Transport Research Foundation

Road Safety – Willing the End and Willing the Means

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Richard Allsop has extensive experience of research, training and advisory work in road safety and traffic management. He has a first in Mathematics from Cambridge and a PhD in Optimisation of Traffic Signal Control and a DSc in Engineering from University College London (UCL), where he has been Professor of Transport Studies since 1976 and was Director of what is now the Centre for Transport Studies until 1997. The Centre has over 20 academic and research staff and typically 10 research students, and offers an MSc Course in Transport jointly with Imperial College with typically about 50 students. Richard is also a member of the Road Safety Advisory Panel, chairing its Statistics Group, a Director of PACTS (the Parliamentary Advisory Council for Transport Safety) and active in the European Transport Safety Council.

Abstract

Road safety in Great Britain is discussed against the background of the evolution of the annual numbers killed or seriously injured as the level of motorisation has increased over the half-century since 1951. This shows an increase to a maximum of 8000 and 100000 respectively in 1966, followed by a decrease to 3400 and fewer than 40000. This pattern, common to most advanced industrialised countries, is the product of interaction between increasing use of motor vehicles accompanied by reductions in walking and cycling on the one hand and complex societal responses to the problem of death and injury in road accidents on the other. These responses are discussed in terms of the varied responsibilities for road safety that are spread across society and the consequent value of adopting a road safety strategy.

The themes of the current British Government road safety strategy and the associated targets for 2010 are set out, and the targets are placed in the context of the reductions in numbers killed or seriously injured that were achieved over the 1980s and 1990s and the continuing rise in the numbers of car users slightly injured over the same period. The likely need for a further target for still lower numbers of killed or seriously injured after 2010 is mentioned in relation to a brief discussion of how far the reduction in their numbers needs to go before they are no longer disproportionate to the scale of accidental death and injury elsewhere in modern life.

The basis for numerical advice to Ministers concerning the setting of the current targets is summarised and the transparency of this basis as a starting point for the envisaged monitoring of progress towards the targets and of concurrent changes in the use of the roads is emphasised. It is concluded that Ministers have been quite cautious in setting the target to reduce numbers killed or seriously injured by 40 per cent by 2010, but rather bolder in aiming to reduce the slight casualty rate per unit vehicle-distance travelled by 10 per cent by then, compared in each case with the average for 1994-1998. The potential vulnerability of the targets to any substantial and sustained increase in motorcycling is pointed out.

The range of ways in which the target reductions can be expected to be achieved is outlined and the potential contribution of road safety engineering is set out, leading to the question how much resources should be devoted to such work. The current high rate of return on investment in road safety engineering is interpreted as an indication of severe underinvestment in it. The level of investment is recognised as being constrained by shortage of skilled human resources for the design of schemes and progressing them through public consultation to adoption as well as by underfunding, and a case is made for the cost-effectiveness of addressing this over the period to 2010 by a systematic effort to double the relevant skilled workforce and level of investment over a period of 3 years starting now.

Road Safety – Willing the End and Willing the Means

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Introduction

For the purposes of this lecture, road safety will mean road safety in Britain, with the European and worldwide contexts mentioned only very briefly. The broad thesis of the lecture is that up to 2010 the end has indeed been willed, by developing, publishing and beginning to implement a strategy with quantitative targets, but that it remains a challenge to will the means.

In Great Britain the annual numbers of people killed and seriously injured in road traffic accidents peaked at about 8000 and 100000 respectively in 1966, and have fallen by the year 2000 to 3400 and clearly fewer than 40000. Figure 1 shows a graph of deaths per year against level of motorisation over the last 50 years. This is a kind of graph that was used by the author's predecessor at UCL, Reuben Smeed (eg 1953) at the then Road Research Laboratory nearly 50 years ago. More recently, Siem Oppe and Mattjis Koornstra have shown (1990) that a pattern of numbers of people killed and seriously injured in road traffic accidents increasing to a maximum and then decreasing as the number of vehicles per head of population increases over the years has occurred in almost all the advanced industrialised countries.

Lest this pattern or anything else in this lecture should mislead into complacency, however, it should be remembered that the situation facing the huge populations of the Third World, who are in the earlier stages of motorisation, is radically different. The annual number of deaths worldwide in road traffic accidents, which was about half a million in 1990, is now about 1 million and is expected to reach 2 million by 2020.

However, the same pattern as here is beginning to be repeated on a shorter timescale in the rapidly industrialising countries of the Pacific Rim. It is the product of interaction between the steadily increasing use of motor vehicles on the one hand and two consequent phenomena on the other: one of these is simple and mechanical, the other complex and societal.

The mechanical phenomenon is that motor vehicles lead to death and injury in two distinct ways: to people

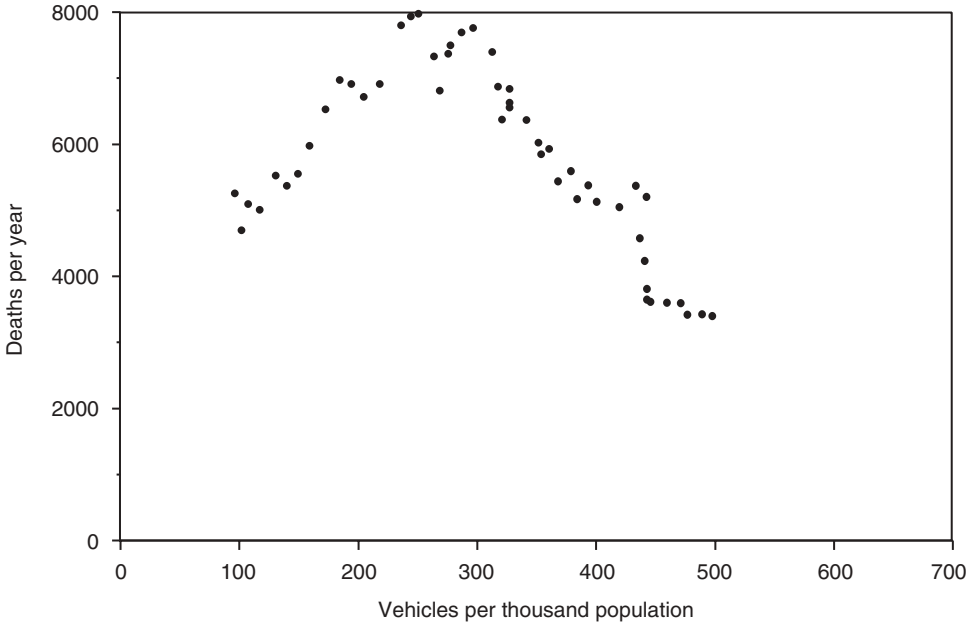


Figure 1 Road deaths and level of motorisation – Great Britain 1951-2000

outside them by hitting them, and to people inside them by subjecting them during collisions to forces much greater than the human frame has evolved to withstand. Both mechanisms lead to injuries ranging in severity from slight to fatal, but at European levels of development and traffic density the average risk of injury in a traffic accident is greater for a person using the highway but outside any motor vehicle than for a person inside a vehicle (see *eg* Collings 1990), and as vehicle use increases, the proportion of people using the highway outside motor vehicles decreases and the proportion inside vehicles increases. The societal phenomenon is that among the many and varied ways in which society adjusts to the increasing use of motor vehicles are a range of responses to the problem of road traffic accidents and their consequences.

Societal responses to the problem of road accidents

People outside motor vehicles get used to keeping out of their way, and people using them learn to do so with greater care and skill, and learn to keep them in better condition. Manufacturers of vehicles and those who maintain them grow in recognition of their responsibility to make and keep them safer. Providers of the highways grow in a similar recognition. Emergency services recognise the new demands placed upon them by the occurrence of injury in traffic accidents. Moreover, public concern leads to political recognition that much that could be done to reduce the resulting death and injury is against the perceived interests of individuals or firms, or beyond existing powers and resources available to public bodies, and this in turn leads to government intervention by way of public information, exhortation, legislation, regulation and allocation of resources. The scope of legislation, regulation and professional effort extends beyond the design and use of the roads and vehicles to the use of sites and buildings, and their layout in respect of access from the highway.

Responsibility for road safety

In addition to the responsibility of each one of us for trying to use the roads safely, professional and ethical responsibility for road safety is spread widely over many kinds of people in a range of commercial, professional, governmental and community organisations. Some of these, like road safety engineers and officers, have duties defined explicitly in road safety terms. Others, like highway and traffic engineers and bus drivers, have roles that are defined in other ways but have quite obvious road safety implications. Yet others, like architects, town planners, teachers and doctors, may not realise how much their activities can influence road safety unless this is brought to their attention by suitable advice or training.

Different kinds of action for road safety are interdependent in many ways. For example:

- road engineering measures need to be compatible with the characteristics of vehicles (eg the texture of road surfaces with the properties of tyres, design of roadside barriers with that of the vehicles that will strike them);
- safety features of vehicles need to be backed up by appropriate user behaviour (eg seatbelts need to be worn, antilock brakes need to be applied differently than earlier types);
- road user behaviour can be influenced by the layout and appearance of the road.

They also compete for resources, most explicitly in the allocation of government expenditure and in management decisions in business, but also in individuals' decisions about their use of time and money for travel and for vehicle ownership and maintenance.

Some aspects of this interdependence and competition are naturally recognised and addressed by those concerned, but this does not necessarily happen to an extent that is commensurate with the scale of avoidable death, injury and damage in road acidents. The range of people and interests involved and the complexity of the interdependencies and tradeoffs in use of resources are such that a more systematic approach is called for.

Government intervention in the interests of road safety has tended to become progressively more systematic, leading in Britain to the adoption of a strategy focused upon a target (Department of the Environment, Transport and the Regions (DETR) 2000c). Sweden has adopted a vision of a road transport system in which there are no fatal or serious injuries (Belin *et al.,* 1997) and The Netherlands has a programme known, somewhat misleadingly, as sustainable safety. The European Union has adopted a strategic approach (Commission for the European Communities 1997) which is currently being enhanced with the help of the European Transport Safety Council. This European dimension requires a separate lecture, but whatever exact form government intervention takes, it can be effective only if it is matched by the efforts of non-governmental organisations and by the population at large.

The value of adopting the road safety strategy

The value of setting the whole range of road safety action in the context of a strategy lies not only in the existence, and the real prospect of successful implementation, of a coherent programme of concerted

action of all kinds, but also in the effects on the participants of being fully involved in the process of formulating the strategy and keeping it up to date.

This process, if it is conducted in a way which achieves the full involvement of all those who can contribute to making use of the roads safer, can deliver:

- a rationally based consensus on an agreed programme of action;
- motivation and commitment on the part of all from whom contributions to its implementation are required;
- a framework within which contributors can each plan for their contribution to the action in the knowledge of what others are planning to contribute;
- explicit identification of synergies and tradeoffs with public policy in other areas;
- coherence and persuasiveness in gaining at least acceptance of the envisaged action, and where possible enthusiasm for its success, on the part of the public and of business;
- a firm basis for cross-party political will to allocate the required public expenditure;
- ranking of actions in terms of cost-effectiveness to inform their sequencing within budgetary constraints, having regard also to equity among different beneficiaries; and
- a clear framework for monitoring the effectiveness of different actions and progress of the programme as a whole to inform the continual updating of the strategy in the light of experience and changing circumstances.

Because road safety action is typically a highly cost-effective use of resources, making this explicit in the strategy should lead to greater allocation of resources to it, and thus to more action, than would be the case in the absence of a strategy. Systematic consideration of interdependencies within the strategy and the enhanced motivation and commitment of the contributors should make the action more effective, and ranking in terms of cost-effectiveness should make the sum total of affordable action more cost-effective. The strategic approach should thus lead to more action, more effective action and more cost-effective action for road safety

Great Britain has had a road casualty reduction target since 1987, when the then government set a target of reducing the annual number of casualties by the year 2000 by one-third compared with the average for 1981-85 (Department of Transport 1987). That target was accompanied by a review of policies and measures by which it might be achieved, but not by an explicit strategy for implementing them. Nevertheless, the target attracted strong commitment from many agencies that have parts to play in road safety work, and by 1996 it was clear that it was likely to be more than achieved in respect of numbers of people killed or seriously injured (KSI). It was also clear by then that the target could not be achieved in respect of numbers of people slightly injured. At that point, the then government consulted widely about whether there should be another target beyond the year 2000, and if so what form it should take (Department of Transport 1996). The response was overwhelmingly that there should be a further target.

The new government that came to power in May 1997 therefore inherited the results of a consultation exercise indicating strong approval for a new casualty reduction target beyond 2000. It also brought with it a manifesto commitment to a new integrated transport policy with an emphasis on sustainability, or rather reduction in unsustainability, upon which it soon launched a national consultation exercise leading to the white paper *A New Deal for Transport* published in July 1998 (DETR 1998a). In advance of the drafting of the white paper, however, the government had announced in October 1997 that the integrated transport policy would include a road safety strategy that would have as its focus a new road safety target for the year 2010. The announcement was accompanied by two papers (DETR 1997a,b) setting out how the strategy was to be developed and the target determined, and this work was assisted by a comprehensive review of speed policy, and new research on the relationship between traffic speed and accident occurrence and on the numerical basis for setting the target. The new strategy and the target for 2010 that forms its focus were launched on 1 March 2000 (DETR 2000c), and the speed policy review (DETR 2000b) and the two related pieces of research (Taylor *et al.,* 2000, Broughton *et al.,* 2000) were published at the same time.

WILLING THE END

The current strategy and target

The strategy calls for many agencies and professions, business, road-user groups and the public to work together with central and local government in a wide range of ways, and to this end it is presented in terms of ten themes, or areas of concern and action. These are:

1. safer road use for children;
2. safer drivers—training and testing;
3. safer drivers—drink, drugs and drowsiness;

4. safer infrastructure;

5. safer speeds;

6. safer vehicles;

7. safer motorcycling;

8. safer walking, cycling and horseriding;

9. better enforcement of traffic law;

10. promotion of safer road use.

The choice of themes is oriented towards outcomes for people who use the roads in different ways in order to encourage participation in the effort needed to implement the strategy, but for each theme an action plan is presented, and these overlap in many ways in terms of the main means by which it is envisaged that casualties will be reduced.

The target is to reduce by 2010:

- the annual number of people killed or seriously injured by 40 per cent;
- the annual number of children killed or seriously injured by 50 per cent; and
- the number of people slightly injured per unit of vehicle-distance travelled by 10 per cent;

compared with the average for the years 1994-1998.

The current target in context

The exact form of the target was a matter for decision by Ministers, and the professional advice provided to them to help them in their decision was based on a range of considerations, including experience with the target for 2000 set in 1987.

Against the background of reduction in people killed from a peak of 8000/year in 1966 when there were about 250 vehicles/1000 people to 3400/year with about 500 vehicles/1000 people in 2000, it is reasonable to think in terms of no more than 2000 people killed/year with about 600 vehicles/1000 people by 2010.

At this point it is worth pausing to consider how far this process should be expected to go. The current Swedish answer is until there are no deaths or serious injuries in road traffic accidents. An alternative approach is to ask at how low a level the risk of death or serious injury on the roads would no longer be disproportionate to the risks elsewhere in modern life. That it is now disproportionately high is indicated by the fact that deaths in road traffic accidents in Britain are about 28 per cent of all accidental deaths, whereas British people spend only about 6 per cent of their waking hours and only about 13 per cent of their disposable income on use of the roads, and road transport consumes only about 17 per cent of the Gross Domestic Product. According to these three comparators, proportionate numbers of people killed on the roads would be about 740, 1600 and 2100 respectively, and these numbers can be expected to decrease as risk is reduced in other areas of life for as long as the current tendency towards greater risk-aversion in society persists. So a further target, perhaps for 2020 set as 2010 approaches, seems likely to be needed.

Returning to the target for 2010, about 2000 is indeed the approximate number of deaths implied for 2010 by the target reduction of 40 per cent in the number killed or seriously injured (KSI) and a slight reduction in the proportion of those KSI who are killed. But it is sounder to base policy on numbers of KSI than of deaths because the larger numbers are less subject to statistical fluctuation, there is an appreciable chance element in whether death is the outcome of very severe injury, and death is not necessarily the worst such outcome, for the individual, their associates or society.

Figure 2 shows on a logarithmic scale the reduction in numbers KSI achieved since the 1980s in pursuit of the previous target, and for comparison the steady percentage rate of decrease required to achieve the new target of a 40 per cent reduction over 14 years (from 1996, the midpoint of the baseline period, to 2010).

The higher target for reduction in children KSI is a response to the fact that the annual number of child pedestrians KSI is about 50 per cent higher in relation to the child population in Great Britain than in most neighbouring countries, and about twice as high as in the best-performing northern European countries.

The previous target was for a similar reduction in casualties of all severities, but the number of slight casualties has nevertheless increased by about 15 per cent over the target period. The increase has been among car users, but has been at a lower rate than the increase in car use. Hence, in order to set a positive yet realistic new target for slight casualties, it has been expressed in terms of a reduction in rate per unit vehicle-distance travelled. The midpoint of the range within which growth in annual vehicle-distance travelled over the 14 years of the new target period can be expected to lie is about 25 per cent. To reduce the slight casualty rate by 10 per cent in the context of a 25 per cent increase in vehicle-use requires the increase in numbers to be held to 12.5 per cent. Figure 3 shows, again on a logarithmic

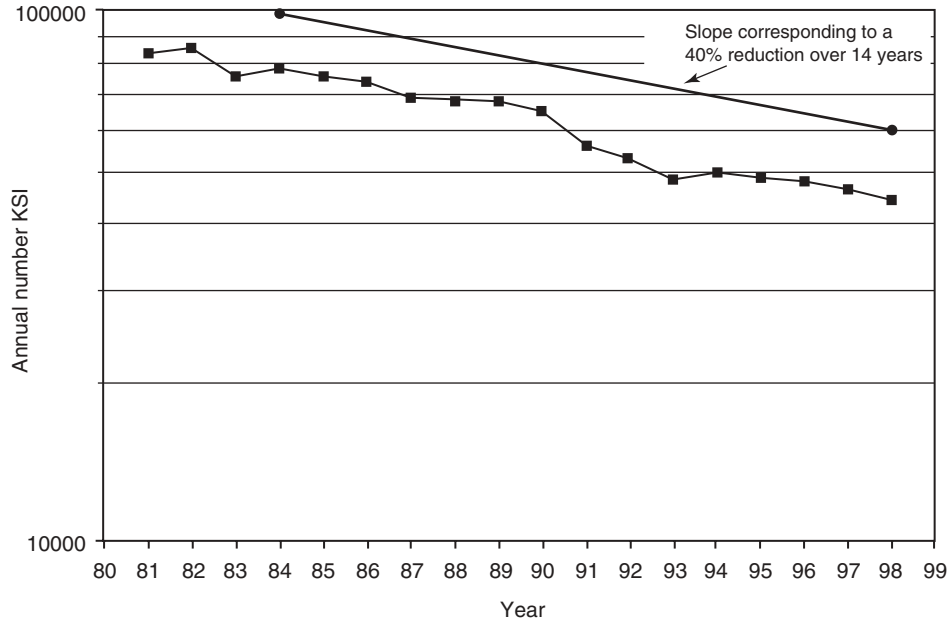


Figure 2 Annual numbers KSI in Great Britain 1981-1998 and slope corresponding to 40 per cent reduction over 14 years

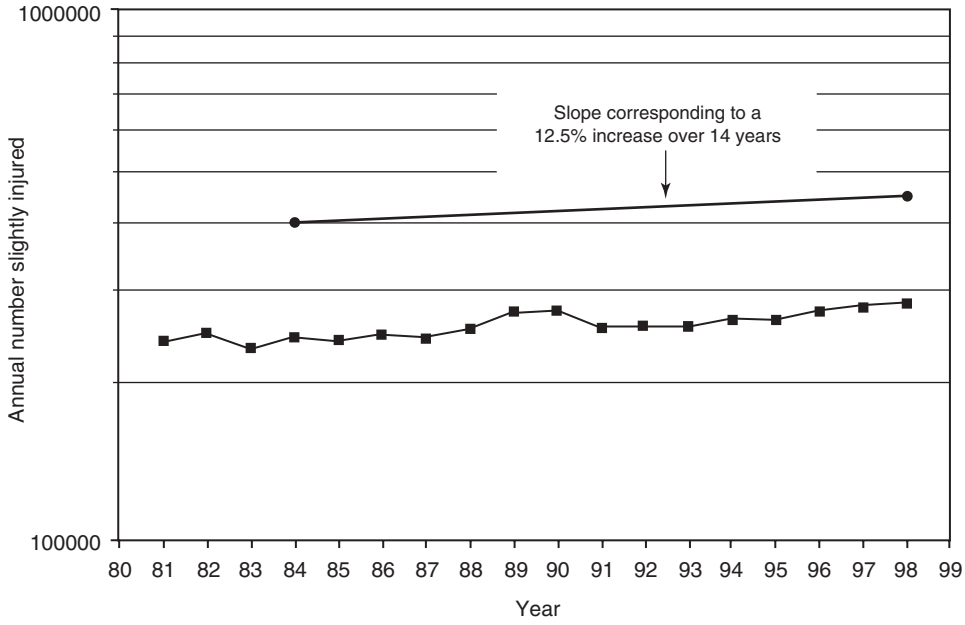


Figure 3 Annual numbers slightly injured in Great Britain 1981-1998 and slope corresponding to 12.5 per cent increase over 14 years

scale, the increase in slight casualties since the 1980s and for comparison the steady percentage rate of increase corresponding to a 12.5 per cent increase over 14 years.

It might seem from Figures 2 and 3 that the target for 2010 was set simply by projecting recent rates of change in casualty numbers, but even if this had been thought sensible, it would not have been acceptable in the light of the integrated transport policy.

The numerical basis for the target levels

The method adopted (Broughton *et al.,* 2000) for developing advice to Ministers on the numerical levels at which the target should be set was influenced by two considerations:

1. The integrated transport policy seeks deliberately to alter the trends of recent decades in road use by encouraging walking, cycling and the use of public transport whilst moderating growth in the use of cars.

2. The government had committed itself to 3-yearly reviews of progress towards the target and of priorities within the strategy, so that the numerical basis of advice on target-setting had to be transparent and the calculations repeatable in the context of the reviews.

These two factors together meant that analysis had to distinguish explicitly between the effects upon future casualty numbers of safety policies on the one hand and changes in use of the roads on the other. Forecasts of future numbers of casualties were therefore made by:

1. Forecasting casualty rates per unit of road use in the absence of new safety policies.

2. Reducing the resulting forecast casualty rates to reflect the likely effects of new safety policies; and

3. Applying these reduced rates to a range of possible future scenarios for road use.

The safety policies considered in this context are discussed in Section 8.

Since current numbers of casualties are affected by current safety policies, the first step was to investigate to what extent it was possible to estimate what current casualty numbers would have been in the absence of particular current safety policies. This turned out to be possible for three policies: measures to reduce drink-driving (D), road safety engineering schemes (E) and improved secondary safety in cars (SS). These three together were referred to as the DESS measures, and all other road safety policies taken together were referred to as the *core* road safety policies. As an example of the estimates made, results for car occupant casualties are shown in Table 1.

Table 1 *Estimated percentage extra car-occupant casualties in 1998 if certain policies had not been in place since 1983*

Type of policy	*Percentage extra KSI*	*Percentage extra slight*
Measures to reduce drink-driving (D)	10.6	8.9
Road safety engineering schemes (E)	6.5	6.5
Improved secondary safety in cars (SS)	14.7	-1.7
DESS measures in combination	35.1	14.1

The estimates for D were made by assuming that casualties in accidents in which a driver was found to be over the alcohol limit would have continued to form the same proportion of all casualties if there had been no D measures. The estimates for E were based on known total expenditure on schemes and observed cost-effectiveness of a sample of schemes. The estimates for SS were based on loglinear modelling of the proportion of car-occupant casualties that are KSI in terms of year of occurrence and year of first registration of the car in which they were travelling, together with knowledge of the proportion of casualties in each year that were travelling in cars of each model year.

In this way, *adjusted* casualty rates per unit vehicle-distance travelled could be estimated for each year from 1983 onwards and for each road user group on the basis that only core road safety policies (i.e. those other than the DESS measures) had been in place. Figure 4, for car occupants, shows by way of example how the logarithms of the adjusted casualty rates have changed approximately linearly over time since 1983. For each severity, lines are fitted for the whole period since 1983 and for the more recent period since 1991.

The linear trends in the logarithms of the two adjusted casualty rates for each road user group were extrapolated to 2010, using the rate of change estimated for the period 1983–1998 unless there seemed to be a strong reason for preferring the 1991–1998 estimate. For users of motor vehicles the relevant casualty rate was the rate per unit vehicle-distance travelled by the type of vehicle being used. For pedestrians and cyclists, the rate was per unit vehicle-distance travelled by all motor vehicles, factored in proportion to the total distance walked or cycled respectively except that for road-use scenarios in which the distance walked or cycled was assumed to increase considerably, that increase was raised to the power 0.6 to reflect the fact that large increases were unlikely to occur unless conditions for walking and cycling somehow became safer than under a continuation of previous trends.

In this way, forecast adjusted casualty rates were estimated for 2010. They are estimates of the rates that might be expected in 2010 if core read safety policies continued until then as in the recent past, but there were no further DESS measures from now on. These rates were then reduced to reflect the estimated effect for the road-user group concerned of new road safety policies that could be implemented in addition to the core policies from now on. This whole process is represented schematically for a notional road-user group in Figure 5.

The resulting rates were applied to road-use scenarios based upon the range of assumptions (Table 2) about changes in use and the consequent levels of use in 2010 relative to those in 1996, having regard to the government's own national road traffic forecasts (NRTF) (DETR 1997c)—which estimate how motor vehicle traffic would increase without any of the growth-moderating policies envisaged in the integrated transport policy.

Not all combinations of these possibilities were considered—it was assumed that large increases in walking and cycling would be associated only with

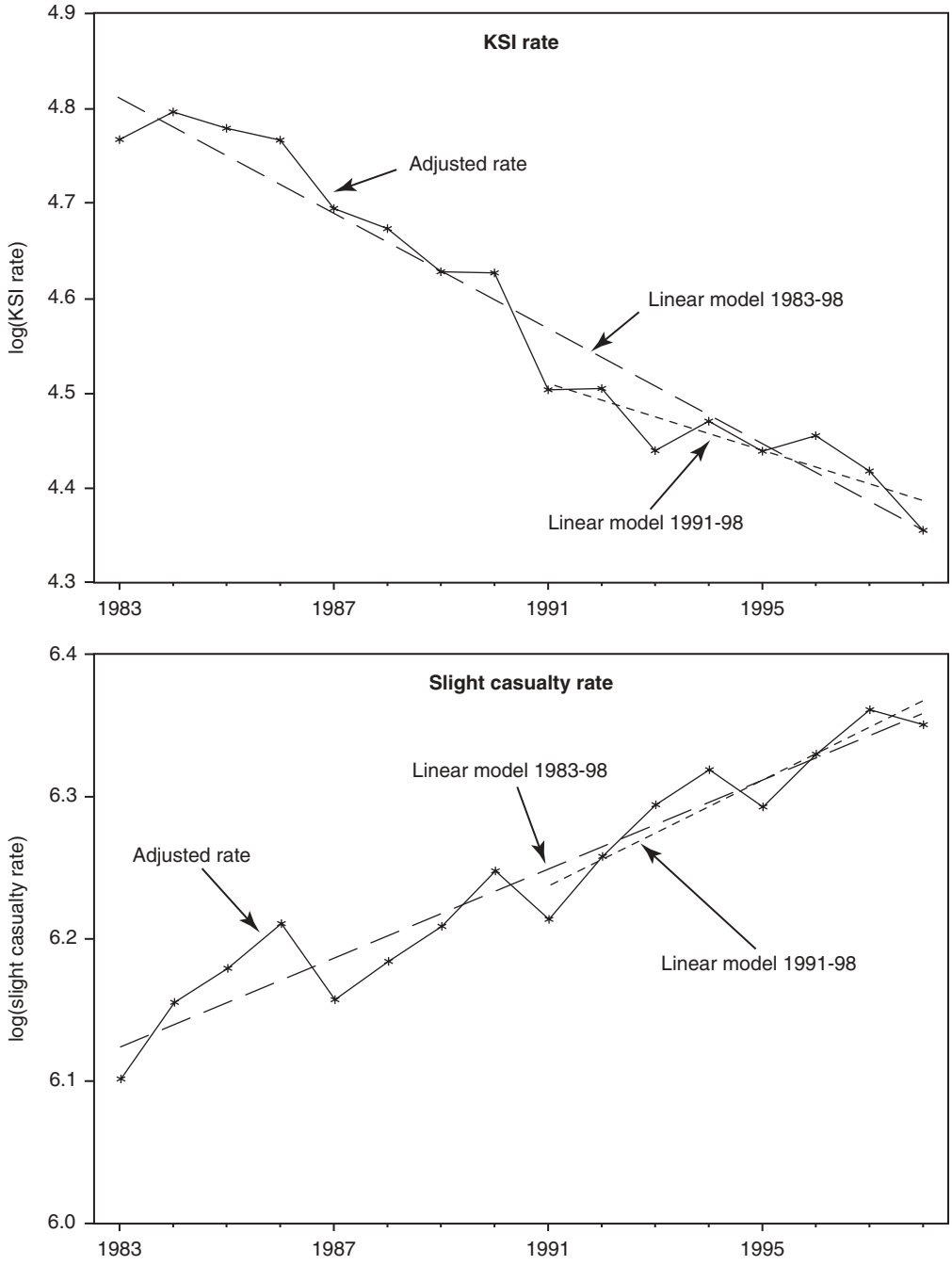


Figure 4 Adjusted car occupant casualty rates 1983-1998 (Broughton *et al*., 2000)

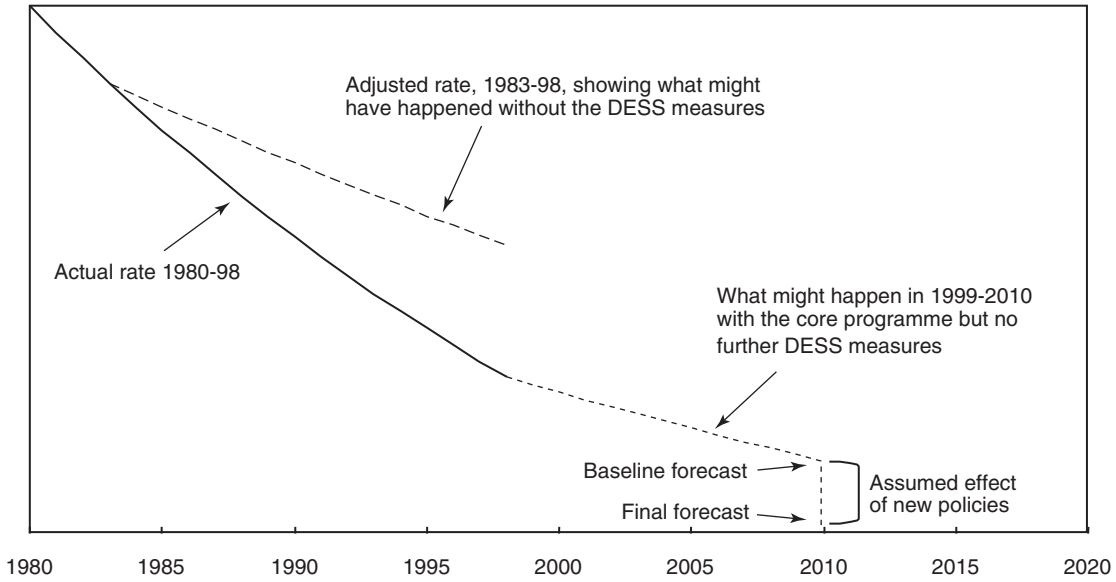


Figure 5 Schematic illustration of the forecasting method for a notional road-user group—casualty rate origin and scale are arbitrary (Broughton *et al.*, 2000)

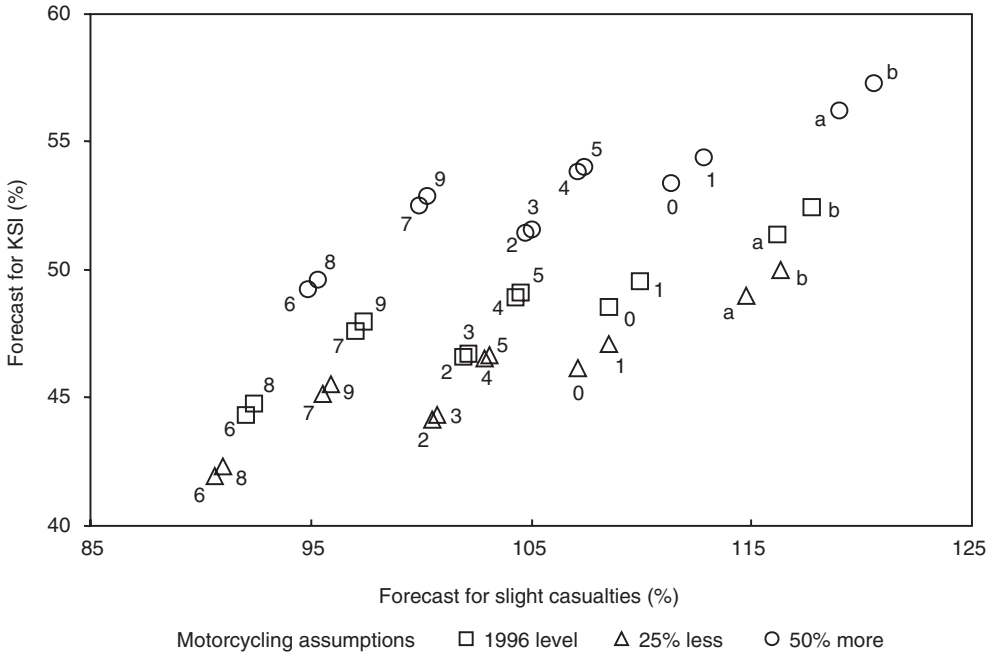
Table 2 *Range of assumptions*

Walking and cycling	
A* continuing to decrease at the same rate as recently	76 per cent of 1996
B remaining at the same level	100 per cent of 1996
C returning to the level of 1983	129 per cent of 1996
D showing major growth (cycling only)	300 per cent of 1996
*A, B, C, D *are used in the key to Figure 6*	
Motorcycling	
decreasing as it had until the early 1990s	75 per cent of 1996
remaining at the same level	100 per cent of 1996
increasing again	150 per cent of 1996
Car traffic	
following the NRTF high forecast	135 per cent of 1996
following the NRTF central forecast	125 per cent of 1996
following the NRTF low forecast	115 per cent of 1996
returning to the 1996 level	100 per cent of 1996
Other motor traffic	
with high growth in car traffic	135 per cent of 1996
with central growth in car traffic	132 per cent of 1996
with low or reversed growth in car traffic	130 per cent of 1996

more moderate or zero increase in car use. In this way the number of scenarios for walking, cycling and motor traffic was reduced to 12, and each of these was combined with each of the three possibilities for motorcycling (to reflect the volatility of motorcycling as a form of road use) to give a total of 36 scenarios.

For each scenario, the appropriate KSI and slight casualty rates were applied for each road-user group, together with percentage reductions in rates to be expected for the road-user group concerned from new road safety policies, to estimate total numbers of KSI and slightly injured casualties in 2010 under each scenario as percentages of the average numbers for 1994–1998. The results are shown in Figure 6, together with the implied changes in the slight casualty rate per unit vehicle-distance travelled under the four assumptions about growth in motor traffic. The percentage increases for traffic in Figure 6 are the result of combining the corresponding percentages for car and other motor traffic.

It can be seen that Ministers have been quite cautious in setting the target for KSI and rather bolder in setting the target for the slight casualty rate. Caution derives from the fact that the estimates are based on continuation of past trends and the implementation in full of a wide range of policies.



Corresponding slight casualty rates for traffic increases of:

35 per cent	63%	70%	78%	85%	93%
26 per cent	67%	75%	83%	91%	99%
17 per cent	73%	81%	90%	98%	107%
5 per cent	81%	90%	100%	110%	119%

Key to points in graph

Point	Traffic	Walking*	Cycling*
a	high	A	A
b	high	A	B
0	central	A	A
1	central	A	B
2	low	A	B
3	low	A	C
4	low	B	B
5	low	B	C
6	least	B	C
7	least	B	D
8	least	C	C
9	least	C	D

* A,B,C,D are defined on page 10, opposite

Figure 6 Ranges and correlation of forecasts for 36 scenarios in 2010 as percentages of averages for 1994-1998 (Broughton *et al*., 2000 with scales for slight casualty rate added). The additional horizontal scales beneath the graphical plot are alternative scales to be applied to the graph to interpret the forecast changes in numbers of slight casualties corresponding to the plotted points in terms of percentage changes in slight casualty rate under the four different percentage increases in traffic between 1996 and 2010 used in the high, central, low and least traffic growth scenarios. The tabular key to points in the graph relates each point by means of its label (a, b, c, 1, 2,...,9) to one of twelve scenarios in terms of motor traffic, walking and cycling. For each such scenario there are three points corresponding to different levels of motorcycling in 2010 according to the shapes of the points as shown immediately below the graph, giving the total of 36 points. The scenarios are described on page 10 opposite.

How the casualty reductions are expected to be made

The reductions required to meet the targets are expected to stem from a combination of two processes. The first is the continuation of the general downward tendency in numbers KSI and in the slight casualty rate that is the product of increased motorisation and associated adaptation by society, including the core road safety policies and their implementation, which have become accepted policy and practice. If past trends continue, this should provide a reduction of 20–25 per cent in the numbers KSI between 1996 and 2010. The second is the implementation of new policies and measures of twelve kinds which, pursued as far as seems foreseeably practicable up to 2010 should reduce the number of KSI by 35 per cent by then. Combining these two estimated reductions multiplicatively gives a reduction of about 50 per cent, and the lower target of 40 per cent recognises that the past tendency may not continue in every respect, and that not all of the envisaged policies may be able to be pursued to the full. But this means that all concerned should be thinking by how much the target can be exceeded, rather than merely how to reach it.

The twelve kinds of policies and measures reflect technical assessment of means by which casualty reduction can be achieved, and the following list indicates the percentage reduction in numbers KSI that has been assumed to result from each of them (Broughton *et al.,* 2000) in arriving at the forecasts shown in Figure 6

There is no simple correspondence between these twelve kinds of measure and the ten themes of the road safety strategy, because most measures contribute in various ways to addressing the concerns reflected in at least several of the themes, and each theme requires measures of several kinds to address it satisfactorily. The broad relationship between the themes and the kinds of measures can be discerned from general knowledge of the problem of road accidents, and further details are set out in the strategy (DETR 2000c).

WILLING THE MEANS

The strategy document (DETR 2000c) sets out an extensive programme of action by, or commissioned by, government and is ambitious in the calls it makes upon other stakeholders to share in the effort. The Road Safety Advisory Panel set up to advise Ministers as part of the strategy, is provided with a formidable spreadsheet, updated quarterly, showing who has been given responsibility for each line of action and what is the current state of progress. This spreadsheet, like all Advisory Panel papers is accessible on the website of the Department for Transport, Local Government and the Regions (DTLR—the successor to DETR). This, together with the commitment to 3-yearly reviews based on the published numerical underpinning of the target, represents a substantial measure of transparency consistent with the widespread ownership that has been sought for the strategy. The format of the relevant article in *Road Accidents Great Britain* (DTLR annually) is being enhanced, and an annual update on progress for Parliamentarians through PACTS (the Parliamentary Advisory Council for Transport Safety) is envisaged

But action in the road system and among its users will require commitment in the form of both human resources and finance. It is here that the means have to be willed. This is true in all the main areas of change—in road user behaviour, enforcement, vehicle engineering and road safety engineering, which is the adaptation of the physical environment of the road system to reduce risk both directly and by influencing road user behaviour. In the rest of this lecture, road safety engineering will be used to exemplify the challenge and opportunity to will the means to reduce death injury and damage on the roads.

1	New road safety engineering programme	7.7 per cent
2	Improved secondary safety in cars	8.6 per cent
3	Other vehicle safety improvements	4.6 per cent
4	Motorcycle and pedal cycle helmets	1.4 per cent
5	Safety on rural single-carriageway roads	3.4 per cent
6	Reducing accident involvement of novice drivers	1.9 per cent
7	Additional measures to protect pedestrians and cyclists	1.2 per cent
8	Additional measures to reduce speeds	5.0 per cent
9	Additional measures to protect children	1.7 per cent
10	Reducing casualties in drink-driving accidents	1.2 per cent
11	Reducing accidents during long-distance work driving	1.9 per cent
12	Additional measures for improved driver behaviour	1.0 per cent
Effects of measures of all these kinds combined multiplicatively		35 per cent

The contribution of road safety engineering

In terms of the twelve routes to casualty reduction discussed in Section 8, the contribution of road safety engineering to efforts to achieve the targets for 2010 will go far beyond the casualty reductions expected from the new road safety engineering programme itself. It will also include important parts of the reductions expected from improved safety on rural single-carriageway roads, and from additional measures to protect pedestrians and cyclists, to reduce speeds and to protect children—altogether perhaps 12 per cent, or one-third of the reduction taken to be expected from all new policies and their implementation in the numerical basis for the target.

Although highway authorities are open to new ideas, relatively few radically new measures are envisaged: most of the road safety engineering tools that are needed are probably in use somewhere already. What are envisaged are a generally higher priority for safety, a wider vision of what highway and traffic engineering can contribute to road safety, and a systematically organisational approach to realising the vision. A new *Good Practice Guide* on road safety engineering has been issued by the DTLR (2001). This should help to raise priority for safety as a main objective and criterion in the planning, design, maintenance and operation of the roads, and in the appraisal of road and traffic schemes.

As part of the vision, high-risk sites and route sections will continue to be identified and treated, the application of independent safety audit will be extended to all new road construction and modifications to existing roads and traffic management. On the national long-distance network, the Highways Agency intends to:

- systematically upgrade all-purpose routes by improving skidding-resistance, signing, markings and junction layout, and by managing speed, especially through villages;
- extend the use of its motorway incident detection and automatic signalling system MIDAS, which can reduce motorway accidents by nearly 20 per cent, mainly by reducing end-of-queue accidents; and
- try out and implement other innovative techniques on motorways through its 'Toolkit' programme (Highways Agency 1999).

On more local roads the aim is to move towards a newly defined safety-oriented functional hierarchy of roads according to usage, especially in terms of speed. This will help to apply the principles of urban and rural safety management through area-wide road safety engineering to encourage not only safer use of each road, but also safer routeing of traffic so that motor traffic is concentrated on main roads except where it is leaving its origin and gaining access to its destination.

In rural areas this should lead to reduced flows and lower speeds on country lanes, and better speed management on main roads (mostly single carriageways) and in villages. In urban areas it should lead to road layouts that contribute to urban design to encourage more walking and cycling, both for whole journeys and to and from public transport, and enable this to take place safely through the creation of safe, convenient and attractive routes for walking and cycling to where people actually want to go. This will require special attention to crossing of and movement along roads that carry a lot of motor traffic. Safety in residential areas, shopping areas and near to schools will be helped by much greater use of 20miles/h zones (made self-enforcing by speed-reducing road features) and in places by home zones designed to induce even lower speeds. Both kinds of zone will help especially to reduce casualties among children.

An important contribution to speed management and safer road user behaviour is expected to be the realisation of the concept of the *self-explaining road*, in which physical layout (including signing, marking, street furniture and landscaping) and new technology such as speed-activated signs create conditions which cause road users of all kinds to use the road safely. Intelligent speed adaptation should in due course extend this concept.

Most of the responsibility for implementing these policies and measures will fall on local government. Under the Integrated Transport Policy, each highway authority is required to produce and keep up to date a Local Transport Plan (DETR 2000a) or its London counterpart, which must incorporate a Local Road Safety Strategy including:

- local casualty reduction targets (initially to 2005);
- assessment of current problems;
- how local people and organisations will be involved in efforts to reduce casualties;
- how road safety issues are taken into account in other local policies;
- performance indicators updated annually, including a prioritised list of proposed schemes and their estimated effects (and later their actual effects); and
- education, training and publicity measures to be undertaken.

Performance in casualty reduction will in due course influence how much funding each local authority will receive from central government from year to year. Much will depend on the effectiveness of this administrative mechanism as well as upon the technical skills of road safety engineers.

How much road safety engineering?

The wide range of ways in which road safety engineering can contribute to reducing risk of death or injury clearly raises the question how much resources should be devoted to it. Evans (2000) has recently provided a comprehensive summary of the relevant background in economics. The key facts needed to address the question specifically can be stated as follows.

The costs of road safety engineering work comprise two roughly equal components. The first is the costs of analysing conditions in an authority's road network to identify appropriate safety schemes, developing the schemes and progressing them through the decision process. The second is the costs of implementing those schemes that are chosen to go ahead. The second component can be identified scheme by scheme and the first component apportioned by each authority *pro rata* among its implemented schemes. Data concerning the relative size of the two components is rather old, but is in the course of updating by means of a PACTS survey funded by the Rees Jeffreys Road Fund.

The benefits of the schemes in terms of accident prevention and casualty reduction are valued in monetary terms on an agreed basis which is updated regularly (DETR 2001). The ratio of the value of benefits in the first year after completion of a scheme to the cost of the scheme (the sum of the two components, typically twice the expenditure on implementation) is called the first year rate of return (FYRR). Benefits continue to accrue in subsequent years (and indeed the FYRR is in practice usually estimated from accident data for 3 years after completion), but not necessarily indefinitely. This is because subsequent changes in the road network and its use can affect the level of benefit from any particular scheme, and the effects of some schemes may wear off after a period of years, perhaps calling for a follow-up scheme.

The most recent general indication of the typical level of FYRR from road safety engineering schemes is 'in excess of 150 per cent' (DETR 1997a). There are reasons to expect this percentage to decrease over time as the most cost-effective schemes are implemented and attention is turned to those offering less benefit in relation to their cost, but there has been little sign of such a decrease over the last decade. It may have been offset partly by changing conditions in the network continuing to generate scope for very cost-effective schemes, and partly by growth in the skill, experience and ingenuity of road safety engineers and in the range of techniques that legislation allows them to apply.

Using the standard discount rate of 6 per cent, partly offset by an assumed increase in real terms of 2.5 per cent/year in the value of accident prevention to reflect growth in Gross Domestic Product/head of population, a FYRR of 150 per cent implies a ratio of benefit over the whole lifetime of the scheme to its cost (B/C) of 7.0 if the benefits continue for 5 years and 12.9 if they continue for 10 years. For comparison, the average estimated value of B/C for motorway and trunk road schemes selected to proceed in the 1998 Roads Review was 3.1 (DETR 1998b).

The high current rate of return on road safety engineering work is a clear indication of underinvestment in it (compared, as an example within the same sector of government expenditure, with investment in motorway and trunk road schemes). This has been pointed out forcibly by advocates of higher investment in road safety for well over a decade, to some but only limited effect. Doing so is often met with the argument that greater allocations of funding could not be spent effectively without extra skilled personnel.

The following is a scenario, presented in round figures, to show how this argument could be addressed, and what could be the general level of cost and benefit of doing so over the timescale of the current strategy. It is based on simplifying assumptions, but these are intentionally cautious in terms of the cost-effectiveness of the outcome.

In terms of the training of additional personnel for analysis and progression of schemes through the decision process, it is assumed that a graduate (with a year or two's experience in a local authority or firm of consultants) can be trained on the job in one year. The training would include attendance at existing short courses or enhancements of them at a cost of up to 25 per cent of the cost of employing the trainees for the year. The cost of provision of the courses would be covered by fees. The trainees would work alongside existing staff and be 50 per cent productive over the year of training. In any year there could be 1 trainee for every 3 existing staff. Concerning the workforce for implementation of schemes it is assumed that tender prices cover the cost of adjusting staffing to match changing demand.

The current level of spending on implementation of road safety engineering schemes is unclear pending the first annual reviews of Local Transport Plans, but

in 1997 it was £65m at 1998 prices (Broughton *et al.,* 2000) and policy has been for it to rise somewhat. Supposing it is £80m, implying a total cost of £160m. The current average value attributed to reducing the number of KSI by 1 is £200k and the value of reduction in numbers KSI represents about one-half of the value of accident prevention. So to reduce the number of KSI by 1 it is necessary on average to achieve £400k of benefit.

If expenditure of £80m/year on implementation were to continue until 2010 on schemes with an average FYRR of only 100 per cent and a life of only 5 years, it can be shown to follow that the resulting percentage reduction in KSI compared with 2001 would be just under 1 per cent in 2002 rising by just under 1 per cent/year to reach just under 5 per cent in 2006 and continue at that level until 2010.

Now suppose that the workforce for analysis and progressing of schemes through the decision process were doubled over 3 years by training one extra person per year for every 3 existing staff. If this had started in 2001, then because the trainees are 50 per cent productive during their year of training, the expected benefit from newly implemented schemes would be multiplied by 7/6 in 2002, 3/2 in 2003, 11/6 in 2004 and 2 from 2005 onwards. Again with schemes with a life of 5 years and giving 100 per cent FYRR, this would increase the expected percentage reduction in KSI to 1.1 in 2002 rising to 9.5 in 2009 and continuing at that rate thereafter. There would be an upfront employment cost of £40m plus the costs of course attendance, or at most £60m in total, without matching benefit, but this would increase the total investment up to 2010 by only 2 per cent.

In this simplified scenario, the increased investment would have a B/C of 4.6 (still 50 per cent greater than for trunk road schemes). The FYRR would have to fall to about 65 per cent to bring B/C down to 3.1 with a scheme life of 5 years. With a scheme life of 10 years it would have to fall to about 35 per cent.

The assumptions of this scenario concerning the continuing cost-effectiveness of road safety engineering work are more optimistic than those which the author was previously involved in making (Broughton *et al.,* 2000). The reasons for this are twofold—the fact that it was appropriate to be particularly cautious in the context of target-setting, and the availability of more recent evidence concerning cost-effectiveness.

The foregoing scenario is intended to demonstrate that a substantial correction of the current underinvestment in road safety engineering is practicable and would be likely to remain cost-effective over the timescale of the current strategy. If the idea is pursued, the calculations can easily be reworked for a range of assumptions to help in the judgement just how great an increase in investment to make. Only time will tell for how long into the future such an increased level of investment will continue to be cost-effective as the risk of death and injury on the roads is progressively reduced by these and other means. But such uncertainty about the longer term is no reason for not acting urgently by willing the means to correct the manifest underinvestment in the short to medium term. Life and limb that could be saved cost-effectively are being lost unnecessarily with every day that the increase is postponed.

Concluding remark

This argument for increased investment in road safety engineering is intended to exemplify the addressing of issues of safety policy through dispassionate analysis of available information, supplemented by research where requisite information is lacking, and the application of reason and logic. To advocate this is in no way to deny the depth of impact of tragic premature death or long-term disablement upon the bereaved and upon those who survive with massive disability and their associates. Society owes such people the deepest compassion, which should be expressed in all reasonably practicable ways. But neither the suffering of grieving fellow-citizens nor desire for retribution against individuals who might in some way be blameworthy should be allowed to displace rational analysis in informing safety policy.

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References

Belin M-A, Johansson R, Lindberg J and Tingvall C (1997). *The vision zero and its consequences*. Proceedings of the 4th International Conference—Safety and the Environment in the 21st Century, Tel Aviv, November 1997, 1-14.

Broughton J, Allsop R E, Lynam D A and McMahon C M (2000). *The numerical context for setting national casualty reduction targets*. TRL Report TRL382. Crowthorne: TRL Limited.

Collings H (1990). *Comparative accident rates for passengers by mode of transport*. In: Department of Transport Transport Statistics Great Britain 1979-1989, 1-5. London: The Stationery Office.

Commission of the European Communities (1997). *Promoting Road Safety in the EU - the Programme for 1997-2001*. COM(97)131 final. Brussels.

Department of the Environment, Transport and the Regions (1997a). *Road safety strategy—current problems and future options*. London: The Stationery Office.

Department of the Environment, Transport and the Regions (1997b). *Road safety—towards safer roads*. London: The Stationery Office.

Department of the Environment, Transport and the Regions (1997c). *National road traffic forecasts (Great Britain) 1997*. London: The Stationery Office.

Department of the Environment, Transport and the Regions (1998a). *A new deal for transport: better for everyone*. London: The Stationery Office.

Department of the Environment, Transport and the Regions (1998b). *A new deal for trunk roads in England: understanding the new approach to appraisal*. London: The Stationery Office.

Department of the Environment, Transport and the Regions (2000a). *Guidance on full Local Transport Plans.* London: The Stationery Office.

Department of the Environment, Transport and the Regions (2000b). *New directions in speed management—a review of policy*. London: The Stationery Office.

Department of the Environment, Transport and the Regions (2000c). *Tomorrow's roads—safer for everyone: the Government's road safety strategy and casualty reduction targets for 2010*. London: The Stationery Office.

Department of the Environment, Transport and the Regions (2001). *Highways economics note No. 1: 1999*. London: The Stationery Office.

Department of Transport (1987). *Road safety—the next steps*. London: The Stationery Office.

Department of Transport (1996). *Road safety casualty reduction—targeting the future*. London: The Stationery Office.

Department for Transport, Local Government and the Regions (annually). *Road accidents Great Britain*. London: The Stationery Office.

Department for Transport, Local Government and the Regions (2001). *A road safety good practice guide for highway authorities*. London: The Stationery Office.

Evans A W (2000). *The economic appraisal of road traffic safety measures in Great Britain.* In: Report of ECMT Round Table 117. Paris: European Committee of Ministers of Transport (to appear).

Highways Agency (1999). *The Highways Agency's Toolkit—towards a balanced transport system*. London: The Stationery Office.

Oppe S and Koornstra M J (1990). *A mathematical theory for related long term developments in road traffic and safety*. In: Koshi M (ed) Transportation and Traffic Theory. New York: Elsevier, 113-132.

Smeed R J (1953). *The international comparison of accident rates*. International Road Safety and Traffic Review 1(1), 16-19.

Taylor M C, Lynam D A and Baruya A (2000). *The effect of drivers' speed on the frequency of road accidents.* TRL Report TRL421. Crowthorne: TRL Limited.

DISCUSSION

Rod Kimber (Chair)

Thank you for a stimulating and challenging lecture. I can see there are many questions waiting to be asked, so let us get straight into them.

Question/Comment

Thank you Richard for a very interesting lecture. I was interested to hear you develop the argument. I have a comment and a question.

The comment is about the 1987 target, on which I have to differ slightly with you, since as far as my memory is concerned, there *was* a strategy document. Of course, it was not so widely available as things are now, on the Internet for example. It was followed up by a group which was a rather slimmed down equivalent of the current Road Safety Advisory Panel. It had a list of maybe 100 actions which were intended to follow through. The main point is that that worked very well for a period of about 3 or 4 years, but after that it seemed to disappear. A very important message is that this process should *not* disappear in time, and that the updating should be used as a mechanism to ensure that that doesn't happen.

The question is: do you think that we in Britain are less well off by not defining a vision to go with our strategy and our target? You commented on the Dutch and the Swedish approaches; and very often the Dutch and the Swedes along with ourselves are regarded as the leading countries in terms of accidents and accident rates. Those two countries have said very strongly that they don't feel that they can produce further major changes without having innovative and radical steps in what they are doing. To bring those to the fore they have adopted what we might call a *vision*. I agree with you that in the Swedish sense I don't think they would realistically believe that they are heading for *vision zero*, ie zero killed or seriously injured, but they are treating it as a radical change, and trying to get acceptance of radical change. The same with the Dutch. If one talks in private they don't moreover really believe that sustainability relates to safety. But it is a popular concept, and it is something to capture a popular mood. So my question is: do you think that we would gain from having something along those lines and should we develop that out of the strategy?

Richard Allsop

My answer basically is yes. The way that you put it, which is that the purpose should be to achieve the momentum of change, is important. But it is better not to have a vision until we have decided on the right one. There isn't a perfect one of course, but as soon as we can find a good one, then we should consider it. What we have done, in a pragmatic way, is I feel undervalued internationally—and it is almost certainly undervalued in the community here—because it doesn't have a label.

But while there would be an advantage in having a label, I am wary of the word *vision*. A vision can become a leading light, or it can become a delusion. That's why I say that until we find the right one we are probably better off without. But if we can find one that encapsulates what we are trying to do then we would be better off.

I certainly didn't mean to diminish what was done in the period 1983 to 1987. Because of my position on the Road Traffic Law Review at the time I did see the full Inter-Departmental Review. I didn't see all of the information that TRL had; and I do know that a great deal of work was done there. The list of measures I thoroughly endorse: and as my students can confirm I do teach that it was an extremely thorough list. Until it was superseded I used to spend some time going through it with them! Now I have a new one to go through! But I don't think it really amounted to a prioritised timetabled programme, which I would see as the essence of a strategy. What we have *now* has a lot more of that about it. I know it has to stand the test of time but I do see a difference.

Question/Comment

Do you think the cost effectiveness of engineering schemes will be maintained over time? In the sense that if you look at most activities in life, what we do is to pick off the easy targets first, and get extremely good benefits, but then it gets harder and harder. So one may get to the point where one has picked off all of the easy targets. How would you project that trend?

Richard Allsop

Of course, in principle, and eventually in practice, if we are successful over time what you suggest should happen; but the reason I confidently put forward the round-figure model is that for it to happen—ie for returns to diminish a lot—by 2010 it would have to come down the track very quickly and rather suddenly compared with the experience since the late 70s (when this sort of work began in local authorities) through to the latest information, which is for 1998/99. We don't see yet any sign of falling off. There are mechanisms why this might be so.

One is that the skill and ingenuity of the people involved has been progressively increasing. Another is that the range of things that legislation has provided that they can do has been extended. Then there is another mechanism, which is that the pattern of use of the road system is continually changing; and traffic has been systematically growing. So there is a mechanism there that is bringing forward further sites that can be treated very cost effectively. The effect is greatly to slow down the rate at which we exhaust the possibilities. But when we do reach the point of diminishing returns, that will be a sign of great success. The reason that I would advocate considerable investment in increasing the workforce is that those people will be needed for certainly a period of the order of 5 to 10 years at a level of about twice the current level (one could go beyond twice, but at twice certainly the period would be 5 to 10 years) before they work themselves out of a job. At the rate of change of skills in the professions at the moment, that is quite a long time for a piece of training to remain relevant.

Rod Kimber

I agree with that, and I am glad that the point was raised, because I believe that it is premised on a *static* model. The premise is that there is a finite store of schemes and that as one works through them from the top, taking first those which produce the biggest benefits, one will progressively reduce the residual number of untreated sites. That premise is widely believed. But I don't believe that it is fully substantiated. One has to look for empirical evidence that returns really are declining.

I believe that *in fact* the process is more dynamic. Whilst high risk sites are being treated, the road system is also changing quite rapidly at the detailed level, for other reasons. Moreover, traffic grows and redistributes. One consequence is that the places where accidents happen appear to some extent to 'migrate'. My feeling is that there are returns that can be obtained robustly into the medium term future at least because of the new high risk sites generally.

Question/Comment

I very much enjoyed the presentation. It is very topical at the moment, because there was a debate in the House this afternoon on road safety; there was the launch of the THINK campaign yesterday; and there was another debate last Thursday evening, on the Opposition motion on speed limits. I was struck by a number of things in the presentation and in the subsequent discussion.

Particularly on your point Rod about accidents migrating: if they do migrate, I wonder why we did the work in the first place! We have to ask the question why are the total numbers of accidents going down if all that happens is that they migrate from one place to another as we do the treatments?

I am slightly worried by the claims that are made for reducing accidents. We have heard a lot over the last few weeks about the possible effects of intelligent speed adaptors, which it has been claimed would reduce accidents by 50%. Claims for other measures are for similar amounts, so we begin to wonder why there are any accidents at all! So in considering the benefit to cost ratio we should allow properly for all of the other factors, to ensure we avoid double counting.

The issue about skill shortages is very valid, and it is something that was picked up in the 10 Year Plan last year and is being addressed. It applies not just in this area but to other investment areas as well.

Another point is where the investment should be. In a sense what you are suggesting is that we should put more into the engineering works because they have a good rate of return. In fact there are lots of areas in Government where there are high rates of return; not just in transport but also in health for example. The real question is whether there is enough investment to go round. In fact a lot more investment is now being put in as a result of the last spending review in government.

It is also necessary to generate the GDP as well as to spend it. That's a battle that has to be taken into account when we consider where we do spend money on the roads programme as well as on everything else. It is not just a question of considering how to save lives, it's a question of stimulating the economy to generate the resources which enable us to save lives.

Rod Kimber

Let me take the migration issue first.

Perhaps I could clarify slightly. It's useful to note that the accident reductions available from small scale engineering schemes constitute only a limited proportion of the total reductions targeted for measures of all types. But within those engineering schemes, the number of schemes available to generate a return is not fixed: there isn't a total 'pot', of defined total number, from which to draw. Instead, changes in the patterns of traffic movement, and in the roads themselves (due to modification and addition, for reasons other than safety) generate some *new* high-risk sites, and these add to the total numbers of sites available for treatment. This will have the effect of slowing the rate at which the overall benefits derived from treating high-risk sites begin to become exhausted, and this will defer the time when diminishing returns set in. It will, of course, also slow the overall rate of reduction of casualties from this type of measure, whilst the returns from individual sites still remain high. So it is not the accidents that are migrating; but rather that some other accidents are being generated elsewhere, at *new* high-risk sites.

Let me pass back to Richard for the remaining issues from the last question.

Richard Allsop

Every spending ministry is no doubt beset by demands for more spending. I think the case here rests on (a) the size of the return and (b) the relatively small size of the extra investment. Clearly if one looked at the health service there is perhaps something which could be done in every district general hospital in the country which would generate these rates of return: but I would guess that the costs of doing that would be one or two orders of magnitude higher than the budget that we are talking about here. The reason why, even within the context of roads, this should be considered is the size of shift compared with the size of the budget for a benefit-to-cost ratio of three. And consider what is being countenanced for spending on rail safety: we could just put the installation of those rail systems back by a month or two and all of these lives (on the roads) would be saved [from deploying the funds saved]. Of course, any advocate of new spending is one amongst a host of voices: I just speak with confidence on this issue.

In terms of the savings, the double counting issue doesn't arise because we never *add* percentage savings, we always work *multiplicatively*. So if one of the things that we were talking about was expected to save 10% and another was expected to save 30%, we should not predict a 40% saving in total but a 37% saving [$= 100 \times (1-(1-0.1)(1-0.3))$] because they act multiplicatively.

Question/Comment

Thank you; but in fact the problem wasn't so much with your calculations as with benefits-to-cost ratios for some of these schemes as they are presented by others. I am not sure that their calculations always take proper account of the expected number of accidents were the scheme not to be introduced.

Richard Allsop

It is true, I think, that there are still some calculations around where proper adjustments have not been made for possible regression to the mean, and in some cases even adjustments for secular trends in time have not been made. But I do think that the proportion of lapses of that kind must be getting pretty small by now.

Question/Comment

I was rather disappointed that Professor Allsop seemed to have such a 'down' on motorcycling. Motorcycles and powered two-wheelers in general are now regarded by government as legitimate transport. Using the term 'dangerous' is prejudicial. Motorcycling should be regarded as a 'higher risk' or 'vulnerable' mode just like walking or cycling. So motorcyclists should be taken in just the same context as other vulnerable road users. Two questions arise from this.

The first is: would you advocate reducing access to vulnerable modes in order to reduce casualties, because they are at higher risk? I hope the answer to that is no. The second question is related: bearing in mind that integrated transport policy is intended to bring about a modal shift towards the more vulnerable and sustainable modes, why aren't the casualty reduction figures for deaths and serious injuries by rate rather than by absolute numbers?

Richard Allsop

Let me take the motorcycling question first. I should say first of all that we are a free society and motorcycling should be an available mode. But I think that we are justified in making access to motorcycling more difficult because of its high risk, and because by the time someone is motorcycling the car has already become available to them as an alternative. In contrast, in the case of the bicycle there are groups of young people who cycle, to whom the car is not available. My personal position is to want a situation in which access to motorcycling is really made quite difficult for the young. For the more mature motorcyclists, of course, the accident rates are not so high; and such people are in a more mature situation to be deciding.

But we should also bear in mind the risk to third parties. These are higher for motorcycle use than for car use. I did a calculation for a colleague in government who was looking into motorcycling. It was this. If 1% of people shifted from cars to motorcycles then there would be 20,000 extra casualties to the group of people who shifted; and of course if they chose to shift then they presumably accept the extra risk; but as well as that 20,000 there are another 2,000 pedestrians and cyclists that they take with them. And that it seems to me gives one pause for thought. I realise that I hold a strong opinion that is not popular with motorcyclists; but I do hold it.

The other question was to do with the use of accident and casualty rates rather than absolute numbers. Ideally we would work much more with rates and less with absolute numbers than we do. But this would be quite difficult at any sort of disaggregated level. Of course, for four-wheeled vehicles the disaggregate rates at national level are pretty clear. But they are somewhat less clear for motorcycles because the reliability of the motorcycle traffic figure needs attention. And as soon as one gets down to localities, or relatively small sub-groups, the rates become extremely difficult to obtain—unless one were to spend very large sums on disaggregate survey work.

I should really like to be able to express more or less everything in terms of rates, because it is the risk that we want to reduce. But the practicalities, and some aspects of public understanding, favour sticking with absolute numbers.

Question/Comment

A question about public reactions to the sort of programme we are going to see introduced over the coming decade. I do sense at the moment the beginnings of a reaction against speed cameras. One sees more and more argument in the press concerned with the fact that the fines are going back to the police; they are being 'hypothecated'. This seems to be talked up as something that is unfair. People start talking in the pub about the cameras being revenue generating for the police and so on. Do you think there is any risk that we are going to run into public opinion and psychological barriers of this kind as we try and move towards much lower casualty levels?

Richard Allsop

We do have to carry people with us, and there can be setbacks if either the wrong things are done or—even without doing the wrong things—the wrong ideas get around. We have to pace ourselves in managing the culture change in relation to speed. It took a generation or so in relation to drinking and driving, and even there the job is not finished by any means. People need to be clear what things are for—and in particular that the speed cameras are not being put up indiscriminately. There should be evidence of speed-related accidents before cameras are installed and used at a particular location. If a local police force were to move away from that for local reasons then that would be counterproductive.

Question/Comment

What can be done to bind drivers into the need for the reduction in accidents? As an example, we give young people a licence to drive anywhere at any time and this is valid until they are 70. Couldn't we have some sort of interview when we hand the licence over to them and set out for them the effects of speed on accidents, and so on. This is not to introduce a nanny state, but simple to make people aware of the issues involved in driving when they are given a licence. This really goes to the attitude of young drivers—and to ensure it is the right one.

Richard Allsop

Quite a lot of thought has been given to the driver training and testing process. We already have one step towards a graduated licencing scheme, in that penalty points have a greater effect when incurred in the first two years after the issue of a full licence (because the New Drivers' Act requires reversion to provisional licence status if a given number of penalty points is exceeded within the first two years of receiving the full licence). The idea of log books during training will make the training process itself more interactive than it is at the moment. I am sure other ideas for interventions could be fed into government. There are various forms that such graduated licencing can take. By international standards we only have a minimal degree of graduation so far.

Question/Comment

Does there exist a record of the road network which would allow one to say which are the spots which we have to improve or is it a question merely of going back to where accidents have happened? We have seen a similar issue with Railtrack: they failed to have a record of the network and we know what chaos ensued from that. To what extent does the road network have records where one can say over the next 10 years that we will be able to improve safety by working on particular road spots which need to be improved, in their own right?

Richard Allsop

The answer to that is that while we know to an increasing extent about such spots, it is not nearly as much as I think *will* come with modern data techniques in due course. Increasingly local authorities have more and more systematic computerised information across their networks. Alongside that there is a whole bank of statistical models that relate accident occurrence to road features. So in principle there are means which enable one to locate (estimated) accident risk in relation to road features and locations. I am sure TRL colleagues would be pleased to offer their software to help anyone wanting to do that. The principle is established: one can put the features of most road junctions and quite a lot of road sections into computer models to predict expected accident risk for that particular site or stretch of road.

We might reach the point where one would be able to say that, even though few accidents have yet happened at a site, these procedures indicate that the potential is high and that therefore we ought to act *ahead* of the accidents actually occurring. If we could get to that point, that would be a great help in public relations terms because there is the awful feeling at the moment that someone has to die before it is the turn of a particular site to be investigated. The sooner that we can get beyond that phase the better; but the case is still so pressing from the places shown up by the accidents themselves (that have already happened) that it is only after one deals with those that one can think of moving on to the more sophisticated next step that you are seeking.

Rod Kimber

On that interesting note, I am afraid we shall have to draw to a close. I should like to thank Richard again for a very clear and lucid deconstruction of a complicated subject, and for signalling the directions that he feels we should be taking. In particular he has strongly advocated a greater emphasis on the training of personnel for road engineering schemes to reduce accidents, and on the investment in such schemes; and he has based his argument on a persuasive cost benefit case. His approach is rational and analytic, and it is just such an approach that has proved so powerful in road safety policy over recent years, and which is convincingly deployed in the government's targets for future casualty reductions. Many thanks to you Richard for giving us this lecture which points so clearly from reasoning to action.