to feel safer in traffic can be realised by applying ten principles. These are:

- ❑ to consider all kinds of road–user, especially the most vulnerable;
- ❑ to consider the functions and use of different kinds of road;
- ❑ to formulate a safety strategy for each urban area as a whole;
- ❑ to integrate existing accident–reduction efforts into the safety strategy;
- ❑ to relate safety objectives to other objectives for the urban area;
- ❑ to encourage all professional groups to help to achieve safety objectives;
- ❑ to guard against adverse effects of other programmes upon safety;
- ❑ to use the scarce expertise of road safety specialists effectively;
- ❑ to translate strategy and objectives into local area safety schemes; and
- ❑ to monitor progress towards safety objectives.

Implementation of good safety management

The focus for the implementation of good safety management is the adaptation of the way in which the road network is perceived and used. The process involves four steps:

- ❑ to identify the current and possible future hierarchy of primary and district distributors, local distributor and access roads, together with associated pedestrian and cycle– routes;
- ❑ to appraise the extent and characteristics of all recent accidents and the public perception of safety on all parts of the network;
- ❑ to assess traffic flows and performance on each route, in relation to the functions expected from its role in the hierarchy; and
- ❑ to set safety objectives for each part of the road network.

Road safety plans

Development of a road safety plan, setting out a strategy for casualty–reduction, is a key recommendation of the LAA Code of Good Practice. Furthermore, such a plan is now expected to accompany any application for funding for local safety schemes by the Department of Transport.

Road safety plans provide a means of stating, clearly, objectives, targets and actions. They almost invariably cover the role of road safety officers and of safety engineers but may extend to other departments. They should also monitor progress. A guide to good practice has been developed on the basis of the experience of local authorities throughout England, Scotland and Wales (Oscar Faber TPA, 1993).

Category of road	(Pedestrian casualty–rate per 100 million–km walked)			
	All ages	Children		Elderly People
		5–9 years	10–15 years	65+ years
Primary and district distributor roads	1026	1981	3634	2067
Local distributor roads	487	2027	883	310
Residential access roads	164	475	375	146

Table 16.3: Pedestrian casualty–rates on different types of road. Source: Ward *et al* (1994).

16.8 Accident Analysis and Investigation

A systematic approach to accident analysis and investigation makes best use of resources for improving road safety. The basis for the management of such a system is outlined in the IHT Guidelines Accident Reduction and Prevention (IHT, 1990a). The objectives are:

- ❑ the application of cost–effective measures on existing roads, as a basis for accident reduction; and
- ❑ the application of safety principles in the provision, improvement and maintenance of roads, as a means of accident prevention.

The former is achieved through detailed accident investigation and the latter through the operation of a safety audit (see Section 16.11).

Accident investigation essentially comprises a phased operation of:

- ❑ identification of problems from accident analysis;
- ❑ diagnosis of sites and situations;
- ❑ selection of treatment;
- ❑ design and implementation of measures; and
- ❑ evaluation of net benefits;

The basis of the structured system is the use of four main approaches, set out below.

- ❑ **Single sites**: treatment of specific sites or short lengths of road at which accidents cluster.
- ❑ **Mass action**: application of a particular type of remedy to locations having common accident factors.
- ❑ **Route action**: application of remedies to a length of road having above average accident–rates for that type or class of road.
- ❑ **Area action**: aggregation of remedial measures over an area with an accident–rate above a pre–determined level.

All these actions are appropriate to urban situations. Their application in Local Safety Schemes and relative returns are indicated in Section 16.10.

Detailed procedures, including techniques for investigation, effectiveness of available remedial measures and needs for monitoring and evaluation are laid down in RoSPA's Road Safety Engineering Manual (RoSPA, 1992). A summary of accident remedial measures appropriate to different situations and an indication of potential savings in accidents is given in Table 16.2. Other sources of information on the safety benefits of a range of measures are summarised in a series of reports compiled by the County Surveyors' Society (CSS, various).

16.9 Involvement of Different Kinds of Road–User

While the accident investigation approaches, outlined in Section 16.8, are generally aimed at seeking remedial measures of an engineering nature, the involvement of different kinds of road–users must not be overlooked. Particularly vulnerable in urban areas are young and elderly pedestrians, young cyclists and motorcyclists. The mass action approach is useful to identify locations where additional facilities for pedestrians and cyclists are desirable but it is also applicable to publicity and road–user training schemes, to identify the needs for guidance on crossing strategies and advice on how to use roads more safely.

Particular attention needs to be paid to the risks for pedestrians on different types of road. An in–depth study in Northampton (Ward *et al*, 1994) sheds light on casualty–rates per distance walked. Table 16.3 indicates overall rates for primary and district distributor roads, local distributor and residential

Local Safety scheme approach	Accident–reduction (before – after)/before	First year economic rate of return (FYRR)
Single sites	33%	50%
Mass action	15%	40%
Route action	15%	40%
Area action	10%	20%

Table 16.4: Typical expected benefits from the four approaches (based on results for 1985–95).

access roads and comparable rates for the more vulnerable, young and elderly, pedestrians.

Relative to the overall rate on all types of road, accident–rates are two and a half times as high on primary and district distributor roads but less than half on residential access roads. Particularly high rates are observed for five to nine year old children on primary and district distributor roads and local distributors; and for 10–15 year old children and those aged 65 and over on primary and district distributor roads.

Specific aspects of pedestrian and cyclist safety are dealt with in Chapters 22 and 23.

16.10 Local Safety Schemes

The potential for accident–reduction in an urban area encompasses all four approaches set out in Section 16.8. The initial step in developing a framework for setting priorities for action is to make an overall assessment of the accident problem and to classify locations falling within these categories. The next step is to prioritise locations for follow–up study and diagnosis, leading to a phased plan for implementation over a period of (say) five years. With the pattern of allocation of resources to road safety engineering that was prevalent in the decade 1985 to 1995, the expected benefits from the four approaches were, at least, as shown in Table 16.4.

The first year economic rate of return (FYRR) has been adopted for small local safety schemes but for large, area–wide, schemes benefits are discounted over longer periods to calculate the Net Present Value (NPV) of each scheme (see Chapter 9).

In economic terms, extra resources should be allocated to the types of scheme for which the highest rates of return are achievable. This should continue until the highest achievable rates, from schemes not yet undertaken, are close to those obtainable in other areas of local government spending.

When first setting out a programme of local safety schemes, it is appropriate to start with single site treatments, which are likely to give the best returns at least cost, but even at the early stages it is important to plan a programme which recognises the potential for action at the other levels. A review of local safety schemes undertaken in the 1992/93 Transport Supplementary Grant (TSG) allocation (Tootill *et al*, 1995) showed that, at that time, area–action schemes were rarely undertaken and accounted for only three per cent of the total number of schemes.

Example of area–action scheme – Cornerhall, Hemel Hempstead

Figure 16.2 illustrates how area–action treatments were implemented in the Cornerhall area of Hertfordshire, where 208 road traffic accidents involving injury were reported over a five–year period between 1986 and 1990: casualties included 48 pedestrians, 32 of whom were children. Speeds of 40 miles/h were common on a majority of the local roads in this area, with a significant amount of rat–running during the peak hours, to avoid queues on the main roads.

Applying the urban safety management approach, a clearly–defined hierarchy of roads and their functions was identified and measures were selected appropriate to those roads. Consultation to gain the views of local people resulted in few objections and widespread support for the scheme.

Implementation of the measures was phased over three years, to spread the cost of £441,000. Since completion of the scheme in 1994, accidents have been reduced by 35% and rat–running has reduced substantially.

16.11 Road Safety Audit

Road safety audit is a formal procedure for assessing the accident–potential and safety performance in the provision of new road schemes and the improvement of existing roads. The basis for audit is the application of safety principles to new scheme design, to prevent accidents occurring or to reduce their severity. It requires an objective approach to the assessment of accident–risk, through the independent checking of schemes by people unconnected with the original design but with experience and expertise in road safety engineering and accident investigation.

The practice of road safety auditing has only developed

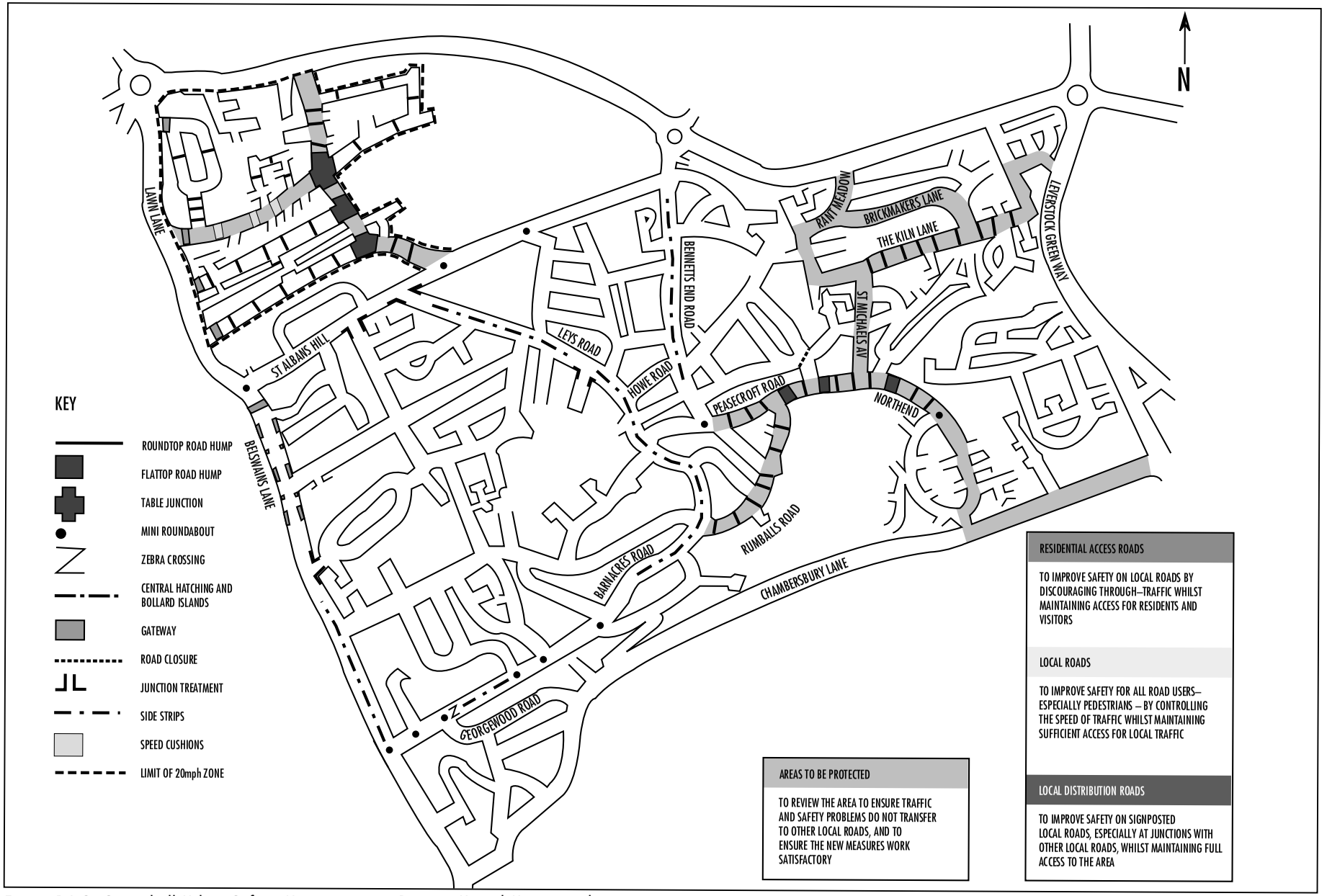

Figure 16.2: Cornerhall Urban Safety Manamgement Project, Hemel Hempstead.

since 1990, when the first IHT Guidelines and DOT Standard were published. In 1991, safety audit of trunk roads became mandatory and, at the same time, many local authorities started undertaking audits on local roads in both urban and rural areas [NIg]. Subsequent practice is reviewed in Review of Road Safety Audit Procedures (Crafer, 1995), which provided a basis for revised IHT Guidelines for the Safety Audit of Highways (IHT, 1996). The DOT standard has also been revised and incorporated into the Design Manual for Roads and Bridges (Volume 5, Section 2).

Road safety audits should be an integral part of highway planning, design, construction and maintenance. To ensure that all highway schemes operate as safely as practicable, safety should be considered throughout the whole preparation and construction of any project. The IHT Guidelines outline the principles, procedures and practice of a road safety audit and make recommendations on good practice. Safety audits for grade–separated junctions are discussed in Chapter 43 and safety considerations in the design and evaluation of performance at junctions are discussed in Chapters 38, 39 and 40.

16.12 Education, Training and Publicity

Education, training and publicity programmes use educational methods, skills, training schemes and publicity activities, often in conjunction with other professionals and volunteers, to seek to influence attitudes and bring about safer behaviour. A range of programmes is needed to address different groups and interests. The main responsibility for implementing these programmes lies with Road Safety Officers. The RoSPA publication Road Safety: A Managers Guide (RoSPA, 1996) provides a practical guide on methodology and sources of relevant information.

Road safety education for children

Road safety education in schools can play an important part in developing children's attitudes and behaviour in a way which should make a positive impact on safer behaviour for life. A comprehensive programme covering all aspects of the safe use of roads should be developed jointly between road safety officers, teachers and other agencies, including the police and health promotion officers. An essential requirement is that it must be amenable to integration into the national curriculum.

Good practice guidelines for education of 5–16 year olds have been issued (DOT, 1994) and major demonstration trials have shown that road safety education can provide a real and very relevant context for the national curriculum (Sykes *et al*, 1995). To be effective, pupils should receive small, but frequent, regular and purposeful inputs. An imaginative lead is required but one which also reflects realism, sensitivity and awareness to current pressures within the primary and secondary schools. Photograph 16.1 illustrates an appropriate resource for 8–11 years olds, developed on these principles (Clayton *et al*, 1995).

Important elements in promoting road safety education in schools are:

- ❑ school–based in–service training (INSET), which is by far the most effective way of promoting good practice in road safety education;
- ❑ road safety officers liaising with the major organisations, to provide advisory services to schools;
- ❑ road safety officers taking the lead in developing and maintaining liaison with other support agencies, such as the police and health promotion officers;
- ❑ evaluating and keeping records, which should be a priority for both education co–ordinators and the road safety department;
- ❑ road safety 'theatre' in schools, such as 'Drivetime' for the pre–driver age–group; and
- ❑ teachers and road safety officers being aware that needs and opportunities are arising

Photograph 16.1: On the Move… teaching resources for eight to 11 year olds.

continually for the further development and updating of road safety education.

Most importantly, the success of any programme for road safety education in schools depends on the commitment and co–operation of all concerned. In preparation for such school education, pre–school children can benefit from programmes such as Traffic Clubs, developed to help parents to guide their children's first footsteps (Bryan–Brown, 1994) [Wb].

Young drivers' training

New initiatives (DOT, 1995) have been directed at young drivers, who are disproportionately involved in accidents. These include:

- ❑ re–testing of all relatively–new drivers convicted of a serious driving offence, within a specified period of passing the driving test;
- ❑ post–test training of young drivers;
- ❑ an enlarged element of theory in the driving test; and
- ❑ education of young people of below driving age.

Influencing road–users' behaviour

Education programmes, mounted at both local and national level, should aim to raise the levels of understanding and awareness of road–users to road safety issues and to influence their behaviour. Publicity campaigns led by central Government are supported by local authorities but local campaigns in themselves have an important role. Local publicity programmes should complement traffic engineering measures aimed at accident–reduction. They should be designed to achieve specific objectives, in terms of improved behaviour, knowledge and attitudes for specific target groups of road–users. Priority objectives and target groups should be determined by rigorous accident–analysis and the impact and effectiveness of campaigns evaluated.

Other important applications of education programmes relate directly to: engineering and enforcement programmes; the consultative element in safety engineering schemes, especially in urban safety management (see Section 16.7); the informative and persuasive element in enforcing legislation; and the use of new technology (see Section 16.13).

16.13 Enforcement

The most successful road safety legislation in recent years has been that on drinking and driving. First, the 1967 legislation, which introduced the 'breathalyser', brought about a substantial reduction in deaths and injuries almost overnight (more than 10% of the national casualty toll) but the benefit was short–lived. Secondly, the 1983 legislation, which simplified procedures and was accompanied by new technology for breath–testing, resulted in a steady decline in drink–related casualties and to a halving of drink–related deaths over the next decade. The essential difference between the two situations was that enforcement of the 1983 legislation was accompanied by continued high–profile publicity and education campaigns, while the 1967 legislation relied on enforcement only. Drinking and driving has now become socially unacceptable.

One of the main concerns in road safety is how to control speed. Not only do many drivers exceed speed–limits but many accidents arise from drivers going too fast for the situation even below the limit. Initiatives to combat this problem include: the use of speed–detection cameras, in both urban and rural areas, to help to enforce speed limits; the use of cameras to detect red light running offenders; and the fitting of speed–limiters to buses, coaches and heavy goods vehicles. However, the level of non–compliance is often so great that the available resources are quite inadequate to process the large number of offenders. Enforcement cannot be fully effective unless major changes in the attitude of road–users to speeding can be effected, through extensive publicity and education.

In urban areas, where 20 miles/h limit zones have been introduced, the requirement to have appropriate physical measures to calm traffic acknowledges the impossibility of enforcement by police presence alone. Traffic calming and the management of speed are dealt with in Chapter 20.

16.14 Relevance of Developments in Vehicle Safety

Good vehicle design and construction are essential for road safety. Vehicles are increasingly being designed to help prevent accidents, for example through better lighting and braking. They are also being designed to prevent or minimise injury, through such devices as air–bags and improved restraints.

Of particular relevance to urban safety are developments to improve the protection of pedestrians through better design of the fronts of cars, for example through the elimination of sharp edges, optimum shape and crush characteristics of front–end design. It is at the lower range of speeds (20 miles/h and less) that these improvements have greatest effect, adding urgency to the need to use traffic–calming measures to lower speeds of traffic in urban areas.

Interactive control of speed through the use of speed–limiters, activated remotely by roadside control systems using short–range communications links, has potential for reducing speeds and casualties in urban areas.

16.15 Valuation of Accident–Prevention

The valuation of traffic accidents and casualties is regularly updated and reported (DOT, 1996b). The methodology has been developed to give more meaningful valuations on human costs, resource costs and medical costs. The elements costed (in decreasing order of magnitude) cover human costs, lost net output, property damage, medical and ambulance services, police services and insurance administration.

Separate average valuations are made for built–up and non–built–up roads and motorways and for different levels of severity. Average values per accident in built–up areas (at June 1995 prices) are:

Fatal	£87,6440
Serious injury	£10,5470
Slight injury	£10,380
All injury	£32,160
Damage–only	£1,020

The overall average value of preventing an injury–accident on built–up roads, together with an allowance for the cost of unreported vehicle–only crashes, is estimated to have been £50,250 at June 1995 prices.

16.16 Appraisal of Safety Measures and Schemes

Appraisal of the effectiveness of different kinds of safety measure and of individual remedial schemes is important to provide feedback, to improve future procedures and practice.

For engineering schemes, the main criterion for assessment is change in frequency of accidents or casualties. The most widely–used technique is by before–and–after analysis, an essential element of which is comparison of changes which introduce an appropriate control, matched for type of site or area.

Factors which can affect the validity of any comparison are:

- ❑ changes in other factors, not associated with the scheme treatment, which may also cause changes in accident frequency. For example, changes in legislation or national publicity campaigns or changes in adjacent infrastructure, which might produce marked changes in traffic flows; and
- ❑ 'regression to mean' effects. Within the statistical fluctuation expected in average values over a number of years, locations with high levels of accidents in one year have a tendency to exhibit lower levels in the following year.

Thus, choice of before–and–after periods (at least three years of each) and choice of control data are critical to the soundness of the evaluation. Suitable statistical tests for different types of scheme are well documented – see the RoSPA Road Safety Engineering Manual (RoSPA, 1992).

For area–wide schemes in particular, it is also desirable to aid interpretation of changes by making before–and–after comparisons of a series of factors, not simply accident or casualty numbers. Of particular relevance are measurements of speed distribution, traffic flow and composition, travel times and public perception of the safety of the scheme. It is also important to examine whether the scheme has led to an increase in accidents, traffic speeds and volumes in adjacent areas and to allow for these consequential changes in the evaluation.

For education, training and publicity activities, the effect on accidents or casualties is likely to be long–term and appraisal of schemes in these terms is difficult. Nevertheless, it is important to undertake before–and–after evaluation in terms of other appropriate measures. These may include questionnaire surveys of awareness of problems and changes in attitudes towards safety issues, as well as observations of behaviour on the road.

16.17 Monitoring and Evaluation

Monitoring enables overall accident–trends in an area to be compared with national trends and targets. It also gives early warning if something goes wrong with an individual scheme. Monitoring the effect of particular measures at a number of sites makes it possible to build up local control data that can improve safety engineering work in the future.

Monitoring should be carried out at two levels: for the whole region covered by the local highway authority and for individual safety schemes or groups of schemes.

Regional Monitoring

In regional monitoring, it is useful to disaggregate the accident data into groups of factors and locations that

may help to highlight particular problems. The main groups should cover:

- ❑ **where? –** accidents per district, class of road, speed–limit, junction or non–junction;
- ❑ **who? –** type and class of road–user and severity of injury;
- ❑ **what? –** type of vehicle involved and type of collision;
- ❑ **when? –** time of day, day of week, month; and
- ❑ **why? –** state of the road (dry, wet, icy) and light (daylight, darkness).

Trends should be monitored and reported annually, to provide a basis against which all road safety workers can judge performance.

Scheme monitoring

Monitoring of individual schemes is essential for three main reasons. These are:

- ❑ to ensure that, if an accident situation worsens following implementation of measures, further steps are taken to reverse the situation;
- ❑ to quantify the change in accidents and to discover if there is any change over time in the effectiveness of the treatment; and
- ❑ to evaluate the benefits of the scheme, in relation to the original objectives.

Monitoring of schemes should add to the overall knowledge and experience of accident investigation and should help to build up control–data for future appraisals. A summary list of individual schemes, grouped by type, should be produced on a regular basis.

16.18 References

Bryan–Brown K (1994) TRL Project Report 99 'The effectiveness of the General Accident Eastern Region Children's Traffic Club', TRL.

Carsten O M J, Tight M R, Southwell M T, and Plows B (1989) 'Urban accidents: why do they happen?', AA Foundation for Road Safety Research.

Clayton A B, Platt V, Colgan M, and Butler G (1995) 'A child–based approach to road safety education for 8–11 year olds', AA Foundation for Road Safety Research.

CSS (various) 'Reports from the Accident Reduction Working Group' (formerly SAGAR), County Surveyors' Society.

CSS (1987) 'Small and Mini–Roundabouts', County Surveyors' Society.

CSS (1988) 'Road Surface Treatments', County Surveyors' Society.

CSS (1989) 'Automatic Traffic Signal Installations', County Surveyors' Society.

CSS (1990) 'Street Lighting Installations', County Surveyors' Society.

Crafer A (1995) 'Review of road safety audit procedures' Occasional Paper No 1, The Institution of Highways & Transportation.

DOH (1992) 'Health of the nation: A strategy for health in England', Stationery Office.

DOH (1993) 'Health of the nation: Key area handbook Accidents', Department of Health.

DOT (1987) 'Road safety: the next steps', DOT.

DOT (1989) 'Road casualty reduction annual progress report 1988/89', DOT.

DOT (1994) 'Road safety education 5–16: Good practice guidelines' DOT.

DOT (1995) 'Road safety report 1995', DOT.

DOT (1996a) 'Road accidents Great Britain: The casualty report', Stationery Office.

DOT (1996b) '1995 Valuation of Road Accidents and Casualties', DOT.

HMG (1980) 'The Highways Act 1980', Stationery Office [Sa].

HMG (1988) 'The Road Traffic Act 1988', Stationery Office.

IHT (1990a) 'Highway safety guidelines: Accident reduction and prevention', The Institution of Highways & Transportation.

IHT (1990b) 'Guidelines for Urban safety management', The Institution of Highways & Transportation.

IHT (1996) 'Guidelines for the Safety Audit of Highways', The Institution of Highways & Transportation.

James H F (1991) 'Under–reporting of accidents', Traffic Engineering + Control 32(12).

LAA (1989) 'Road safety code of good practice', Association of County Councils.

LAA (1996) 'Road safety code of good practice', Association of County Councils.

Mackie AM, Ward HA, and Walker RT (1990) TRL Research Report 263 – 'Urban safety project 3: Overall evaluation of area wide schemes', TRL.

Oscar Faber TPA (1993) 'Road safety plans: A guide to good practice', DOT.

PACTS (1995) 'Targets 2001: Where do we go from here?' Conference Proceedings, Parliamentary Advisory Council for Transport Safety.

RoSPA (1992) 'Road safety engineering manual', Royal Society for the Prevention of Accidents.

RoSPA (1996) 'Road Safety: A Managers Guide', Royal Society for the Prevention of Accidents.

Sykes J, Broome W, O'Leary K, and Harland G (1995) TRL Report 148 'Road safety education: Good practice in Hertfordshire', TRL.

Tootill W J and Mackie A M (1995) TRL Report 127 'Transport supplementary grant for safety schemes: Local Authorities' schemes from 1992/93 allocations', TRL.

Ward H, Cave J, Morrison A, Allsop R, Evans A, Kuiper C and Willumsen L (1994) 'Pedestrian activity and accident risk', AA Foundation for Road Safety Research.