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VALUATION OF ROAD ACCIDENTS

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EXECUTIVE SUMMARY

The benefits of new roads, road improvements, safety schemes and other transport projects are calculated in terms of the saving of time and accidents. Benefits are estimated in monetary terms so that they can be directly compared with the costs of implementation in the evaluation of proposed schemes. Investment in road safety also depends partly on the value of savings in accidents which are likely to result from such spending. Thus estimates of the cost of road accidents are required for decisions on many transport issues, at a national and a local level.

Costs are estimated for casualties and injury accidents recorded by the police, and for an estimated number of damage only accidents. Since 1988, the Department of Transport has valued road accident fatalities using a Willingness to Pay approach, by considering what people would be willing to pay to reduce the risk of being killed in a road accident. This approach is consistent with cost benefit analysis in that decisions reflect the preferences and attitude to risk of people who are likely to be affected by them. A Willingness to Pay approach was used to revise the values for non-fatal road accident casualties in 1993 and accident related costs were revised in 1994, in addition to the usual uprating for Gross Domestic Product (GDP) per capita. These revisions were based on the results of research conducted and managed at the Transport Research Laboratory which collected new information on the costs associated with casualties and accidents.

Total accident costs include those attributable to each casualty and those attributable to each accident. Casualty related costs include the value to the economy of loss of production potential (lost output), the cost of medical and support services and an estimate of the human costs to reflect the pain and distress of victims and their families. Accident related costs include property damage, insurance administration and police costs.1994 estimates are shown in the following table.

In 1988, the value of saving road accident fatalities was estimated using Willingness to Pay criteria. This value has been updated annually for changes in GDP per capita and is estimated at £784,090 in 1994 prices. Lost output per fatality is based on the loss of future production and consumption and takes into account average earnings, morbidity rates and average consumption per capita. The medical cost per fatality is estimated from data provided by the Department of Health (DOH) based on a number of assumptions about use of hospital facilities. The human costs element is calculated by subtracting the lost output and medical costs from the total cost.

In 1993 (and 1994) costs for non-fatal casualties were revalued using a Willingness to Pay approach. Non-fatal casualties are classified as either serious or slight according to the severity of their injuries. To improve the accuracy of the cost estimates, and to allow changes in the distribution

SUMMARY OF 1994 ACCIDENT COSTS

	Casualty-related costs (per casualty)			
Casualty severity	Lost output	Human costs	Medical & support	Total
Fatal	£272,690	£510,880	£510	£784,090
Serious	£11,500	£70,910	£6,970	£89,380
Slight	£1,220	£5,190	£520	£6,920
All casualties	£5,880	£20,750	£1,470	£28,100
	Accident related costs (per accident)			
Accident severity	Damage to property	Insurance administration	Police costs	Total
Fatal	£5,880	£160	£1,020	£7,070
Serious	£2,710	£100	£140	£2,950
Slight	£1,590	£60	£30	£1,690
All injury	£1,840	£70	£60	£1,980
Damage only	£1,020	£30	£2	£1,050
All accidents	£1,070	£30	£6	£1,110

of severity within these groups to be taken into account in the future without the need to collect further information on costs, the serious and slight injury groups were subdivided into more homogeneous sub groups according to the extent and duration of pain, period of hospital treatment, recovery time and level of residual disability. Cost estimates for the sub groups were weighted together to derive average costs for casualties with serious and slight injuries.

Data from surveys of road accident casualties treated in hospital in the Manchester area were used to estimate lost output for serious and slight casualties using information on the number of days off work and the length of time to recover. Medical costs were also estimated from hospital based surveys of the treatment, care and support provided to road accident casualties as a result of their injuries. The costs were estimated from the level of use and the unit costs of providing each service in the Manchester area and where possible for England as a whole.

The human costs associated with non-fatal casualties were estimated from a national sample survey of Willingness to Pay to reduce the risk of injury. Using the results of the survey, values for each injury group relative to the value for death were calculated from which overall values for serious and slight injuries were derived.

A survey of insurance claims dealt with by a major insurance company was used to estimate the cost of damage to property resulting from fatal, serious, slight and damage only accidents and the number of damage only accidents per injury accident. The values were adjusted to take account of accidents where no claim is made which tend to have lower costs.

Insurance administration costs were estimated from information provided by a few insurance companies on the average handling cost per claim and the average number of transactions per claim for accidents of different levels of severity. These costs were also adjusted to take account of the proportion of accidents with no claim which will have no administrative cost.

Police costs were estimated from a study of accidents dealt with by the Avon & Somerset Constabulary. The cost of police officers' time was estimated in detail for fatal and serious accidents from interviews with the officers involved in a sample of accidents. Costs for 'average' slight and damage only accidents were also estimated. Administrative staff time was estimated for fatal, serious, slight and damage only accidents in general.

Total accident valuations take into account the numbers of casualties of different levels of severity per accident which vary each year (see Road Accidents Great Britain. The Casualty Report published by DOT). In 1994 the average cost per accident was £913,140 for a fatal accident, £108,080 for a serious accident and £10,630 for a slight accident. This averaged £39,800 per injury accident, £27,220 per non-fatal injury accident and £3,460 over all accidents, including damage only (see Table 16). Using a Willingness to Pay approach means that the costing of fatal and non-fatal casualties is consistent and the methodology used in the UK is now at the forefront of thinking in road safety worldwide.

VALUATION OF ROAD ACCIDENTS

ABSTRACT

Since 1988, the Department of Transport has used a Willingness to Pay approach to value road accident fatalities by considering what people would be willing to pay to reduce the risk of being killed in a road accident. The value of non-fatal accidents was revised in 1994, so that non-fatal accidents are now estimated in a comparable way to fatal accidents and the values are based on up-to-date information about the consequences of road accidents. The report sets out the values and provides a brief summary of the results of research on each component of the costs: the lost contribution to the economy which results from road accident injuries, medical and support costs associated with casualties, the human costs which reflect people's pain, grief and suffering and the costs of property damage, police time and insurance administration.

1. INTRODUCTION

The benefits of new roads, road improvements, safety schemes and other transport projects are calculated in terms of the saving of time and accidents. To assess the value of proposed schemes, the costs of implementation are offset against the benefits; benefits are estimated in monetary terms so that they can be directly compared with the costs. The distribution of spending on road safety also depends partly on the value of savings in accidents which are likely to result from such spending. Thus estimates of the cost of road accidents are required for decisions on a variety of transport issues, at a national and a local level.

Each year the Department of Transport (DOT) publishes the latest values for accidents in Highways Economics Note 1 (HEN1). This document records how the figures are produced and presents new values uprated for changes in Gross Domestic Product (GDP) and accident patterns. It also records any significant changes in the underlying methodology. Figures for casualty and accident costs, and the average costs of accidents on different types of road, and the overall cost of road accidents to society at June 1994 prices are set out in HEN1, 1995 (Department of Transport, 1995).

The DOT collects information nationally on road accidents reported to the police. A police officer classifies each injured casualty as either fatal, serious or slight according to agreed definitions (see Appendix A). Values are estimated for casualties in each of these groups.

This report shows how these values were derived, with a brief summary of the results of the research. It does not attempt to present the details of the methodology but more detailed information is available in the individual project reports covering each part of the research. These reports are referenced at the end of Sections 3 and 7. The results of research to revise the medical costs for non-fatal casualties, which have not been published elsewhere in their final form, are presented in Appendix B.

2. VALUATION METHODS

Values are estimated for the costs associated with each casualty and the costs associated with each accident at each level of severity. Casualty costs include an estimate of lost output (potential production and consumption) as a result of injury or death, the medical and support costs and an element to reflect the human costs of pain, grief and suffering. Accident related costs include the cost of damage to property, and the cost of police time and insurance administration. The methods used for valuing these elements are described briefly in this section.

2.1 VALUATION OF CASUALTY RELATED COSTS

Since 1988, the DOT has valued road accident fatalities using a Willingness to Pay approach, whereby individuals place a value on a small decrease in the risk of a fatal accident. The theory underlying Willingness to Pay is that decisions in the public sector which improve safety reduce the risk of an individual being killed or injured, so that a safety improvement can be considered to be avoiding a 'statistical' injury. For small reductions in risk, the total value which society as a whole is willing to pay to avoid a statistical injury is equivalent to the marginal rate of substitution of wealth for the probability of being injured (or the small amount of money, at the margin, which people are prepared to pay to reduce the risk of injury). The average of individual values for the population affected by the safety improvement represents the Willingness to Pay for that group as a whole.

In 1993 a Willingness to Pay approach was used to revise the values for non-fatal road accident casualties. This provided new values for the human costs of serious and slight injuries derived from Willingness to Pay estimates and meant that the valuations of all severities of injury were brought onto a consistent basis. The approach is also consistent with cost benefit analysis in that decisions reflect

the preferences and attitude to risk of people who are likely to be affected by them.

Human costs reflect the non-resource element of the cost of road accident casualties; the pain and distress suffered by accident victims, their relatives and friends, and in the case of fatalities, the intrinsic loss of enjoyment of life, beyond the consumption of goods and services. The human costs component represents only part of the casualty related costs. The other costs associated with each casualty are lost output and medical costs.

The value of lost output is calculated by estimating the loss of future production for individuals at each level of injury severity. For fatalities, the calculations take into account average current and future estimates of income, activity rates, the growth in the economy and life expectancy. For non-fatal casualties, estimates are based on the amount of time off work and the average current and estimated future annual income. In the case of serious casualties, the calculations also took account of the lost output of permanently and severely disabled people who would never return to work by using the lost output figures for fatalities.

Estimates of medical costs are based on data provided by the Department of Health (DOH) and surveys of the use of medical and support services by road accident casualties. Costs for fatalities are based on data provided by the DOH and include the use of the ambulance and blood transfusion services and hospital costs. Costs for non-fatal casualties are based on the results of research on the consequences of road accidents in which road accident casualties treated in hospital provided details of all episodes of treatment, care and support provided during the period following their injury, which were a direct consequence of the injury.

2.2 VALUATION OF ACCIDENT RELATED COSTS

In addition to the costs associated with casualties there are also costs which cannot be directly attributed to individuals in an accident. These are accident related costs and include the cost of damage to property, the costs to insurance companies of handling road accident claims and the costs of police time in dealing with and recording road accidents.

Accident related costs are estimated for accidents of each level of severity; the accident severity is defined as the severity of the most severely injured casualty in that accident. Some accidents do not result in anybody being injured but only incur costs associated with the accident. Values for these 'damage only' accidents are also estimated.

Estimates of the cost of damage arising from road accidents are based on the results of a national sample survey of insurance claims. The costs of damage cover the cost of damage to the vehicle or vehicles involved and to other third party property. Damage costs also include related costs such as engineers' and assessors' fees, the amount of excess on the insurance policy and payments made for loss of use of the vehicle and for hire of a replacement vehicle.

Insurance administration costs are based on the average handling cost per road accident claim. This was estimated from a few insurance companies and is based on the average staff time required to process a claim plus some allowance for overheads and expenses.

The cost of police time in dealing with and investigating road accidents is estimated from a study of accidents dealt with by the Avon and Somerset Constabulary. The costs take account of the time spent by police officers and the administrative support teams.

3. CASUALTY COSTS

Table 1 shows the value of each element of the casualty related costs and the overall value per fatal, serious and slight casualty at 1994 prices.

The methods used to estimate each element are discussed in more detail for casualties at each level of severity in the following sections. More detailed information is available from the following reports: Dalvi (1988, 1992), Department of Transport (1988), Galasko et al (1986), Hopkin and O'Reilly (1993), Hopkin et al (1993), Ives and Kemp (1992), Ives et al (1992), Jones-Lee (1989, 1991, 1992), Jones-Lee et al (1985, 1992), Murray et al (1993, 1994) and O'Reilly (1992). See Section 12 for the full references.

TABLE 1

Summary of costs per casualty: June 1994 prices

Severity	Lost output	Human costs	Medical & support	Total
Fatal	£272,690	£510,880	£510	£784,090
Serious	£11,500	£70,910	£6,970	£89,380
Slight	£1,220	£5,190	£520	£6,920
Average	£5,880	£20,750	£1,470	£28,100

4. FATAL CASUALTIES

The value of saving road accident fatalities is based on results of several studies of the valuation of statistical life using both stated preference and revealed preference techniques. Following a review of these research findings and a consultation exercise, the value of saving a fatality was set at £500,000 (including resource costs of medical services and lost output) in 1987 prices. A considerable degree of judgement was used in deciding on this value, but it has received wide acceptance as a Willingness to Pay estimate of the value of preventing one fatal road accident casualty.

Since 1988, this value has been increased annually by the growth in GDP per capita; at June 1994 prices the value of saving a fatality was £784,090. This value encompasses all aspects of the cost of a fatality, both the resource costs of gross lost output (i.e. loss of potential production and consumption) and medical costs, and the less tangible human costs. The methods used to calculate these elements are explained in more detail in the following sections.

4.1 LOST OUTPUT

Lost output was calculated by assuming that current and future incomes of fatalities would be equal to the average for members of the population as a whole of the same age and gender. Average earnings were estimated for various age and gender groups; for every fatality, of a specified age and gender, it was assumed that they have average earnings and that as they get older they will earn the average of the subsequent age groups, taking into account activity rates, general growth in the economy and mortality rates. The stream of future income was discounted back to its present value. The overall average value of gross lost output per fatality is estimated at £272,690.

This methodology implicitly assumes that each person is unique and irreplaceable and there is therefore maximum loss from a fatality. It also assumes that the at risk population is the same as the average population. The calculations were originally made in June 1990 prices, and were therefore based on the number of fatalities in each age group in 1990, and data on earnings and consumption in 1990. The method used to derive this figure is outlined in the remainder of this section.

To estimate the value of potential production, future earnings were estimated for each of 22 age and gender groups by combining the average income of employees and self employed people, according to the proportion of the workforce they represent in each age and gender group. It was necessary to assume that self-employed people of different age and gender groups had the same distribution of income as their employed counterparts. Overheads in the form of National Insurance contributions were added to earnings to produce a figure for the total value of production lost.

This was multiplied by the activity rate. Those classified as 'active' were those whose contribution to the economy would have to be replaced if they were to be killed. These include people working, those seeking work and those who are temporarily sick, plus those making an unpaid contribution to the economy, such as household managers, unpaid carers and voluntary workers.

The future stream of income was estimated using life tables to take account of different lengths of life expectancy for people of different age and gender groups. It was assumed that income is worth more to an individual at present than it is in the future. Therefore the stream of future income, including overheads, was discounted, also taking account of the future growth rate of the economy. For each age group the net accumulated effect of growth and discount rates was calculated. A 2 per cent long term growth rate was selected; the rate was assumed to be positive and constant over the future lifetime. This rate is typical in Cost Benefit Analysis, and reflects historical performance of the UK economy. A discount rate of 6 per cent was used, this being the rate recommended by the Treasury for use in Social Cost Benefit Analysis.

4.2 MEDICAL COSTS

The estimated costs associated with fatalities take account of the use of the ambulance service, Accident and Emergency Department costs, in-patient costs and the cost of blood transfusions. An overall administrative overhead is also included. (See Hopkin and O'Reilly 1993 for details).

Costs are based on Department of Health data for 1984/5, uprated for the growth in GDP. At June 1994 prices, these costs amount to £510 per fatal road accident casualty.

4.3 HUMAN COSTS

By subtracting the value for lost output and medical costs per fatal casualty from the overall value for a fatality, an estimate of the human costs is derived. The medical costs of a fatality are estimated at £510, and the cost of gross lost output is estimated at £272,690. Subtracting these resource costs from the overall value for a fatality gives a figure of £510,880 for the human costs component of the value of avoidance of a fatal road accident casualty.

A summary of the cost per fatality by cost element is shown in Table 2.

5. SERIOUS CASUALTIES

The injuries defined by the DOT as serious cover a wide range, from a fractured finger, to those resulting in severe permanent disability or death more than 30 days after the accident. In addition, the distribution of injury severity

TABLE 2

Summary of costs per fatal casualty: June 1994 prices

Lost output	Human costs	Medical & support	Total
£272,690	£510,880	£510	£784,090

within the serious category may change; for example severity can reduce as a result of new road safety measures. To improve the accuracy of estimates of costs associated with road accident injuries, and to enable changes in severity to be taken into account in future without collecting further data on costs, the serious injury group was subdivided. Cost estimates for the sub-groups were weighted together to derive average costs for casualties with serious injuries.

5.1 INJURY SEVERITY

A group of experts derived a set of 'Injury State Descriptors', which together comprised the range of serious injuries, summarising in plain English the consequences of injuries. The descriptors covered several dimensions: extent and duration of pain or discomfort, period of treatment in hospital, recovery period, consequences for home and working life and level of residual disability.

The descriptors are listed in Table 3, which also shows a shorthand letter code which was used for reference to individual injury states; these codes are used in the remainder of this report.

Before costs or valuations associated with each injury descriptor could be combined into an overall average value for all serious injuries, the percentage distribution between groups was estimated for casualties with a serious injury reported by the police in accident statistics. This percentage distribution was estimated on the basis of the results of statistical studies of police and hospital data, work on linking police and hospital data for road accident casualties and expert clinical judgement on likely recovery rates. The initial distribution was modified using the results of studies of road accident casualties treated in hospital in the Manchester area which included information on actual recovery rates. The percentage of casualties in each group is shown in the last column of Table 3.

5.2 LOST OUTPUT

The estimate for lost output for serious casualties was calculated by weighting together three separate estimates: first, the average loss of output after one year; the loss of output for those who did not recover from their injuries after one year but did eventually recover; and the loss of output from those serious casualties that are permanently and severely disabled.

The proportion of serious casualties in each of these three groups was estimated from surveys of road accident casualties treated in hospitals in the Greater Manchester area. It was assumed that those with permanent restrictions on leisure activities would be able to resume paid employment within a year. Those in the 'permanent disability with scarring' group (R) were assumed to be distributed between those recovering in a year, in 1-3 years and not recovering in the same proportions as casualties in the other injury state groups. The resulting figures for the proportions estimated to recover within each time period were: 57.2 per cent within a year, 40.6 per cent in 1-3 years and 2.2 per cent were assumed to be permanently unable to work.

For those that recovered after one year, the average annual income for each age group was calculated and the average number of days off work in the first year, from the study in Manchester, was applied to produce costs per day. When multiplied by the number of serious casualties of that age group, this produced an average figure for lost output in the first year per serious casualty. The figures for days lost were for all casualties, averaged over those that worked and those that did not, so there was no need to apply activity rates.

For the people who took 1-3 years to recover, it was assumed that on average they recovered after 2 years. Their age distribution was assumed to be the same as for all serious casualties. The method for those recovering in a year was used to calculate lost output in the first year. For the second year a 2 per cent growth rate was assumed and the income for the second year was discounted at a rate of 6 per cent, to derive the present value of lost output in this group.

Permanently and severely disabled people would not be expected to return to work for their remaining lifetime. Thus the gross lost output figures for fatalities could be applied to these serious casualties to reflect the present value of the stream of future lost earnings. It is possible that the life expectancy of people in this group would be reduced, but no information on the effect of disabling injuries on life expectancy was available, so gross lost output was estimated for the full lifespan of this group, assuming that life expectancy was the same as for other people of the same age and gender.

The estimates of lost output were made for serious casualties in three age groups: 0-15, 16-59 and over 60, and were

TABLE 3

Injury state groups

Injury code	Description	Summary description	% of casualties
F	No overnight stay in hospital (seen as an out-patient); experience slight to moderate pain for 2-7 days followed by some pain/discomfort for several weeks; some restrictions to work/leisure activities for several weeks/months; after 3-4 months, return to normal health with no permanent disability.	Recover 3-4 months (Out-patient)	19
W	In hospital 2-7 days in slight to moderate pain; after hospital, some pain/discomfort for several weeks; some restrictions to work and/ or leisure activities for several weeks/months; after 3-4 months, return to normal health with no permanent disability.	Recover 3-4 months (In-patient)	13
X	In hospital 1-4 weeks in slight to moderate pain; after hospital, some pain/discomfort, gradually reducing; some restrictions to work and leisure activities, steadily improving, after 1-3 years, return to normal health with no permanent disability.	Recover 1-3 years	36
V	No overnight stay in hospital (seen as out-patient); moderate to severe pain for 1-4 weeks; thereafter, some pain gradually reducing but may recur when you take part in some activities; some permanent restrictions to leisure and possibly some work activities.	Mild permanent disability (Out-patient)	5
S	In hospital 1-4 weeks in moderate to severe pain; after hospital, some pain gradually reducing, but may recur when taking part in some activities; some permanent restrictions to leisure and possibly some work activities.	Mild permanent disability (In-patient)	12
R	In hospital several weeks, possibly several months in moderate to severe pain; after hospital, continuing permanent pain, possibly requiring frequent medication; substantial and permanent restrictions to work and leisure activities; possibly some prominent scarring.	Some permanent disability with scarring	13
N	In hospital several weeks, possibly several months; loss of use of legs and possibly other limbs due to paralysis and/or amputation; after hospital, permanently confined to a wheelchair and dependent on others for many physical needs, including dressing and toiletting.	Paraplegia/ quadriplegia	2
L	In hospital several weeks, possibly several months due to head injuries resulting in severe permanent brain damage; after hospital, mental and physical abilities greatly reduced permanently; dependent on others for many physical needs, including feeding and toiletting.	Severe head injuries	

made separately for men and women, although the figures on number of working days lost in the first year were averages for casualties in those age groups (0 days for under 16s, 64 days for 16-59 year olds and 4 days for over 60s). The 0-15 year olds were included in the analysis to ensure that the loss of working time over their lifetime was taken into account. For the 0-15 age group, who were below working age at the time of injury, the loss of output was only relevant for the proportion who were disabled and therefore unavailable for work for a year or longer.

The estimated lost output for each of the three groups of casualties is shown in Table 4, and the overall value of £11,500, is the weighted mean of the three groups.

TABLE 4

Estimated lost output for serious casualties

Recovery period	All casualties
Up to one year	£2,250
1-3 years	£8,270
Never return to work	£311,480
All serious	£11,500

5.3 MEDICAL AND SUPPORT COSTS

Costs were estimated for casualties in each of the injury state groups shown in Table 3. Information on the services used was collected in the Manchester surveys of road accident patients. The levels of use of each service were converted into costs using information on the unit costs of providing services in the Greater Manchester area in 1991/2, uprated to 1994 prices.

The costs included comprise the main costs of hospital treatment, District Nurses, and the provision of medical appliances, and Social Security Benefits. They are the costs which arose directly as a result of road accident injury, during the first 18 months after the accident. Some costs could not be included; these tend to be associated with casualties suffering long term disability, for example medical and Social Security costs after 18 months, costs to carers, costs to local authorities in adapting homes. However costs associated with General Practitioner consultations, which affect casualties with all types of injury, are also excluded, because information on the use of GP services by road accident victims is not available. Thus figures shown here can be regarded as minimum estimates, particularly for the more severe disabling injuries.

For some of these costs, averages for England as a whole are now available from the Department of Health. Where possible the Manchester unit costs were replaced with the up to date DOH estimates to provide the best available estimate of the likely costs nationally.

The costs for each injury state group were weighted together to provide an overall weighted average cost per serious casualty of £6,970 based on the combined Manchester and English costs. Details of the surveys, the methods of estimation used, and some of the more detailed results are shown in Appendix B.

5.4 HUMAN COSTS

The methods used to derive the value of avoidance of non-fatal casualties were linked with the value of avoidance of a fatality, based on a national sample survey of willingness to pay to reduce the risk of injury. This ensured consistency in the valuation of fatal and non-fatal casualties. The approach used was to derive indirect estimates of the value of serious injuries relative to the value of a fatality. Several methods of valuation were tested and the Standard Gamble approach[1] was adopted. Values were derived for the injury state groups within the serious category described in Table 3, which could be weighted to produce an overall average value of avoidance of a serious injury.

A national sample survey of individuals aged 17 and over who had experience of car travel as a driver or passenger in the last year was carried out in 1991. Some 450 people completed the Standard Gamble questionnaire. These were representative of the population of Great Britain in terms of age, gender, occupational background and household income. However, as expected, there were more drivers and more people in car-owning households than in the population. In answering the questions, respondents were asked to concentrate only on the personal, non-financial effects of injuries (such as pain, distress and disability), and ignore direct financial effects.

In a procedure known as 'Contingent Ranking', respondents ranked the injury state descriptors shown in Table 3 and then placed each injury state on a scale from 0 (worst) to 100 (best). Thus respondents' views of the injury states relative to each other could be assessed, and they became familiar with the injury state descriptors. Many people regarded severe permanent brain damage (injury L) as being as bad as or worse than death, and quadriplegia/paraplegia (injury N) was on average considered to be only slightly better than death.

In the Standard Gamble section of the questionnaire, the 'worse' health state was death (injury K) in most questions; in the remaining cases the 'worse' prognosis was a more severe injury description. To avoid overloading respondents, the questions covered a sub-set of the injury states (R, S, X, W, K and normal health). The results of the Contingent Ranking exercise were used to estimate L, N, V and F, by interpreting these states as equivalent to those for which questions had been asked: L=N=K, V=X, and F=W.

Respondents were presented with a range of possible risks of failure and success expressed as the chance in 100 and asked to specify the level of risk at which they would opt for treatment for the injury, which if it succeeded would return

[1] In the Standard Gamble approach respondents were asked to suppose that they had suffered a given road accident injury which, if treated in the normal way, would have a given prognosis. They were then asked to suppose that an alternative medical treatment was available which, if successful, would return them to normal health, but if unsuccessful, would leave them in a specified health state that would usually be regarded as worse than the prognosis associated with normal treatment.

them to normal health, and if it failed, would result in more severe consequences, or in some cases, death. There was also an option not to accept the treatment at any risk of failure. The point where it was most difficult to decide whether or not to accept the risky treatment was interpreted as the probability of failure at which the respondent was indifferent between accepting and rejecting the treatment, or the 'best estimate' for that respondent of the ratio of the marginal rate of substitution for risk of injury for the two injury states (explained in section 2.1).

Using the survey results, it was possible to convert the ratios for each injury state into values relative to the value of death. The human cost element of a non-fatal casualty is measured relative to the human costs and consumption component of a fatality. Consumption is included since the ability to consume goods and services is seen as part of the enjoyment of life and would therefore be taken into account by respondents in Willingness to Pay surveys. The value of consumption is estimated at £217,480. Adding this to the human cost figure shown in Table 1 gives a value of £728,360.

The resulting values for each injury state were weighted by the percentages shown in Table 3 to give an overall value for a serious injury. Table 5 shows the resulting values. The weighted mean value for a serious injury is £70,910, just under 10 per cent of the value for a fatality.

The three components of cost are summed to provide an overall value for a serious casualty, shown in Table 6.

6. SLIGHT CASUALTIES

The majority of slight injuries are minor cuts and bruises which have only limited short term consequences. However, slight injuries also include whiplash neck injuries which often result in a prolonged period of temporary disability and can therefore have longer term effects.

In the work on linking police and hospital data on casualties, it was estimated that 20 per cent of slight casualties recorded by the police in the national accident database (Stats19) have 'whiplash' injuries, and the rest have minor cuts and bruises. Clinical information showed that half of the whiplash patients recover within one year and half take between one and three years to recover. Thus altogether, 90 per cent of slight casualties were estimated to recover within a year of the accident, and 10 per cent were in the group with longer term recovery (1-3 years).

6.1 LOST OUTPUT

The method used in the calculation for lost output for slight injuries was similar to that used for serious injuries. The surveys of road accident casualties in Manchester were used to estimate average figures for working days lost per casualty with slight injuries requiring hospital treatment. An allowance was made for the casualties recorded by the police as slight who did not require hospital treatment.

TABLE 5

'Best estimates' of the relative value of serious injuries in relation to death

Injury state	% of value of death	Value (June 1994 prices)
Recover 3-4 months (Out-patient): F	2.0	£14,570
Recover 3-4 months (In-patient): W	2.0	£14,570
Recover 1-3 years (In-patient): X	5.5	£40,060
Mild permanent disability (Out-patient): V	5.5	£40,060
Mild permanent disability (In-patient): S	15.1	£109,980
Some permanent disability with scarring: R	23.3	£169,710
Paraplegia/quadriplegia & severe head injuries: L & N	100.0	£728,360
All serious	9.736	£70,910

TABLE 6

Summary of costs per serious casualty: June 1994 prices

Lost output	Human costs	Medical & support	Total
£11,500	£70,910	£6,970	£89,380

An average figure of 10 days lost per slight casualty aged 16-59 was used to estimate lost output for the 90 per cent of slight casualties who recovered within one year.

For the 10 per cent of slight casualties with longer term recovery (1-3 years), it was assumed that they took on average two years to recover. A 2 per cent growth rate and 6 per cent discount rate were applied to estimate the present value of their lost earnings in the second year.

Table 7 shows the value of lost output per casualty in the first year, the value per casualty taking between 1 and 3 years to recover, and the weighted mean assuming that 90 per cent recover in the first year. At 1994 prices, this was £1,220.

TABLE 7

Estimated lost output per slight casualty

Recovery period	All casualties
Up to one year	£390
1-3 years ('whiplash')	£8,620
All slight	£1,220

6.2 MEDICAL AND SUPPORT COSTS

For the purposes of assessing medical costs, casualties with slight injuries are by definition those requiring only out-patient treatment. Casualties with slight injuries, including whiplash, in two studies of road accident patients in the Manchester area were divided between the two injury state groups treated as out-patients: group A (who recovered in 3-4 months) and group B (who had mild permanent disability). When weighted together to represent a cross section of all casualties with slight injuries, there were 80 per cent in group A and 20 per cent in group B. This distribution was used for estimating medical and support costs.

Use of the medical services was estimated on the basis of the surveys of road accident patients treated in hospital in the Manchester area, as for serious injuries and outlined in Appendix B. Tables B4 and B5 show that slight out-patient casualties have substantially lower average unit costs than serious out-patient casualties. The average unit costs for those that recover in 3-4 months are £201 and £364 for slight and serious out-patients respectively. For mild disability, the average unit costs are £633 for slight and £743 for serious out-patient casualties. As with serious injuries, some costs are excluded, although apart from the G.P. costs, these are likely to be very small.

The unit costs of providing services were based on those in the Greater Manchester area. Again, for some of these costs, averages for England as a whole were available from the Department of Health. Where possible the Manchester unit costs were replaced with the DOH estimates to provide a better estimate of the likely costs nationally.

The weighted average medical cost per slight injury was £520 based on the combined Manchester and DOH costs.

6.3 HUMAN COSTS

As with lost output, to assess the human costs for slight injuries, casualties with slight injuries were divided between those with 'whiplash' and those with other slight injuries.

The value for the 'whiplash' injuries was derived in a similar way to that of serious casualties. The research on Willingness to Pay showed that respondents considered 'whiplash' neck injuries to be a little better than serious injuries in group X (recover in 1-3 years), but much worse than those in group W (recover in 3-4 months). Table 5 showed that the value for injury state W was £14,570 (2 per cent of the value of death) and the value for injury state X was £40,060 (5.5 per cent of the value of death). As respondents felt that whiplash was slightly better than injuries in group X, the monetary value of injury state X was reduced marginally to 5.0 per cent of the value of death, giving a value of £36,420. Assuming that half of 'whiplash' injuries are equivalent to W and half are equivalent to X, the average value of 'whiplash' injuries is £25,490.

For the remaining slight injuries, the Willingness to Pay survey included a question which asked about the sum of money that would 'just make up for' an injury involving minor cuts and bruises with a quick and complete recovery. The respondents' best estimate of this amount of money is £120.

Assuming that 20 per cent of all slight casualties in Stats19 have 'whiplash' neck injuries and 80 per cent have minor slight injuries, the weighted mean overall value of a slight injury is estimated to be £5,190.

In summary, the costs per slight casualty by element of cost is shown in Table 8.

7. ACCIDENT COSTS

Some costs cannot be attributed to a particular casualty but are a result of the accident itself. These are accident related costs comprising damage to property costs, insurance administration costs and police costs.

Estimates of the accident related costs at 1994 prices are shown in Table 9. Only costs that are directly attributed to the accident are included, therefore the costs presented here are minimum values.

TABLE 8

Summary of costs per slight casualty: June 1994 prices

Lost output	Human costs	Medical & support	Total
£1,220	£5,190	£520	£6,920

TABLE 9

Summary of costs per accident: June 1994 prices

Accident severity	Damage to property	Insurance administration	Police cost	Total
Fatal	£5,880	£160	£1,020	£7,070
Serious	£2,710	£100	£140	£2,950
Slight	£1,590	£60	£30	£1,690
All injury	£1,840	£70	£60	£1,980
Damage only	£1,020	£30	£2	£1,050
Average	£1,070	£30	£6	£1,110

The methods used to estimate each element are presented in detail in Simpson and O'Reilly (1994) and are summarised in the following sections, covering injury accidents first and then damage only accidents.

8. ACCIDENT COSTS IN INJURY ACCIDENTS

8.1 DAMAGE TO PROPERTY

A major component of accident related costs is the cost associated with damage to the vehicle or vehicles involved, and the cost of damage to other property at the scene of the accident.

A survey of insurance claims data from a major insurance company was used to obtain estimates of the cost of damage arising from accidents occurring in different locations and of different levels of severity. Accident location is defined as one of three road type categories: motorway (including A(M) roads), urban road (non-motorway road of up to and including 40 mph) and rural road (non-motorway road of 50-70 mph). Accident severity is defined as the severity of the most severely injured casualty: fatal, serious, slight or damage-only. These costs are weighted according to the proportions of accidents occurring on each type of road to give estimates for each severity level.

The payments made to claimants were grouped into broad categories reflecting the cost of damage to the policy holder's vehicle, third party vehicle(s) and other third party property, and payments made for loss of use of the vehicle and for hire of a replacement vehicle. Damage costs also included related costs such as engineers' and assessors' fees and the amount of excess on the insurance policy.

8.1.1 Vehicle damage

The cost of damage to motor vehicles by accident location and severity was estimated for each vehicle type, based on the amounts paid out as a result of damage to the policy holder's vehicle.

In addition to the cost of damage to the policy holder's vehicle, the cost of damage to other vehicles involved in road accidents was required to obtain overall vehicle damage costs. This was not estimated directly from the insurance company's payments to third parties as it was considered that they might not cover the costs of damage to <u>all</u> other vehicles involved in an accident. Some costs may be claimed from the insurance companies of other vehicles involved in the accident depending on the precise circumstances. Instead, the average cost per vehicle type (based on the cost of damage to the policyholder's vehicle) was weighted by the average numbers of vehicles of different types involved in accidents of different levels of severity derived from national statistics. Because of the small sample size, separate estimates for fatal and serious accidents were based on the weighted averages for all motor vehicles rather than weighted estimates for individual vehicle types. This provided a more accurate reflection of the total vehicle damage costs in an accident because it allowed all vehicles involved in an 'average' accident to be included.

The cost of damage to pedal cycles in injury accidents is included in vehicle damage costs. Using details of payments made for third party vehicle damage, the average cost per pedal cycle involved in injury accidents was estimated. This value was then weighted to reflect the proportions of pedal cycles involved in injury accidents on urban and rural roads reported nationally.

8.1.2 Other property damage

Damage to other property included damage to both private and public property such as personal effects, walls/fences and street furniture. Payments made for damage to third party property were identified from the insurance claims. Using details of these payments, the average costs of damage to third party property resulting from accidents of different levels of severity and on different types of road was estimated.

8.1.3 Loss of use and car hire

Victims of road accidents may suffer financially through loss of use of their vehicle. The information supplied by the insurance company included details of payments made to third parties in respect of loss of use of the vehicle and for hire of a replacement vehicle whilst repairs were carried out. The average cost of vehicle hire and payments made in view of loss of use by accident severity and location were estimated.

8.1.4 Total damage costs

The estimates calculated in previous sections for each road type were weighted by the number of accidents occurring on different road types to produce estimates for each severity group. However, basing the estimates purely on the insurance company data would over-estimate the costs associated with injury accidents as not all reported injury accidents result in a claim being pursued and those that do not are likely to have lower damage costs. The relative difference in the cost of damage in injury accidents where a claim was made and in reported injury accidents overall was required.

Data from a national questionnaire survey of some 30,000 car and van drivers (Taylor, 1990) were used to provide these estimates. Taylor's survey showed that the average cost of damage per accident for all reported serious accidents was estimated to be 9 per cent lower than the average cost of damage in serious accidents where a claim was pursued. For slight accidents the average cost of damage over all reported accidents was estimated to be 36 per cent lower than average cost of damage in slight accidents with a claim.

The damage costs for serious and slight accidents were adjusted to take account of the cost of injury accidents where no claim was pursued. It was assumed that all fatal accidents gave rise to a claim so the values derived from the insurance data were not adjusted for fatal accidents. The resulting estimates of damage costs are shown in Table 10. Figures for all injury accidents are weighted averages based on the numbers of fatal, serious, slight and damage only accidents which were reported in national statistics in 1994.

8.2 INSURANCE ADMINISTRATION

In addition to the amounts paid out in respect of claims for property damage, insurance companies also incur administration costs associated with the handling of insurance claims resulting from road accidents.

The average handling cost per claim was estimated from two sources; an individual insurance company, and several insurance companies providing insurance via the Automobile Association. The estimates were based on the average staff time required to process a claim plus some allowance for overheads and expenses. From this the average cost of handling a claim was estimated at £56.

Information on the number of transactions per claim, supplied by one insurance company, showed that the average number of transactions per claim was 2.5. Using the average cost per claim and the average number of transactions, the cost per transaction was calculated. The number of

TABLE 10

Average damage to property costs per accident by accident severity: June 1994 prices

Accident severity	Vehicle damage *	Other property damage	Loss of use/car hire	Total cost
Fatal	£5,740	£4	£130	£5,880
Serious	£2,600	£30	£80	£2,710
Slight	£1,500	£40	£60	£1,590
All injury	£1,740	£30	£70	£1,840

* Insurance company data weighted to reflect distribution of vehicles involved in accidents nationally

transactions per claim for accidents of different levels of severity was used to estimate their administrative costs. As mentioned earlier, not all accidents result in an insurance claim being pursued and so it would be inappropriate to apply the full average insurance administration cost to all accidents. Taylor's survey showed that around three quarters of reported serious accidents resulted in a claim and less than two-thirds of slight accidents. As stated earlier, it was assumed that all fatal accidents resulted in a claim.

The average costs were adjusted to take account of the proportion of accidents with no claim. The resulting costs are shown in Table 11. These figures represent minimum estimates as the information is claim based rather than accident based and there may be more than one claim per accident.

TABLE 11

Average insurance administration cost per accident by accident severity: June 1994 prices

Accident severity	Cost
Fatal	£160
Serious	£100
Slight	£60
All injury	£70

8.3 POLICE COSTS

The cost of police time in dealing with and investigating road accidents is also included within accident costs. The cost of policing accidents was estimated from a study of accidents dealt with by the Avon and Somerset Constabulary. Within Avon and Somerset, recording and administration of road accidents is done by Administrative Support Units (ASUs). Two ASUs were selected for the survey covering the relatively urban and relatively rural areas of North Bristol and Taunton respectively.

Estimates of police costs were separated into police officers' time and administrative staff time. Police officers' time was estimated in detail for fatal and serious accidents occurring within the areas covered by the ASUs because these were more time consuming and involved an officer overseeing the case who could identify all the tasks and persons involved. Slight accidents were not analysed in detail as these are relatively frequent but do not usually require as much police time. It was also difficult to identify the tasks and individuals involved in slight accidents on a case by case basis. Estimates of administrative staff time covered the length of time it took on average to administer road accidents of each severity.

8.3.1 Police officers' time

Police time was estimated in detail for six categories of accident; fatal and serious accidents on motorways, rural and urban roads. The accidents were selected on the basis that they were likely to cover a large range of tasks: for example, ranging from a fatal accident in which there was only one person/car involved and there were no subsequent investigations, to a multiple injury/fatal accident, requiring many statements, numerous police at the scene, subsequent investigations and prosecutions. A variety of accidents were selected in each category to include accidents on each road type including 'A' and 'B' roads where appropriate, pedestrian, pedal cycle, motorcycle and other vehicle accidents as well as accidents involving cars, and also single and multiple vehicle accidents.

Information was collected via face to face interviews with the police officer in charge of each case to identify the tasks associated with each accident and to estimate the time taken for each task. In addition to the main tasks there were other common elements for which estimates of the time taken were made, such as dealing with the press, typing and supervision of reports. The information sought via the questionnaire was supplemented by data from other sources such as police records, control logs, and officers' notebooks. It was only possible to obtain detailed estimates of the amount of time spent on a particular accident from the main individuals involved, typically the officer in charge of the case and, less often, the accident investigator, the vehicle examiner and the Coroner's Officer. These individuals provided estimates of the numbers and rank of others involved.

Monetary equivalents for the number of hours spent on the accidents by the police were calculated using the police ready reckoner which took account of the cost of the time spent by individuals of different ranks. Allowance was made for overtime which occurred in many of the cases in the study but was usually only a few hours.

The average length of time it took to police fatal and serious accidents for each road type was weighted by the national distribution of accidents for each road type to produce average figures. The average cost of police officers' time in dealing with road accidents was estimated at £990 for a fatal accident and £120 for a serious accident. It was assumed that on average one hour of a police constable's time was spent by officers in dealing with slight accidents. The equivalent monetary value was £20. Following the survey, these results were circulated for review to a number of other police forces.

8.3.2 Administration

The work of the ASUs included completing and checking accident books and Stats19 forms, and following up records as required. The ASUs also dealt with enquiries about

accidents from solicitors, insurance companies, hospitals and the general public which involved providing copies of an accident report book or, more commonly, more detailed information including the accident report book, statements and questionnaires.

The time taken to complete the Stats19 form, accident book and deal with enquiries was estimated for fatal, serious and slight accidents. The administrative time was largely dependent on the number of casualties, the number of witnesses and whether there were any allegations. Fatal accidents took much longer than other injury accidents but there was little difference in the amount of administration required for slight and serious accidents.

The cost of administration associated with an accident was estimated at £30 for a fatal accident and £20 for a serious or slight accident, based on an hourly rate equivalent to that of a police constable.

8.3.3 Total police costs

The best estimate of the costs involved in policing road traffic accidents is the average cost of officers' time plus the average cost of administrative time, shown in Table 12. These costs represent minimum costs as they do not include specialist police services and transport costs.

9. ACCIDENT COSTS IN DAMAGE ONLY ACCIDENTS

Some accidents do not result in personal injury but involve damage to vehicles or other property. The costs associated with these damage only accidents are also estimated.

9.1 THE NUMBER OF DAMAGE ONLY ACCIDENTS

Damage only accidents are much more frequent than injury accidents but many are not reported to the police, so they are not included in national accident statistics. To calculate the cost of damage over all types of accident, an estimate of the number of damage only accidents is needed. This is done by estimating the ratio of damage only accidents to personal injury accidents for urban and rural roads separately using data from the insurance claims survey about the different types of vehicles involved in each accident. Injury accidents were defined as those involving injury regardless of whether a claim for personal injury was made since a claim may not always be pursued, especially if the injuries were less severe.

The ratios for each road type were calculated from the ratios for each vehicle type weighted by the proportions of each involved in injury accidents recorded in national accident statistics. The number of vehicles involved in damage only accidents per vehicle involved in injury accidents was estimated at 9.0 for urban roads, 4.1 for rural roads and 7.6 for all locations, including motorways, as shown in Table 13.

To estimate the number of damage only accidents per injury accident, the number of vehicles shown in Table 13 was converted into the number of accidents using the average number of vehicles per injury accident and the average number of vehicles per damage only accident for each type of road (estimated from the insurance data). The estimated number of damage only accidents per injury accident is shown in the centre column of Table 14.

In order to calculate average costs over all accidents an estimate of the additional number of damage only accidents without claims was required. Data from Taylor's survey showed that for every damage only accident where a claim was made, there were 0.69 damage only accidents with no claim. Therefore the number of damage only accidents per injury accident shown in the centre column of Table 14 was multiplied by 0.69 and the total number of damage only accidents per injury accident was estimated at 15.2. The last column of Table 14 shows these ratios for each road type.

The costs of property damage, insurance administration and police costs resulting from damage only accidents were estimated in the same way as was done for injury accidents. The results were as follows.

TABLE 12

Average total police costs per accident by accident severity: June 1994 prices

Accident severity	Police time	Administration	Total cost
Fatal	£990	£30	£1,020
Serious	£120	£20	£140
Slight	£20	£20	£30
All injury	£50	£20	£60

TABLE 13

Estimated number of vehicles involved in damage only accidents per vehicle involved in injury accidents

Type of vehicle	Urban roads	Rural roads	All locations
Cars	9.5	4.4	8.0
Motorcycles	2.9	-	2.5
Bus/coach	3.4	2.7	3.3
Goods vehicle	14.0	4.2	10.1
All vehicles	9.0	4.1	7.6

Source: Insurance company data
- insufficient data

TABLE 14

Estimated ratio of damage only accidents to injury accidents

Road type	Number of damage only accidents per injury accident	Number of damage only accidents per injury accident (including those with no insurance claim)
Urban road	10.5	17.7
Rural road	4.6	7.8
Motorway	4.5*	7.6
All roads	9.0	15.2

* There were insufficient data from the insurance survey to change the ratio used for motorways and the value shown is therefore based on Dawson's previous research

9.2 DAMAGE TO PROPERTY

The average cost of damage to different types of vehicles on each type of road was calculated from the insurance claims data. No estimate of vehicle damage could be made for pedal cycles in damage only accidents. These values were weighted by the proportions of vehicle types involved in an average damage only accident on each type of road. The values for each road type were weighted by the proportions of damage only accidents on each road type to give an overall value. The numbers of vehicles and accidents were estimated from the numbers of vehicles involved in injury accidents and the number of injury accidents reported nationally multiplied by the ratios shown in Tables 13 and 14.

Basing the cost figures on the insurance company data alone will over-estimate the cost per damage only accident as those which do not result in a claim are likely to have costs below those estimated from the insurance data. An estimate for the average cost of damage in these cases was obtained from Taylor's survey and the costs derived from the insurance survey were adjusted to take account of the lower costs in accidents without a claim. These resulting estimates are shown in Table 15.

9.3 INSURANCE ADMINISTRATION

The administration cost per damage only claim was estimated from the cost per transaction and the average number of transactions per damage only claim. Again, this value was adjusted as Taylor's survey showed that only 59 per cent of damage only accidents resulted in a claim. The average value across all damage only accidents was estimated at £30 per damage only accident.

9.4 POLICE COSTS

For injury accidents police costs included police officer's time and administrative staff time. For damage only accidents, there are assumed to be no police officers' costs. Estimates of administrative staff time covered the length of time it took on average to administer damage only accidents. This was converted to a monetary value based on an hourly rate equivalent to that of a police constable.

Taylor's survey of car/van accidents showed that only 26 per cent of all damage accidents were reported to the police. The average cost per damage only accident over all damage only accidents was therefore estimated to be £2.

TABLE 15

Average cost of damage to property per damage only accident: June 1994 prices

Vehicle damage *	Other property damage	Loss of use/car hire	Total cost
£980	£20	£20	£1,020

* Insurance company data weighted to reflect distribution of vehicles involved in accidents nationally

10. SUMMARY OF CASUALTY AND ACCIDENT COSTS

This section brings together the values for each component of casualty related costs and accident related costs estimated in previous sections. The values represent the benefit to society of reducing the risk of road accidents and injuries.

Table 16 shows the average cost per accident for accidents occurring in 1994. There may be more than one casualty per accident so estimates of the total casualty related costs per accident take into account the average number of casualties at each level of severity involved in fatal, serious or slight accidents. The latest estimates of these numbers can be found in the DOT's annual publication, Road Accidents Great Britain: The Casualty Report.

Average values across all accidents take into account the number of damage only accidents. Many of these are not reported to the police, therefore the number of damage only accidents is estimated from those appearing in the insurance data, plus those considered not to have resulted in a claim, estimated from Taylor's postal survey.

It is important to note that these estimates should be treated as minimum estimates because a 'cautious' approach was adopted in deriving the figures. Some costs were not included but these are likely to be small amounts when averaged over casualties at each severity level. Examples of such costs are: costs to the individual associated with travelling to hospital or staying in hospital, medication, time off work (other than lost earnings), costs associated with long term disability (such as the cost of adapting homes or cars) and cost of private medical treatment, and costs to carers. Some costs to the nation are also excluded: long-term costs to the Department of Health and the Department of Social Security (for casualties who do not recover within 18 months of the accident), and the costs of G.P. consultations.

Other accident related costs, such as the cost of the fire and rescue service, court costs and delays to other vehicles following road accidents have not been estimated.

This report has summarised the results of new work which revised almost every component of the cost of accidents and casualties. Using a Willingness to Pay approach to valuing personal safety means that the methods used for costing fatal and non-fatal casualties are now on a consistent basis. It has also brought the methodology used in the UK to the forefront of thinking in road safety world wide. Accident and casualty costs have been estimated using more refined techniques from updated and more comprehensive information on the nature and consequences of road accidents and injuries.

This means that when the results are used to evaluate new road schemes or road safety initiatives, the values will

TABLE 16

Summary of costs per accident occurring in 1994: June 1994 prices

Type of accident	Casualty related costs			Accident related costs			Total
	Lost output	Human costs	Medical costs	Damage to property	Insurance administration	Police costs	
Fatal	£305,310	£596,660	£4,110	£5,880	£160	£1,020	£913,140
Serious	£13,660	£83,280	£8,190	£2,710	£100	£140	£108,080
Slight	£1,570	£6,710	£670	£1,590	£60	£30	£10,630
All injury	£7,910	£27,940	£1,980	£1,840	£70	£60	£39,800
Damage only	-	-	-	£1,020	£30	£2	£1,050
All accidents	£490	£1,740	£120	£1,070	£30	£6	£3,460

provide a better reflection of the benefit to society of reducing road accidents and injuries.

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12. REFERENCES

Dalvi, M Q (1988). The value of life and safety: a search for a consensus estimate. Department of Transport, London.

Dalvi, M Q (1992). The valuation of non-fatal road casualty costs: estimation of consensus value. Report to The Department of Transport.

Department of Transport (1988). Valuation of road accident fatalities. Department of Transport, London.

Department of Transport (1995). Road Accident Costs 1994. *Highways Economics Note 1,* Department of Transport, London.

Galasko, C S B, P A Murray, M Hodson, R J Tunbridge, and J Everest (1986). Long term disability following road traffic accidents. *Department of Transport, TRRL Research Report 59.* Transport and Road Research Laboratory, Crowthorne.

Hopkin, J M, and D M O'Reilly (1993). Revaluation of the cost of road accident casualties: 1992 revision. *TRL Research Report 378,* Transport Research Laboratory, Crowthorne.

Hopkin, J M, P A Murray, M Pitcher and C S B Galasko (1993). Police and hospital recording of road accident casualties: a study in Greater Manchester. *TRL Research Report 379,* Transport Research Laboratory, Crowthorne.

Ives, D and D Kemp (1992). Revaluation of non-fatal casualty costs: a review of literature on relative utility loss methodologies. *TRL Contractor Report 307,* Transport Research Laboratory, Crowthorne.

Ives, D, B Soby, D Ball, and R Kemp (1992). Revaluation of non-fatal casualty costs: a report of the application of the relative utility loss approach. *TRL Contractor Report 329,* Transport Research Laboratory, Crowthorne.

Jones-Lee, M W (1989). The value of avoidance of non-fatal road injuries: an exploratory study. Report to the Department of Transport. University of Newcastle upon Tyne.

Jones-Lee, M W (1991). Altruism and the value of other people's safety. *Journal of Risk and Uncertainty, 4,* pp 213-9.

Jones-Lee, M W (1992). Paternalistic altruism and the value of statistical life. *Economic Journal, 102,* pp80-90.

Jones-Lee, M W, M Hammerton, and P R Philips (1985). The value of safety: results from a national sample survey. *Economic Journal, 95,* pp 49-72.

Jones-Lee, M W, G Loomes, D M O'Reilly, and P R Philips (1992). The value of preventing non-fatal road injuries: findings of a willingness-to-pay national sample survey. *TRL Contractor Report 330,* Transport Research Laboratory, Crowthorne.

Murray P A, M Pitcher and C S B Galasko (1993). The cost of long-term disability resulting from road traffic accidents: four year study - final report. *TRL Project Report 45.* Transport Research Laboratory, Crowthorne.

Murray P A, M Pitcher and C S B Galasko (1994). The cost of some road accident injuries within the DOT serious and slight range. *TRL Project Report 106.* Transport Research Laboratory, Crowthorne.

O'Reilly, D M (1992). Costing road traffic accidents: the value of lost output. Transport Research Laboratory *Working Paper WP/SRC/09.* Transport Research Laboratory, Crowthorne. (Unpublished report, available on direct personal application only)

Simpson, H F and D M O'Reilly (1994). Revaluation of the accident related costs of road accidents. *TRL Project Report 56.* Transport Research Laboratory, Crowthorne.

Taylor, M C (1990). The cost of vehicle damage resulting from road accidents. *TRRL Research Report RR256.* Transport and Road Research Laboratory, Crowthorne.

APPENDIX A: DEPARTMENT OF TRANSPORT DEFINITIONS OF INJURY SEVERITY

Fatal

Death from a road accident which occurs within 30 days of the accident.

Serious

Casualties who die as a result of their injuries more than 30 days after the accident.

All casualties who are admitted to hospital as an in-patient as a result of their injuries.

Casualties who are not detained in hospital but have any of the following injuries are also included: fractures, concussion, internal injuries, crushings, severe lacerations, and severe general shock requiring medical treatment.

Slight

Casualties with injuries such as a sprain, bruise or cut which are not judged to be severe, or slight shock requiring roadside attention.

APPENDIX B: HEALTH AND SOCIAL SECURITY COSTS

The results of research on costs to the health service and to the Department of Social Security are summarised here, because unlike other components of accident and casualty costs, they have not been published elsewhere in their final form. (The results are based on re-analysis of research reported in Murray, Pitcher and Galasko, 1993 and 1994).

Data on use of medical and support services were collected in two linked panel studies of road accident casualties seen at hospitals in the Manchester area, which were conducted for TRL by the Department of Orthopaedic Surgery at Manchester University. These studies identified the amount of hospital treatment received by road accident patients, their use of ambulance and district nurse services, and the Social Security benefits received. The first study focused on road accident casualties with fractures involving the upper or lower limbs (classified by DOT as serious), and those with a soft tissue injury to their cervical spine ('whiplash'[2], classified by DOT as slight); the second study sampled road accident casualties with other serious and slight injuries, and excluded those with whiplash or fractures of upper and lower limbs. Patients were interviewed a few days after the accident, and then every six months. Fracture and whiplash patients were followed for a period of four years after the accident, and patients with other injuries were followed for an 18 month period, unless they had fully recovered earlier.

B.1 HEALTH SERVICE COSTS

To estimate health service costs for all serious and all slight road accident casualties, the data were re-analysed and combined at TRL, as follows:

i) To ensure that the data from the two studies were comparable, cases were excluded if patients dropped out after the initial interview, and treatment and costs were included only if they were incurred in the first 18 months after the accident. The analysis was then based on interviews with 100 'fracture' patients, 383 others with serious injuries, 357 'whiplash' patients and 246 with other slight injuries.

ii) 'Whiplash' and 'fracture' patients were assigned to injury state groups (as described in Section 5.1) on the basis of their length of hospital stay, recovery time and level of disability four years after the accident. The patients with other injuries had already been assigned to these groups on the basis of clinical judgement of the team at Manchester University.

iii) Data from the two studies were combined for each injury state group by weighting on the basis of the ratio of whiplash patients to others with slight injuries treated at hospitals, and the ratio of limb fracture patients to others with serious injuries treated at hospitals. These ratios were derived from the numbers of road accident patients included in, and excluded from, the sample for the second study.

iv) A check for bias associated with the method of sample selection was carried out. Samples of road accident casualties treated at hospitals are known to be different from casualties recorded in Stats19, in terms of the nature and severity of their injuries (Hopkin et al, 1993). The cases were matched manually with Stats19 records at TRL, on the basis of details of the casualty and the accident, and classified according to whether they were judged to be 'exact', 'probable' or 'possible' matches. Health service costs were then calculated for those which were either exact or probable matches. The cost estimates were within 1 per cent of those derived for all casualties treated in hospital, so it was concluded that there was no need to correct for sample selection bias.

Tables B1 and B2 show average use of health services per casualty in each injury state group, for DOT serious and slight injuries, and the weighted mean for all casualties, based on the proportion of casualties in each injury state group. The services included in the tables are mainly hospital-based, and represent the major components of health service costs.

However some services were not included. G.P. consultations were excluded, because G.P.s are paid on the basis of the patients registered with the practice, not the number of patient consultations. The use of home help and meals on wheels services was investigated, but these were used by very few road accident patients, so when averaged over all cases, they would not add to the costs.

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[2] The true medical definition of a whiplash injury is a soft tissue injury to the cervical spine as a result of a rear impact, but this study included such injuries irrespective of whether they were a result of rear, front or side impacts.

TABLE B1

Average use of health services per casualty over 18 month period: serious injuries

	Injury state group							
	Recover 3-4 months		Recover 1-3 years	Mild permanent disability		Some permanent disability with scarring	Paraplegia/ quadriplegia & severe head injuries	All serious: weighted mean
	Out-patient	In-patient	In-patient	Out-patient	In-patient			
	F	W	X	V	S	R	N & L	
In-patient days								
Intensive care unit	0.00	0.00	0.30	0.00	0.35	3.25	34.00	1.25
Neurosurgery unit	0.00	0.00	0.04	0.00	0.03	0.44	0.00	0.08
Plastic surgery unit	0.00	0.02	0.00	0.00	0.04	1.24	2.33	0.22
Ward	0.04	2.37	21.33	0.04	26.84	57.28	126.00	21.18
Outpatient visits								
A & E department	1.30	1.18	1.54	1.90	1.14	1.66	1.01	1.42
Orthopaedic clinic	0.10	0.05	0.15	0.00	0.83	0.66	0.00	0.26
Fracture clinic	2.16	3.07	5.19	3.29	6.35	7.75	5.33	4.72
Physiotherapy clinic	1.50	2.91	5.04	8.04	16.35	20.82	15.34	7.85
Neurosurgery clinic	0.00	0.02	0.00	0.00	0.08	0.13	0.00	0.03
Plastic surgery clinic	0.00	0.07	0.00	0.04	0.00	0.16	1.00	0.05
Other clinic	0.22	0.45	0.54	0.89	1.72	2.68	3.68	0.97
Other services								
Emergency ambulance journeys	0.78	1.07	1.19	0.81	1.31	1.49	5.00	1.21
Other ambulance journeys	0.00	0.13	4.97	0.00	13.23	6.81	0.00	4.28
District nurse hours	0.04	0.25	0.35	0.00	0.78	2.00	4.85	0.62
Appliances	1.03	1.04	1.02	1.12	1.02	1.01	0.13	1.01

Hospital appliances and orthoses can be grouped under three headings: standard items which are not re-usable such as slings, ankle braces and collars, items which are loaned to patients such as crutches and wheelchairs, and items which are individually tailored to the patient, such as artificial limbs, spinal jackets and callipers. Cost estimates were based only on use of those in the first group: the standard items which are not re-usable. The few cases of individually tailored items were excluded, as were the loaned items.

Ambulance journeys were split into those involving fully equipped emergency ambulances, and those providing non-emergency transport. It was assumed that transport from the accident to the A & E department, and transfers and transport of the more severely injured cases involved emergency ambulances, and that other ambulance journeys were in non-emergency vehicles.

The health service costs were estimated by multiplying the figures in Tables B1 and B2 by the unit cost of providing the services in 1991/2, and then adjusting to June 1994 prices using the health service costs index. Initially, the data on unit costs of services were those for the Manchester area where the two studies were carried out. Figures for England as a whole are now available from the Department of Health for some of the costs. The Manchester figures were therefore replaced with the DOH estimates where possible to provide a best estimate of the likely costs.

The unit costs for the Manchester area and for England are shown in Table B3. In-patient services are quoted on a cost per day basis and out-patient on a cost per attendance. The ambulance service is costed on a 'per journey' basis.

The average costs per serious and slight casualty based on the combined unit costs are shown in Tables B4 and B5.

TABLE B2

Average use of health services per casualty over 18 month period: slight injuries

	Injury state group Out-patient		All slight:
	Recover 3-4 months	Mild permanent disability	weighted mean
	A	B	
In-patient days			
Intensive care unit	0.00	0.00	0.00
Neurosurgery unit	0.00	0.00	0.00
Plastic surgery unit	0.00	0.00	0.00
Ward	0.01	0.69	0.15
Outpatient visits			
A & E department	1.55	1.84	1.61
Orthopaedic clinic	0.03	0.29	0.08
Fracture clinic	0.05	0.58	0.16
Physiotherapy clinic	1.89	7.37	3.00
Neurosurgery clinic	0.00	0.00	0.00
Plastic surgery clinic	0.00	0.00	0.00
Other clinic	0.10	0.29	0.14
Other services			
Emergency ambulance journeys	0.42	0.48	0.44
Other ambulance journeys	0.03	0.06	0.04
District nurse hours	0.00	0.15	0.03
Appliances	0.62	0.65	0.63

TABLE B3

Unit costs of services (91/92 prices)

Service	Cost	
	Manchester	England (DOH)
In-patient care		
Intensive care unit	£781.50	-
Neurosurgery unit	£311.70	-
Plastic surgery unit	£34.50	-
Ward	£152.30	£181.00
Outpatient treatment		
Accident & Emergency	£19.83	£35.00
Orthopaedic clinic	£49.50	£46.00
Fracture clinic	£57.00	-
Physiotherapy	£37.75	-
Neurosurgery clinic	£90.00	-
Plastic surgery clinic	£34.50	-
Other clinic	£20.64	-
Other services		
Ambulance (Emergency)	£76.51	£108.00
Ambulance (Non-emergency)	£7.45	-
District nurse	£13.00	-
Appliances	£5.00	-

TABLE B4

Average cost of health services per casualty over 18 month period: serious injuries (£, June 1994 prices)

	Injury state group							
	Recover 3-4 months		Recover 1-3 years	Mild permanent disability		Some permanent disability with scarring	Paraplegia/ quadriplegia & severe head injuries	All serious: weighted mean
	Out-patient	In-patient	In-patient	Out-patient	In-patient			
	F	W	X	V	S	R	N & L	
In-patient care								
Intensive care unit	0	4	260	0	299	2,787	29,132	1,075
Neurosurgery unit	0	0	14	0	10	150	0	26
Plastic surgery unit	0	8	0	0	14	418	787	73
Ward	8	470	4,233	9	5,326	11,367	25,005	4,204
Outpatient treatment								
A & E department	50	45	59	73	44	64	39	55
Orthopaedic clinic	5	2	8	0	42	33	0	13
Fracture clinic	135	192	325	205	397	485	333	295
Physiotherapy clinic	62	120	209	333	677	862	635	325
Neurosurgery clinic	0	2	0	0	8	13	0	3
Plastic surgery clinic	0	2	0	2	0	6	38	2
Other clinic	5	10	12	20	39	61	83	22
Other services								
Emergency ambulance	93	127	140	96	155	176	592	143
Other ambulance	0	1	41	0	108	56	0	35
District nurse	1	4	5	0	11	28	69	9
Appliances	6	6	6	6	6	6	1	6
Total	364	994	5,311	743	7,134	16,511	56,714	6,284

B.2 SOCIAL SECURITY COSTS

The Social Security costs were derived from details of all the benefits received by patients in the two Manchester studies that were directly a result of their road accident: Statutory Sick Pay, Sickness Benefit, Unemployment Benefit, Income Support, Family Credit, Mobility Allowance, Attendance Allowance, Severe Disability Allowance, and Invalidity Allowance. These payments were made over varying periods of time, often intermittently, and at different levels depending on people's financial circumstances. The actual payments received were recorded, and then standardised to June 1994 prices.

The complexity of the payments meant that Social Security costs in the original studies were calculated manually on a case by case basis. It was not therefore practical to re-analyse the data as described above for the health service costs. Therefore Social Security costs were not derived separately for each injury state group, but overall estimates for serious and slight injuries were made. For the 'whiplash' and 'fracture' patients, Social Security costs in each year after the accident were available. Costs in the first 18 months were estimated by adding half of the costs in the second year to the costs in the first year. For patients with other injuries, costs over the 18 month period were available. To derive figures for all serious and all slight casualties, the two sets of data were combined using the ratios of whiplash to other patients with slight injuries, and of fracture to other patients with serious injuries, as for the health service costs.

Social Security costs were estimated at £687 per serious casualty and £228 per slight casualty at June 1994 prices. This is likely to under-estimate costs for serious casualties as it does not take account of the variation in all serious casualties. For example, using this method of estimation for the health service costs produced a cost per casualty which was about half that which obtained by separating injury state groups and weighting them together to estimate costs for all serious injuries.

B.3 TOTAL MEDICAL AND SUPPORT COSTS

The best estimate of the total medical and support costs is the health service cost plus the estimated cost of Social Security payments. Table B6 shows the cost of medical and support services estimated for each injury state group and the weighted average for serious and slight casualties overall.

TABLE B5

Average cost of health services per casualty over 18 month period: slight injuries (£, June 1994 prices)

	Injury state group Out-patient		All slight:
	Recover 3-4 months A	Mild permanent disability B	weighted mean
In-patient care			
Intensive care unit	0	0	0
Neurosurgery unit	0	0	0
Plastic surgery unit	0	0	0
Ward	3	137	30
Outpatient treatment			
A & E department	59	71	62
Orthopaedic clinic	2	15	4
Fracture clinic	3	37	10
Physiotherapy clinic	78	305	124
Neurosurgery clinic	0	0	0
Plastic surgery clinic	0	0	0
Other clinic	2	7	3
Other services			
Emergency ambulance	50	57	52
Other ambulance	0	1	0
District nurse	0	2	0
Appliances	3	4	3
Total	201	633	288

TABLE B6

Medical and support costs for injury state groups: serious and slight casualties (June 1994 prices)

Injury state	Health service	Social security	Total cost
Serious			
Recover 3-4 months (Out-patient): F	£365	£687	£1,052
Recover 3-4 months (In-patient): W	£992	£687	£1,679
Recover 1-3 years (In-patient): X	£5,311	£687	£5,998
Mild permanent disability (Out-patient): V	£745	£687	£1,432
Mild permanent disability (In-patient): S	£7,135	£687	£7,822
Some permanent disability with scarring: R	£16,512	£687	£17,199
Paraplegia/quadriplegia & severe head injuries: L & N	£56,714	£687	£57,401
All serious	£6,284	£687	£6,971
Slight			
Recover 3-4 months (Out-patient): F	£200	£228	£428
Mild permanent disability (Out-patient): V	£633	£228	£861
All slight	£288	£228	£516