



MEMORANDUM

ROAD TRAFFIC ACCIDENT COSTS 1990

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ROAD TRAFFIC ACCIDENT COSTS IN FINLAND IN 1990

The costs caused by road traffic accidents have been calculated in Finland since the 1960's. The methods of calculation have changed somewhat during this period, but essentially they have remained the same since the 1970's, when the Parliamentary Traffic Committee determined the method for calculating the costs. The accident cost calculations presented here are based on a just completed study on road accidents in 1988. This study was carried out by the Business Economics Research Centre as a commission from the Finnish National Road Administration.

1 THE CALCULATION METHOD AND THE COST COMPONENTS

Accident costs have been estimated according to the **social willingness-to-pay** principle. The costs are divided into two parts: the real economic losses and the welfare losses i.e. human sufferings.

The economic losses contain the costs due to resources used in repairing the damages caused by the accident, the production losses due to the accident, and other similar real losses. The real economic losses are studied for the whole national economy.

No generally accepted method for estimating the welfare losses exist. Their evaluation is here based on the social willingness-to-pay. The welfare losses are determined through using as an alternative cost the resources contributed by the society in the institutional care of person with a 100 percent invalidity. The value thus obtained can be regarded as a minimum value for the welfare loss.

All costs and losses caused by a traffic accident are difficult or even impossible to evaluate in monetary terms. Such cost components are listed in Appendix 3.

1.1 Economic costs

The economic costs are divided into direct and indirect costs. Direct costs consist of such costs components that are directly caused through repairing the damages due to the accidents i.e. hospital expenses and material damages.

The indirect costs are usually caused to third parties in an accident i.e. not to the persons involved in the accident. The indirect costs are usually due to lost work con-

tribution, which cause additional costs and profit losses for the society or private organizations.

Direct costs

The following hospital care measures are included in the calculation of the direct cost components: the transportation of the injured, first aid and hospital care, additional care in an institute or at home, rehabilitation, and funerals.

Accidents cause administrative expenses to insurance companies, police authorities, the judiciary, and the prison establishment. The accident research and statistical costs can also be included in this component. The administrative costs included in the calculation contain only the costs due to the results of the accident. The costs due to the prevention of accidents are not included despite their substantial magnitude e.g. most of the police activities.

The direct costs also include the material damages to the vehicles and the traffic environment resulting from the accident. Their magnitude has been estimated on the basis of the compensations by the insurance companies.

Indirect costs

The premature death due to a traffic accident causes production losses, if the deceased belonged to the potential labour power. The potential labour power consists of the following groups: the employed labour, the unemployed, students, draftees, and persons in household duties.

The production loss per a traffic accident fatality is estimated by dividing the gross national product by the number of persons in the potential labour power. When the age distribution of the accident victims is known, the production losses can be calculated for the expected remaining life span. In the calculations, the production growth rate was 2.4 %, and the rate of discount was 4 %. The same production loss value is used for all fatalities, whether the victim was a member of the labour power or not.

The production loss for persons suffering a 100 % invalidity in the accident is calculated in the same manner as for the fatalities. For persons partially disabled, the production loss has been calculated by using the working ability handicap level. These are obtained from the income loss compensations paid by the insurance companies. The production losses due to sick leaves are calculated by using the average length of sick leaves.

Private enterprises and the society have to maintain some extra resources in case of traffic accidents, and also this causes additional costs. The costs due to the additional resources are evaluated here only for the transportation fleet from the compensations paid by the insurance companies for down time costs, rental costs to compensate for damaged vehicles, and the additional travel costs.

1.2 Welfare losses

No generally accepted method exists for the evaluation of the human or welfare losses of the persons prematurely killed or disabled in traffic i.e. the »value of life«. In empirical studies, the valuation of persons prematurely killed has usually been based on the **human capital method** or the **willingness-to-pay method**.

In the human capital method, the value of life is determined through assessed/potential economical and production losses caused by the accident. The method has been criticized for considering only the person's value as a part of the production process. The humanitarian aspect i.e. the person's value as a human being is neglected.

In the economic theoretical sense, the willingness-to-pay method is well suited for the determination of the value of life. In practice, this valuation is, however, difficult. The »statistical value« of life has been estimated from two different angles: by determining the willingness-to-pay from survey or interview studies, or by studying the choices made by people.

In surveys, the willingness-to-pay estimates have been derived by asking the inhabitants of a certain area, what they would be willing to pay in order to decrease their risk of being involved in a severe traffic accident. As the risk of a severe accident is quite small, it is quite questionable whether the persons can interpret small changes in the probabilities. On the other hand, the level of income has a profound effect on the willingness to pay for increased safety according to some studies: the estimates of the value of life derived from the surveys have a large variation. In addition, the various studies give very different conclusions.

In other countries the willingness-to-pay has been the subject of many recent studies, but in Finland such studies have not been made. Therefore, the willingness-to-pay has been determined by the other method i.e. by studying the choices made. By studying choices made by the individuals or the society we can indirectly assess, how much the decrease in risk is appreciated in practice.

At the individual level, the value of life has been determined by e.g. comparing the salaries of some risky occupations to those of other occupations. The social willingness-to-pay has been measured e.g. by studying the investments made by the society.

The society has to evaluate the benefits and costs of its investments when allocating its meagre resources. The investments in the care of infants and elderly, and the health services and hospital care are examples of such decisions. The welfare society is willing to make these investments although they are not economically profitable.

The estimation of welfare losses due to persons killed or injured in traffic accidents is here based on the social willingness-to-pay principle. The calculations are based on the society's willingness to contribute its resources in keeping a person with a 100 % invalidity due to an accident alive in institutional care. This cost of institutional care can be regarded as the minimum value of welfare losses of the victims of severe accidents.

The welfare loss of a person killed in an accident is the same as the average cost of the institutional care of a totally disabled person for his/her expected life span. The welfare loss of a permanently disabled person has been estimated in proportion to the medical disability degree. For persons injured in traffic accidents the average disability degree is 46 %. For persons slightly injured, the welfare loss has been estimated in proportion to the ratio of the number of sick leave days to the aforementioned time of institutional care. Of those temporarily disabled, the more severely injured have an average sick leave of 40 days, and the less severely injured a leave of 10 days.

2 UNIT COST VALUES OF ACCIDENTS

Injury types were determined according to the severity of the accidents in order to estimate the unit cost values. The costs and effects of an accident depend on the injury type. The cost components are estimated for the various accident and injury types. The medical care costs were estimated for the injury types, and the administrative costs, material damages, and the additional resource costs for the accident types only, as all data required was not available by injury type.

The unit cost values for the different accident and injury types have been calculated by summing their cost components. The total costs of road traffic accidents have been calculated by multiplying the unit costs of different accident types with the number of corresponding accidents (all traffic accidents).

2.1 Unit cost values by injury type

The costs by injury type are evaluated at the price level of 1990. The injury types are: fatalities, permanent injuries, including all disabled persons, and temporary injuries, divided further into severe and slight injuries. The injury types are described in more detail in Appendix 1. The unit cost values by injury type are shown in Table 1.

Table 1. Road traffic accident unit cost values by injury type in 1990 (FIM, all roads).

Cost component	Injury type			
	Fatality	Permanent injury	Temporary injury	
			Severe	Slight
Transportation	600	600	1 100	400
Hospital, first aid	-	112 000	12 200	2 000
Additional care	-	520 000	-	-
Rehabilitation	-	65 000	1 500	-
Funeral	8 500	-	-	-
Production loss	2 913 000	1 935 000	20 300	5 100
Economic losses, total	2 922 000	2 633 000	35 100	7 500
Welfare loss	4 630 000	2 112 000	12 900	3 200
Total costs	7 550 000	4 745 000	48 000	10 700

On the basis of Table 1, the following average injury costs can be calculated:

- injury average 276,000 FIM
- non fatal injury average 86,800 FIM

2.2 Unit cost values by accident type

The costs by accident type are determined by assessing the injuries caused by different types of accidents, and by adding to them the administrative and material costs, and the costs due to maintaining additional resources. On average, the accident types result in different injury types as shown in Table 2.

Table 2. The average number of injuries by accident type.

Injury type	Accident type		
	Fatal	Resulting in permanent injury	Resulting in temporary injury
Fatalities	1.11	-	-
Permanent injury	0.09	1.16	-
Temporary injury	0.763	0.50	1.21

The administrative and additional resource costs were not divided by accident type due to insufficient data. They were evenly divided for all accident types. The road traffic accident unit costs are shown in Table 3 at the price level of January, 1990.

Table 3. The road traffic accident unit cost by accident type in 1990 (FIM).

Cost component	Accident type			
	Fatal	Resulting in permanent injury	Resulting in temporary injury	Material damages only
Injuries	8 842 000	5 505 000	35 800	-
Material damages	36 000	15 400	15 400	9 100
Administration	1 200	1 200	1 200	1 200
Additional resources	600	600	600	600
Total	8 880 000	5 522 000	53 000	10 900

The following average costs by accident type can be calculated from Table 3:

- Injury accident	375,000 FIM
- Non fatal injury accident	128,000 FIM
- Material damages only accident	10,900 FIM
- Road traffic accident average	51,000 FIM

3 TOTAL COSTS OF ROAD TRAFFIC ACCIDENTS 1988

The most current data on traffic accidents exists for 1988. As all accidents are not reported, we have multiplied the number of accidents with the corresponding correction coefficients. The accidents not reported result either in material damages only or in slight injuries. Table 4 shows the corrected accident numbers and the total accident costs by accident type in 1988. The cost level is for January, 1990. The costs by cost component are shown in Appendix 2.

Table 4. Total costs of road traffic accidents in 1988 (FIM).

Accident type	Number of accidents	Costs (MFIM)
Fatal	590	5 240.0
Resulting in permanent injury	270	1 490.9
Resulting in temporary injury	19 000	1 012.3
Material damages only	160 000	1 744.0
Total	179 960	9 487.2

4 ACCIDENT COSTS PER KILOMETRE DRIVEN

The accident costs per kilometre driven have been calculated by road class on the basis of accident rate data. The costs were calculated by speed limit, and divided among vehicle types according to their accident involvement. The costs per kilometre driven are average costs for the road types.

The decrease in accident costs for increasing speed limits is due to the improved road conditions e.g. road geometry. The high accident costs of low speed limits (50 and 60 km/h) on main and secondary roads are affected by the different transport mode distribution in urban areas or their vicinity with substantial percentage of unprotected road users and their accidents. The higher junction density in urban areas also affects the number of accidents.

Note that on the same road a higher speed limit results in more accidents and higher accident rates

The accident costs per kilometre driven for light and heavy type vehicles are shown in Tables 5 and 6.

Table 5. Accident costs of light type vehicle (p/km).

Car	Speed limit (km/h)								
	40	50	60	70	80	90	100	110	120
Road type									
Motorway				9	9	9	9	9	9
Motortrafficway				12	12	12	12		
Main/Secondary road	28	28	23	23	21	17	14		
Regional road	23	23	21	18	17	16	14		
Local/oil gravel	17	17	17	16	14				
Local/gravel	17	17	17	16	14				

Table 6. Accident costs of heavy type vehicle (p/km)

Lorry	Speed limit (km/h)								
	40	50	60	70	80	90	100	110	120
Road type									
Motorway				28	28	28	28		
Motortrafficway			40	34	34	34	34		
Main/Secondary road	85	85	68	63	57				
Regional road	75	75	63	50	50				
Local/oil gravel	63	63	50	40	40				
Local/gravel	63	63	50	40	40				

5 COMPARISON OF COSTS TO PREVIOUS ESTIMATES

The new accident cost unit values for severe accidents are notably higher than the values previously used. The main reasons for this are the production growth rate and the rate of discount chosen for the calculations. Both of these rates affect significantly the magnitude of the largest cost components i.e. production loss and extended institutional care.

Previous estimates have been based on a production growth rate of 3 % and a rate of discount of 7.5 % (the gross national product per capita and the cost of institutional care were expected to increase by 3 % annually). In the new calculations, the production growth rate as well as the real increase in the costs of institutional care were chosen as 2.4 % annually, and the rate of discount was 4 %. Had the previous values been used, the new unit costs values would have been much closer to the previous ones.

The magnitude of the welfare component is also affected by new information about the disability degrees. In the previous calculations, the disability degree and welfare loss of a permanently injured person was estimated as 20 % of the corresponding value for a person killed in an accident, according to Swedish studies. New information from the insurance companies shows that the average medical disability degree of persons permanently injured in Finnish road accidents is 46 %. Therefore the welfare loss of the severely injured is clearly higher in the new calculations than before.

The average accident costs and the total accident costs are affected by the statistical data used in the calculations. The costs presented here are based on as extensive data base as possible. The accident statistics based on police reports as well as those from the insurance companies have been used with correction coefficients in order to obtain the total accident numbers. This enables a reasonably correct estimate of total accident costs.

The accidents included through the use of the correction coefficients, i.e. those not reported by the police or to the insurance companies, are usually slight accidents. For the cost of the average accident, this causes a decrease. The statistical data base does not, however, affect the costs of severe accidents.

ROAD ACCIDENT INJURY TYPES

I Injuries

1. Fatality

The person involved in an accident dies within 30 days of the accident.

2. Permanent injury

The person involved in an accident is disabled for the remaining life span.

3. Temporary injury

3a The person involved in an accident receives severe injuries but regains full working ability after treatment.

3b The person involved in an accident receives slight injuries but regains full working ability after treatment.

II Material damages

1. Vehicle and other material damages

**TOTAL COSTS OF TRAFFIC ACCIDENTS IN 1988
BY COST COMPONENT.**

Cost component	Total cost MFIM
Medical costs	460.0
- transportation	18.2
- first aid	58.7
- hospital care	177.7
- additional care	165.7
- rehabilitation	33.9
- funerals	5.9
Material damage costs	1 466.4
Administrative costs	230.0
- insurance companies	146.0
- police	41.5
- judiciary	13.7
- prison establishment	23.4
- research and statistics	5.4
Additional resources	76.1
Production losses	2 875.0
- premature deaths	1 979.7
- 100 % invalidity	366.7
- partly disabled	260.0
- sick leaves	268.3
Welfare losses	4 070.3
- premature deaths	3 138.4
- 100 % invalidity	347.2
- partly disabled	584.7
Total costs	9 487.0

LIST OF COST COMPONENTS NOT INCLUDED IN THE CALCULATIONS

It was not possible to include all cost components in the calculation of road traffic accident costs due to the lack of data. Some other cost components were difficult to confine. Such components are listed below.

Temporary effects on production and working places such as maintaining of additional resources (not just transportation fleet) or temporary additional costs to production

Normal household work

Leisure activities benefiting the society

Retraining of a disabled

Cost differences by the accident location, the difference of consequences

Restriction of administrative costs; should the accident prevention costs be also included in addition to the costs caused by the accidents, e.g. the entire traffic and vehicle insurance system

Costs due to drinking and driving, these are not compensated for by the traffic insurance, and data is thus not available

The development of the accident statistics in order to facilitate the monitoring of accident costs