USER COSTS IN ROAD TRAFFIC 1989

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Tutkimustoimiston vuosittain julkaisema *Tieliikenteen ajokustannukset*-julkaisu ilmestyy myös englanninkielisenä versiona. Sisällöltään suomen- ja englanninkieliset painokset ovat lähes samanlaisia.

Julkaisua "*User costs in road traffic 1989*" on rajoitetusti saatavana tutkimustoimistosta Sirkka Salkosalmelta (p. 90-154 2475).

Apulaisjohtaja Kirill Härkänen

Liitteenä

User costs in road traffic 1989

Jakelu

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Foreword

This report contains unit values of road user costs for the economic evaluation of road projects.

The report is published annually by the Research Centre of Road and Waterways Administration of Finland (RWA). The vehicle costs are calculated by the Development Centre of RWA.

Deputy Director Kirill Härkänen

Foreword

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Notes to the Foreign Reader

This report is a translation of the original Finnish publication "*Tieliikenteen ajokustannukset 1989*", published annually by the Research Centre of RWA's Planning Division. English edition by Nils Halla and Arto Tevajärvi.

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The currency in the cost tables is Finnish Mark (FIM) and metric units are used throughout.

Some exchange rates (April 6, 1989): 1 FIM = 100 penniä (p)

1 USD	=	4,23 FIM
1 GBP	=	7,19
1 SEK	=	0,66
1 NOK	=	0,62
1 DKK	=	0,58
1 DEM	=	2,26
1 FRF	=	0,67

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RWA - Finland

To the Reader

The Research Centre of the Roads and Waterways Administration (RWA) has ever since 1978 been responsible for publishing this annual report on road user costs. Figures and values in this report are outlined according to the roadkeepers point of view on purchase and operating costs of vehicles. These values are meant to be used in economic evaluations of public road projects.

Road user costs consist of three cost components: *vehicle, time and accident costs*. They also describe in a broader sense the consequences which affect the use of vehicles. *Vehicle costs* can be linked with such expressions as mobility, use of money and driving comfort. *Time costs* respectively are connected to easier accessibility and driving comfort. *Accident costs* are linked with traffic safety.

The vehicle cost values are presented as prime cost prices including indirect taxes. The percentage of indirect taxes are presented, so the calculations can be made without taxes if necessary. The share of capital cost in vehicle costs can also be found in the tables.

The principles in the defining of user costs have changed during years. So it is inevitable that some values are only limitedly comparable with the values in the very early reports. However, since 1983 the principles have been almost the same. Last year the calculation of indirect taxes in vehicle costs was checked.

Compared to the values in the year 1988:

In *vehicle costs* there is rise especially in service prices and a small rise in fuel prices. Also the rate of interest has gone up.

There is an additional rise in *time costs* because the average number of persons in a vehicle has been revised to be consistent with the latest studies of personal mobility (in Finland).

In *accident costs* the average price of an traffic accident has been reduced because the proportional share of serious accidents has decreased.

1 SUMMARY OF THE ROAD USER COSTS IN 1989

The price level in tables is according to January 1989. Principles in evaluating the unit value costs are found in paragraphs 3.1 - 3.3.

A: Vehicle costs (annual average)

Vehicle	*Vehicle-cost p/km*	*Share of indirect taxes p/km*	*%*
Passenger car	116	37	32
Van	131	30	23
Bus	350	42	12
Truck	382	92	24

B: Time costs

Passenger car

Purpose of trip	*FIM/hour /person*	*/vehicle*[1]
Work	70,65	134,25
Business (work/personal)	15,75	28,35
Leisure and holiday	9,00	20,70
Combined value	(17,10)	35,20

Other cars

Vehicle	*FIM/hour /person*	*/vehicle*[2]
Van	63,10	63,10
Truck	79,20	87,10
Bus (on public roads)		538,20

1 Value of time of the average number of passengers (incl. the driver) in the vehicle.

C: Accident costs in public roads[1]

Type of injury/ Accident type	*Cost (FIM)*
Fatalities	3 500 000
Permanently injured	1 250 000
Temporarily injured	38 000
Injured in average	98 000
Fatal accident	4 000 000
Injurious accident	150 000
Injury accident (average)	625 000
Material damages only	22 000
Road accident on average	155 000[2]

Tables on pages 14...19 contain also time and accident costs as p/km.

1 Values are based on RWA's accident statistics.
2 The average cost of a road accident has fallen from the previous year. The reason is the diminishing proportional share of serious accidents.

D. Road user costs in graphs

Fig. 1: **Percent shares of different components in vehicle costs of passenger cars and trucks on an average (speed: pass. car 90 km/h and truck: 80 km/h)**

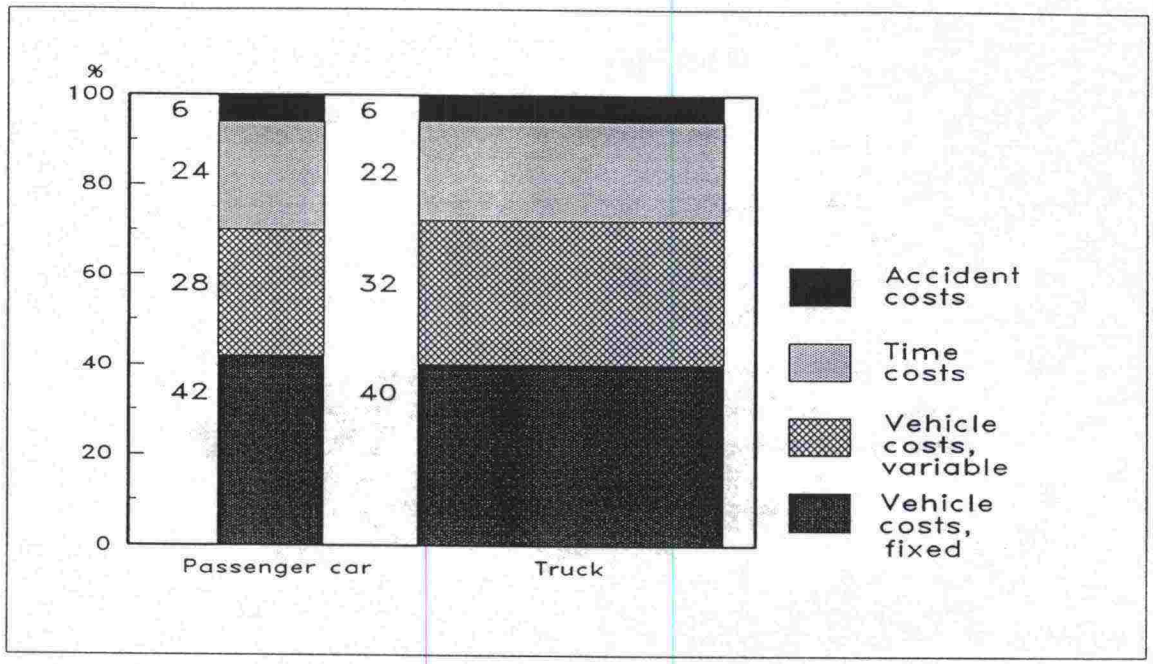


Fig. 2: **Average formation of vehicle cost of different types of cars**

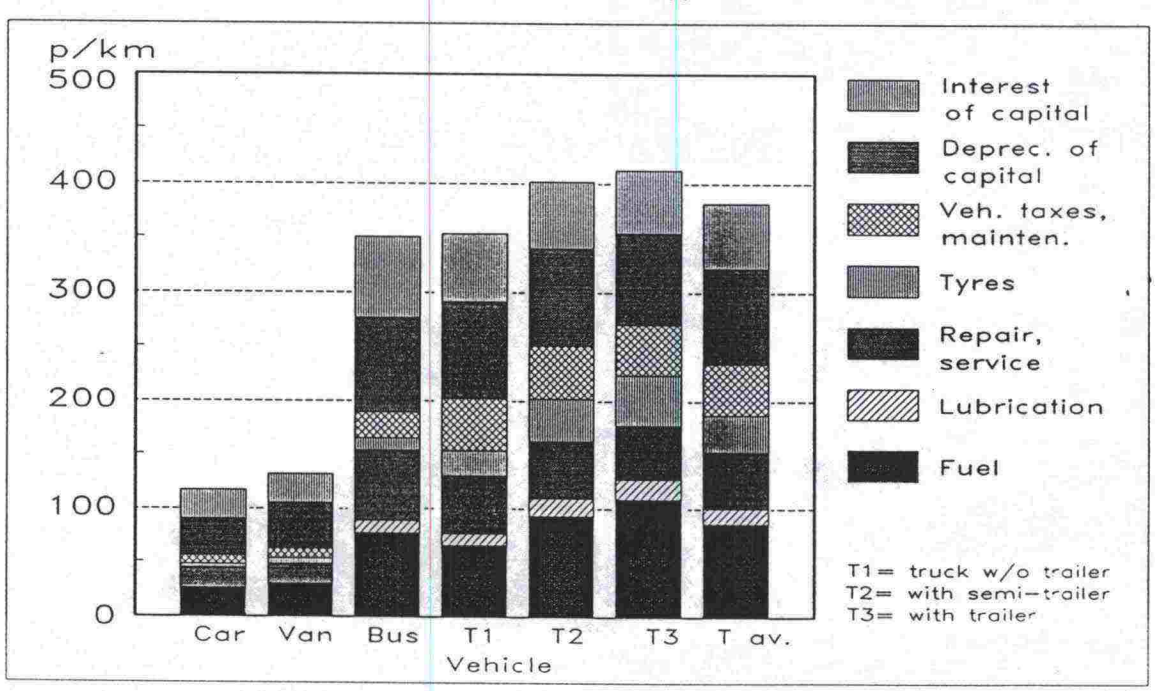


Fig. 3: Average vehicle costs of passenger car on different road classes and at various speeds

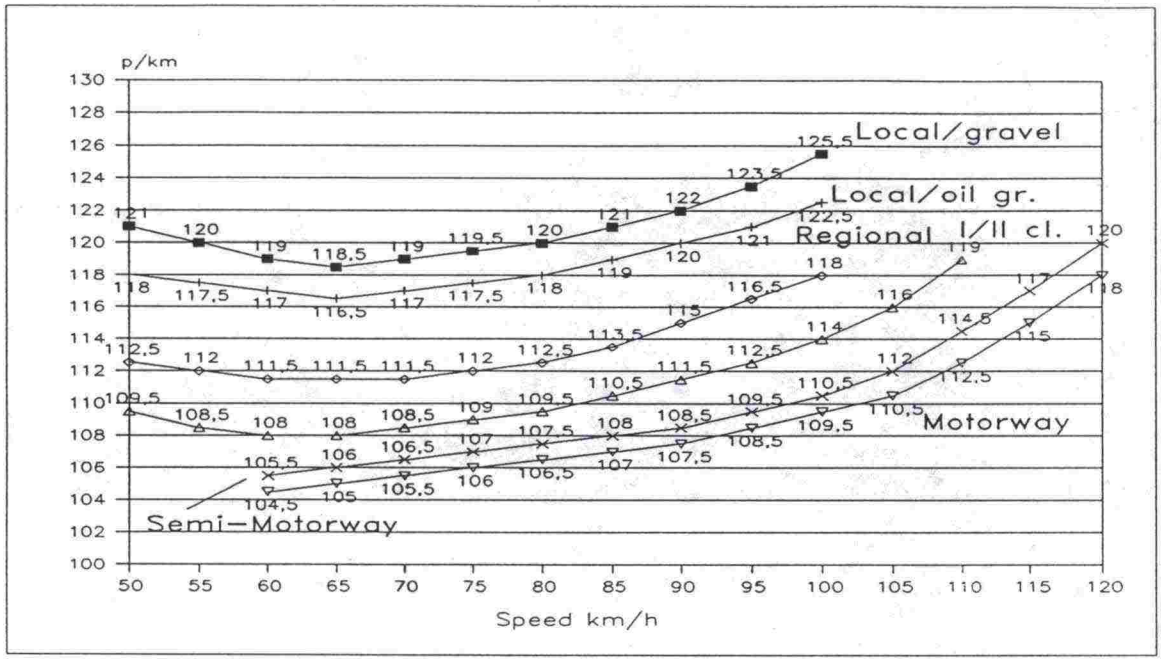


Fig. 4: Average vehicle costs of truck on different road classes and at various speeds

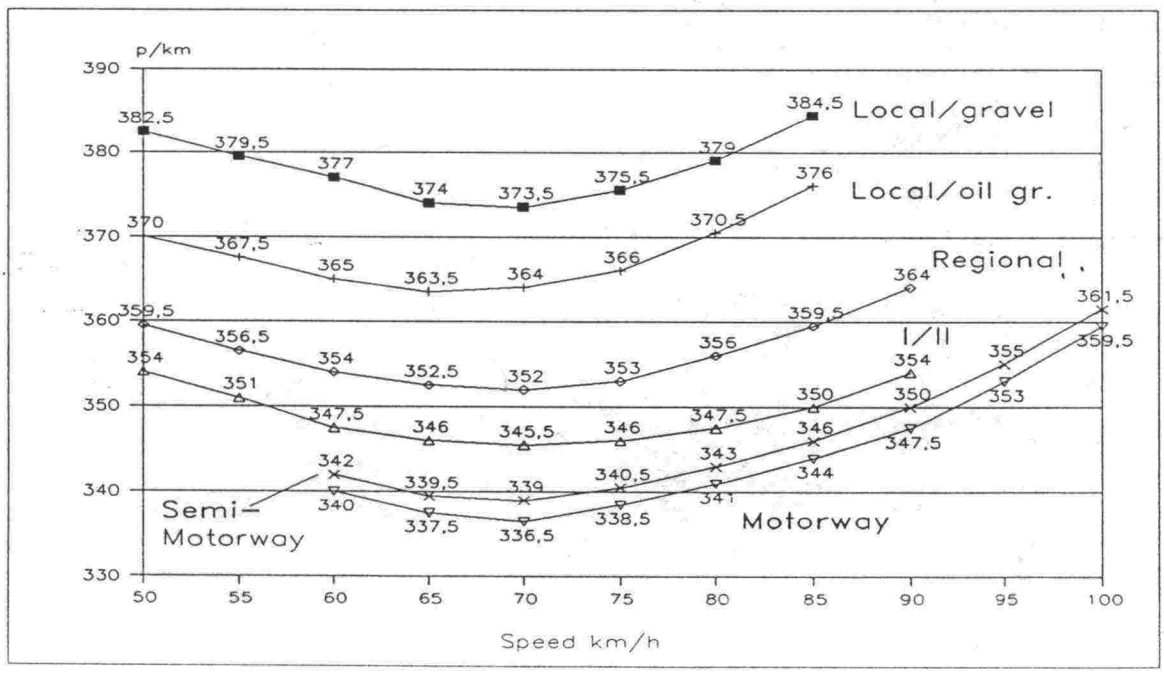
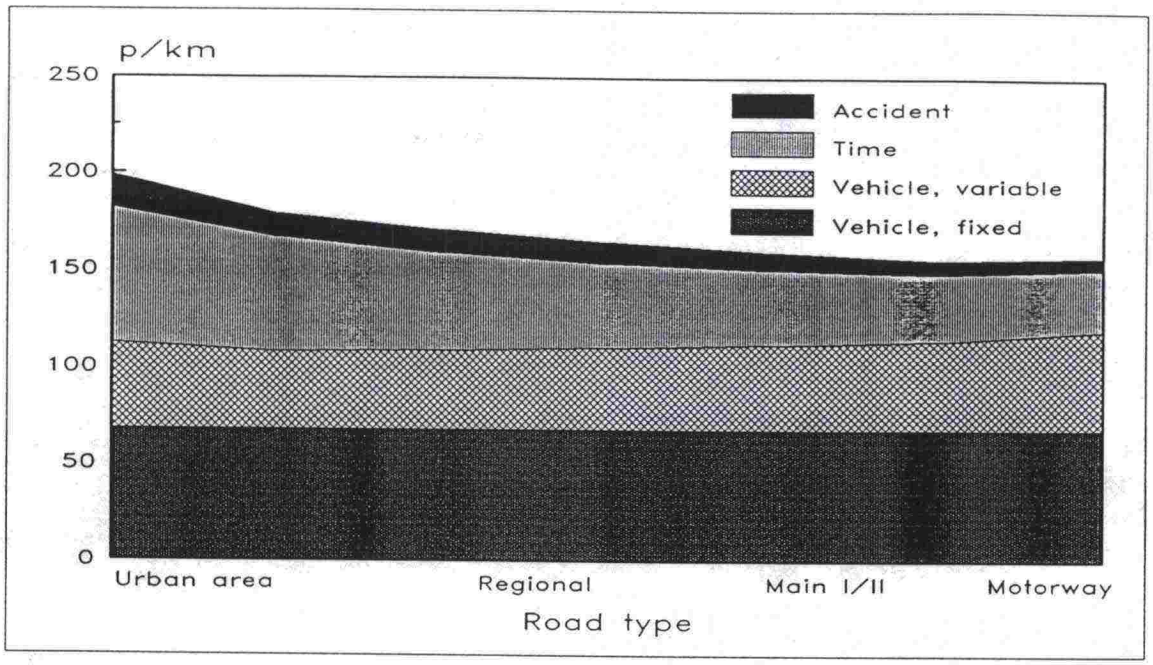
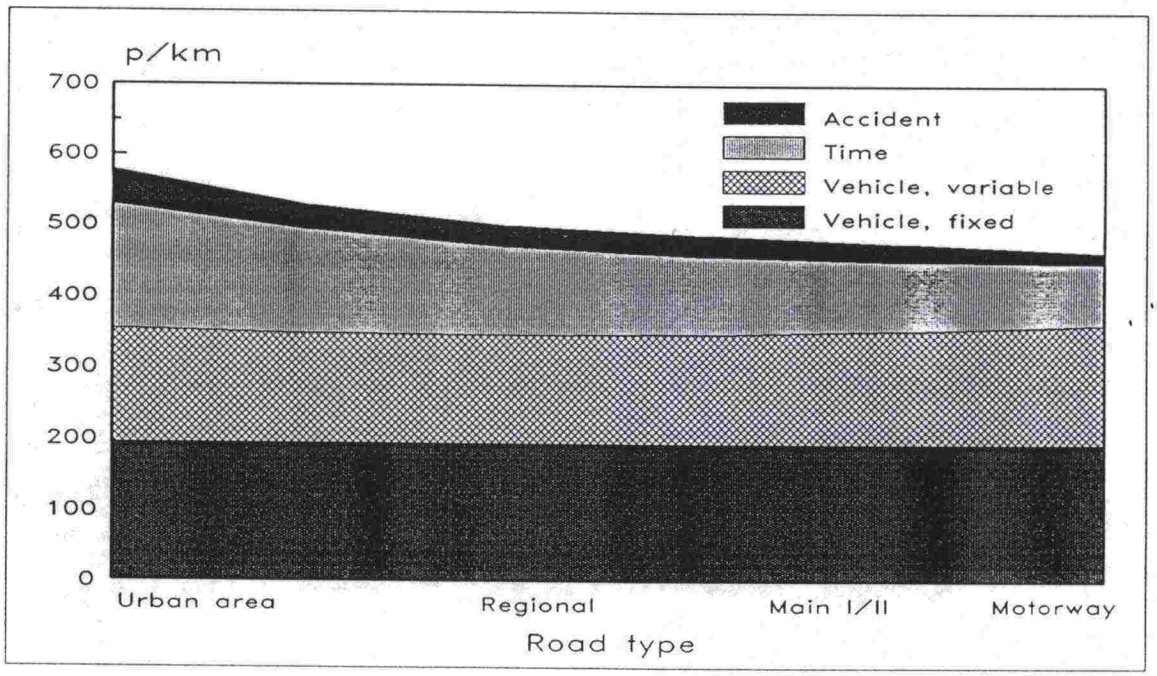


Fig. 5: Shares of cost components in user cost of passenger car, in different road classes



Kuva 6: Shares of cost components in user cost of truck, in different road classes



2 ROAD USER COSTS FOR THE YEAR 1989: TABLES

NOTES TO THE USER

For the economic evaluation of road projects' alternatives there are in tables 1...6 and 9...11 user costs of an average passenger car and truck at various speeds. In economic evaluations the speed is the average speed of the vehicles (passenger car, truck) on road sections in question.

Vehicle and accident costs have been estimated for road classes (classified according to their functional meaning) to correspond to the present average traffic conditions on that road class in summertime when the speed is relatively steady. The table values of vehicle costs represent the average condition of a road class. The average values or basic values should be corrected by correction factors to correspond to the actual pavement conditions of a road. The correction factors are given in table form and they depend on the evenness of the road's surface. Usually it is recommended to use the basic values (average condition).

The effect of hilliness and traffic flow to vehicle costs can be estimated using the change values given in tables 1 and 2 (change p/km, plus or minus).

First must be done the possible correction due to the condition of the road surface and after that, if needed, corrections due to other than average road geometry and traffic volume.

When evaluating alternative maintenance measures should the weather and road condition been taken into consideration. Correction factors for different weather and road conditions are in tables 13 and 14, but in normal evaluation of road projects they are not needed.

In tables 9...11 there are average user costs for urban area conditions. These values can be used when evaluating congested traffic on main road projects. When the speed is steady, vehicle costs in tables 1 and 2 are also valid for urban area evaluations.

Some judgement is needed when using cost values, because the average values as such seldom correspond to the reality on some certain road project.

Eg. due to a reconstruction project of a road the speed of vehicles as a rule increases and the characteristics of the road improve although the functional class of the road do not change. Changes in vehicle costs and rate of accidents/costs must then be estimated comparing different rows of the cost tables.

In economic evaluations can vans be treated as passenger cars and busses as trucks, if there is no special reason to handle them separately.

If the lengths of the alternative road projects vary to a great extent, it is recommended to use vehicle costs for passenger cars without fixed costs.

EXAMPLES OF DEFINING VEHICLE COSTS

Example 1 Regional road (asphalt concrete) will be reconstructed, the functional class does not change.

Actual average speeds (km/h):

- present road 1. year:	car 85, truck 81
- present road 10. year:	car 75, truck 75
- improved road:	whole evaluation period: car 90, truck 81

Vehicle costs for the present road should be taken from the row of regional road:

- present road 1. year:	car 114, truck 356 p/km
- present road 10. year:	112,5+2 and 354+5 p/km (extra cost due to increased traffic added)

The actual class of the improved road is Main II, so the vehicle costs must be taken respectively from the Main I/II row. Here the increased traffic has no effect on vehicle costs:

car 112, truck 348 p/km

Example 2 Regional road, which is hilly, curved and with poor pavement will be improved. The vehicle costs of present road are the same as on poor local road with oil gravel pavement.

Actual speeds (km/h):

- present road:	car 78, truck 70
- improved road:	car 82, truck 78

Respective vehicle costs are:

- present road:	car 1,03x118 =	122 p/km
	truck 1,03x364 =	375 p/km
- improved road:	car	113 p/km
	truck	355 p/km

Example 3 The vehicle costs in congested main roads should be taken for rush hours from table 9 and for the rest of the time from tables 1 and 2 (the possible extra cost due to above average traffic must be added).

GENERAL INFORMATION

ABBREVIATIONS OF ROAD TYPES

Motorway	=	Motorway
Semi-Mw	=	Semi-motorway (motortrafficway)
Main I/II	=	Major roads, I and II class
Regional	=	Regional roads
Local/oil gr.	=	Collector/Connecting roads, oil gravel
Local gravel	=	Collector/Connecting roads, gravel

ROAD AND TRAFFIC CONDITIONS

The cost values are calculated to correspond to the following average conditions on different types of roads (excl. the urban area tables):

Road	*Pavement*	*Hilliness m/km*	*Curvature grad/km*	*Traffic volume*[1]
Motorway	AC	-	-	17000
Semi-Mw	AC	-	-	6000
Main I/II	AC	10	20	2800
Regional	AC	15	50	1200
Local/oil gr.	OG	20	90	400
Local/gravel	GR	20	90	150

1 Average daily traffic (ADT)

VEHICLE COSTS - Passenger car

Table 1: Vehicle costs of passenger car (p/km)

Passenger car	*Speed km/h*							
Road type	*50*	*60*	*70*	*80*	*90*	*100*	*110*	*120*
Motorway	-	105	106	107	108	110	113	118
Semi-mw	-	106	107	108	109	111	115	120
Main I/II	110	108	119	110	112	114	119	
Regional	113	112	112	113	115	118		
Local/oil gr.	118	117	117	118	120	123		
Local/gravel	121	119	119	120	122	126		

Share of fixed costs is 68 p/km
See also pic. 3 (p. 9)

Correction factors:

Condition of pavement:	*Good*	*Average*	*Poor*
Motorway,Semi-Mw,Main I/II,Regional	0,99	1,00	1,03
Local/oil gravel	0,99	1,00	1,03
Local/gravel	0,99	1,00	1,03

Change p/km:

Hilliness:		*0 m/km*	*Average*	*35 m/km*
Motorway,Semi-Mw		-	-	-
Main I/II,Regional		-1	-	+2
Local		-1	-	+2
Traffic volume (ADT):	*-100%*	*Average*	*+200%*	*+300%*
Motorway	-	-	-	+1
Semi-Mw	-	-	+1	+2
Main I/II	-1	-	+1	+3
Regional	-2	-	+2	+3
Local	-2	-	+2	+4

VEHICLE COSTS - Truck

Table 2: Vehicle costs of truck (p/km)

Truck	*Speed km/h*							
Road	*50*	*60*	*70*	*80*	*90*	*100*	*110*	*120*
Motorway	-	340	337	341	348	360		
Semi-mw	-	342	340	343	350	362		
Main I/II	354	348	346	348	354			
Regional	360	354	352	356	364			
Local oil gr.	370	365	364	371				
Local/gravel	383	377	374	379				

Share of fixed costs 195 p/km
See also pic. 4 (p. 9)

Correction factors:

Condition of pavement:	*Good*	*Average*	*Poor*
Motorway,Semi-Mw,Main I/II,Regional	0,99	1,00	1,03
Local/oil gravel	0,99	1,00	1,03
Local/gravel	0,99	1,00	1,03

Change p/km:

Hilliness:	*0 m/km*	*Average*	*35 m/km*
Motorway,Semi-Mw	-	-	+4
Main I/II,Regional	-3	-	+10
Local	-5	-	+11

Traffic volume (ADT):	*-100%*	*Average*	*+200%*	*+300%*
Motorway	-	-	-	-
Semi-Mw	-	-	-	-
Main I/II	-3	-	+2	+5
Regional	-5	-	+5	+8
Local	-5	-	+5	+9

TIME COSTS - Passenger cars and trucks

Table 3: Time costs of passenger car (p/km)

Passenger car	*Speed km/h*							
Road	*50*	*60*	*70*	*80*	*90*	*100*	*110*	*120*
Motorway	70	59	50	44	35	32	32	29
Semi-mw	70	59	50	44	35	32	32	29
Main I/II	70	59	50	44	35	32	32	
Regional	70	59	50	44	35	32		
Local/oil gr.	70	59	50	44	35	32		
Local/gravel	70	59	50	44	35	32		

Table 4: Time costs of trucks (p/km)

Truck	*Speed km/h*							
Road	*50*	*60*	*70*	*80*	*90*	*100*	*110*	*120*
Motorway	174	145	124	109	97	87		
Semi-mw	174	145	124	109	97	87		
Main I/II	174	145	124	109	97	87		
Regional	174	145	124	109	97	87		
Local/oil gr.	174	145	124	109	97	87		
Local/gravel	174	145	124	109	97	87		

ACCIDENT COSTS - Passenger cars and trucks

Table 5: Accident costs of passenger cars (p/km)

Passenger car	*Speed km/h*							
Road	*50*	*60*	*70*	*80*	*90*	*100*	*110*	*120*
Motorway	-	-	5	5	5	5	5	5
Semi-mw	-	-	6	6	6	6	6	6
Main I/II	17	12	12	11	9	7		
Regional	15	11	10	9	8	7		
Local/oil gr.	13	10	9	8	9			
Local/gravel	13	10	9	8	9			

Table 6: Accident costs of trucks (p/km)

Truck	*Speed km/h*							
Road	*50*	*60*	*70*	*80*	*90*	*100*	*110*	*120*
Motorway	-	-	15	15	15	15		
Semi-mw	-	20	15	15	15	15		
Main I/II	50	35	30	30	25			
Regional	45	30	25	25				
Local/oil gr.	35	25	20	20				
Local/gravel	35	25	20	20				

Note:

The actual vehicle speed depends on the speed limit, which is based on road and traffic conditions. So the values in the tables 5 and 6 represent in a way the dependency of accident costs in local road and traffic conditions.

These values can not be used when the effects of speed limits are evaluated. When e.g. the speed limit is raised from 80 to 100 km/h, increases the number of accidents usually 30...100 %.

RATE OF ACCIDENTS - Cars on average

Table 7: Average rate of accidents (all cars, all accidents, number of accidents/100 mill. autokm)

All cars	*Speed km/h*							
Road	*50*	*60*	*70*	*80*	*90*	*100*	*110*	*120*
Motorway	-	-	-	35	35	35	30	35
Semi-Mw	-	-	-	50	45	40	40	
Main I/II	250	120	70	60	55	50		
Regional	150	100	70	60	55	50		
Local/oil gr.	140	80	70	70	70			
Local/gravel	140	80	70	70	70			

Table 8: Average rate of accidents (all cars, accidents with personal injuries or fatalities, number of accidents/100 mill. autokm)

All cars	*Speed km/h*							
Road	*50*	*60*	*70*	*80*	*90*	*100*	*110*	*120*
Motorway	-	-	-	10	10	10	10	10
Semi-mw	-	-	-	15	15	13	13	
Main I/II	70	35	25	20	16	13		
Regional	60	30	25	20	16	13		
Local/oil gr.	50	30	25	20	20			
Local/gravel	50	30	25	20	20			

Note:

The actual vehicle speed depends on the speed limit, which is based on road and traffic conditions. So the values in the tables 7 and 8 represent in a way the dependency of rate of accidentss in local road and traffic conditions.

These values can not be used when the effects of speed limits are evaluated. When e.g. the speed limit is raised from 80 to 100 km/h, increases the number of accidents usually 30...100 %.

ROAD USER COSTS - Urban area conditions

Table 9: Vehicle costs (p/km)

Speed (km/h)	*Passenger car*	*Truck*
20	132	423
30	122	393
40	117	377
50	113	360
60	109	354

Table 10: Time costs (p/km)

Speed (km/h)	*Passenger car*	*Truck*
20	176	436
30	117	290
40	88	218
50	70	174
60	59	145

Table 11: Accident costs (p/km, actual speed before accident)

Speed (km/h)	*Passenger car*	*Truck*
20	8	25
30	10	30
40	12	35
50	15	45
60	17	50

Table 12: Rate of accidents (number of accidents/100 mill. autokm)

Speed (km/h)	*Passenger car*	*Truck*
20	50	20
30	60	25
40	75	30
50	90	40
60	110	50

Table 13: Correction factors for different road conditions: *vehicle costs*
(same figures apply to passenger cars and trucks)

Road	Summer conditions[1]			Winter fact.[2]		Winter conditions[3]	
		AC[4]	*OG*	*AC*	*OG*		
Motorway	Good	0,99				Thin snow (<5cm)	1,05
Semi-Mw	Average[5]	1,00		1,03		Thick snow(5-10cm)	1,10
Main I/II	Poor	1,03				Packed snow	1,05
						Slush (5cm)	1,10
						Icy road	1,05
Regional	Good	0,99	1,00			Thin snow (<5cm)	1,05
roads	Average[5]	1,00	1,02	1,03	1,05	Thick snow (5-10cm)	1,12
	Poor	1,03	1,05			Packed snow	1,08
						Slush (5cm)	1,10
						Icy road	1,08
		OG	*GR*	*OG*	*GR*		
Local	Good	0,99	1,00			Thin snow (<5cm)	1,05
roads	Average[5]	1,00	1,01	1,05	1,08	Thick snow (5-10cm)	1,12
	Poor	1,03	1,05			Packed snow	1,10
						Icy road	1,10

Other conditions: Frost damage period

Regional	Light	1,10/1,15	Local	Light	1,15/1,15
roads	Severe	1,15/-	roads	Severe	1,20/-

Table 14: Correction factors for different road conditions: *accident costs*

Road	Summer conditions	Winter conditions (passenger car = truck)		
All	Minor effect	Slush (5cm)	10	
		Icy road	30	Southern Finland
			10	Rest of country
		Winter factor av.	1,5	

1 The condition of the pavement
2 Extra costs due to the winter (uncovered, dry surface of the road)
3 Notice the speed effect: the average speed of cars reduces
4 AC = asphalt concrete, OG = oil gravel, GR = gravel
5 The cost values in this report are for average conditions

FUNCTION APPROXIMATIONS OF COST TABLES

K = cost p/km v = speed km/h

Vehicle costs/passenger car:

Motorway	$K = 118{,}62 - 0{,}43v + 0{,}0035v^2$
Semi-Mw	$K = 125{,}17 - 0{,}58v + 0{,}0044v^2$
Main I/II	$K = 129{,}72 - 0{,}65v + 0{,}0050v^2$
Regional	$K = 133{,}00 - 0{,}65v + 0{,}0050v^2$
Local/oil gr.	$K = 138{,}00 - 0{,}65v + 0{,}0050v^2$
Local/gravel	$K = 138{,}29 - 0{,}56v + 0{,}0041v^2$
	$K = 153{,}60 - 1{,}29v + 0{,}0093v^2$

Vehicle costs/trucks

Motorway	$K = 118{,}62 - 0{,}43v + 0{,}0035v^2$
Semi-Mw	$K = 125{,}17 - 0{,}58v + 0{,}0044v^2$
Main I/II	$K = 129{,}72 - 0{,}65v + 0{,}0050v^2$
Regional	$K = 133{,}00 - 0{,}65v + 0{,}0050v^2$
Local/oil gr.	$K = 138{,}00 - 0{,}65v + 0{,}0050v^2$
Local/gravel	$K = 138{,}29 - 0{,}56v + 0{,}0041v^2$
	$K = 153{,}60 - 1{,}29v + 0{,}0093v^2$

Time costs *a = 35,20 b = 87,10*

Passenger car	$K = 100a/v$
Truck	$K = 100b/v$

Accident costs/passenger car

Motorway	$K = 5{,}0$
Semi-Mw	$K = 6{,}0$
Main I/II	$K = 30{,}86 - 0{,}36v + 0{,}0013v^2$
Regional	$K = 35{,}00 - 0{,}54v + 0{,}0027v^2$
Local roads	$K = 43{,}66 - 0{,}90v + 0{,}0057v^2$

Accident costs/trucks

Motorway	$K = 15{,}0$
Semi-Mw	$K = 68{,}29 - 1{,}24v + 0{,}071v^2$
Main I/II	$K = 156{,}43 - 3{,}05v + 0{,}018v^2$
Regional	$K = 227{,}25 - 5{,}53v + 0{,}038v^2$
Local roads	$K = 160{,}00 - 3{,}74v + 0{,}025v^2$

Note: Values calculated by function approximations may differ from table values (error ± 1,5p, in accident costs even more).

3 PRINCIPLES OF DETERMINING UNIT COST VALUES

3.1 Vehicle costs

The user costs have been evaluated from vehicle owner's point of view. So the values have been taken as prime cost prices including indirect taxes on the price of fuel, spare parts and vehicles.

The rate of interest in investments into busses and trucks has been valuated according to profit demand of 11%. Respectively the calculated rate of interest for passenger cars is 9,5% and for vans 10%.

The depreciation periods of average vehicles used in calculations correspond to the average expected life cycle of each vehicle type.

Passenger car

The basic data for the estimation of vehicle cost are:

- Fuel consumption	8,1 l/100 km	
- Average annual kilometrage	17 500 km[1]	
- Purchase price	88 000 FIM	
- Depreciation time	13 years	
- Price deduction	15 %/a	
- Rate of interest	9,5 %/a	
- Fuel prices[2]	3,42 FIM/l	(99-oct.,45%)
	3,21 FIM/l	(92-oct.,40%)
	2,53 FIM/l	(diesel, 15%)
	3,20 FIM/l	(average)

Table 15: Annual average vehicle cost of passenger car (p/km)

Cost factor	*p/km*	
Fuel	25,9	Variable
Repair, service and lubrication	18,6	share
Tyre-wear	3,6	48,1 p/km
Motor vehicle tax, maintenance	7,4	Fixed
Capital depreciation	34,0	share
Capital interest	26,6	68,0 p/km
Total	116,1	

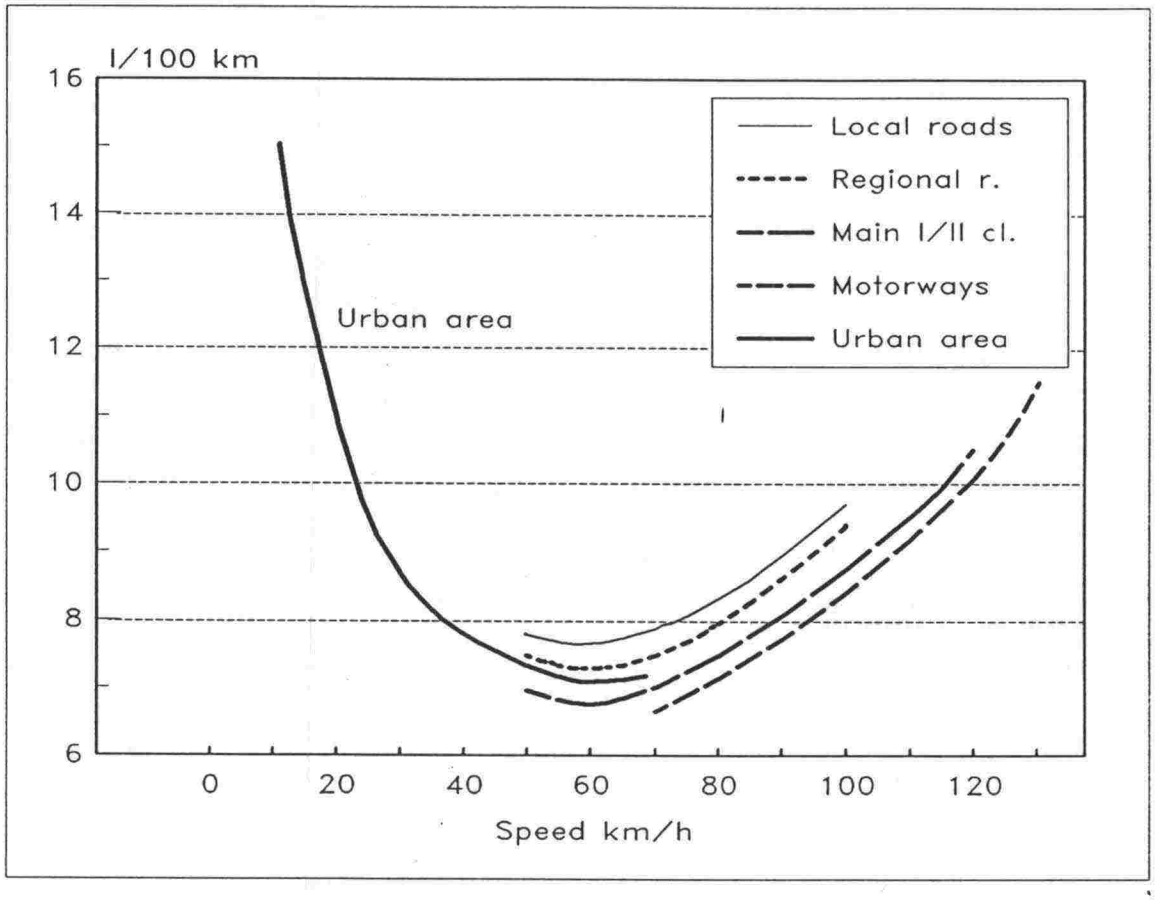
Insurance fee (13,2 p/km) is not included in vehicle costs, because accident costs have been defined separately.

1 Proportion of diesel-driven cars of the passenger car fleet is 7,7% and respectively 15% of the traffic performance of passenger cars.

2 Average prices in gas-stations in Finland 1.2.1989

The dependency between fuel consumption and speed on different road classes for an average passenger car is shown in figure 7. The consumption curves are estimated for each road class under their average traffic conditions (free-flowing traffic).

Fig. 7: Average fuel consumption of passenger car in different speeds and road classes (steady traffic flow)



With the curves the fuel consumption of a passenger car can be estimated when it moves on a certain type of road in free-flowing traffic at a fairly steady speed. They can not be directly used when comparing different roads and speed alternatives: if the road and traffic conditions (local speed limits, gradients, junctions, congestion etc.) cause local and/or occasional slow-down of speed, fuel consumption increases noticeable and that is not taken into account in estimating these curves.

Van

The basic data for the estimation of vehicle cost are:

- Fuel consumption	11 l/100 km	
- Average annual kilometrage	16 500 km	
- Purchase price	78 000 FIM	
- Depreciation time	10 years	
- Price deduction	20 %/a	
- Rate of interest	10 %/a	
- Fuel prices[1]	3,21 FIM/l	(92-oct.)
	2,53 FIM/l	(diesel)
	2,73 FIM/l	(average)

- About 30% of the kilometrage of the vans is estimated to be driven using gas

Table 16: Annual average vehicle cost of a van (p/km)

Cost factor	*p/km*	
Fuel	30,0	Variable
Repair, service and lubrication	17,9	share
Tyre-wear	5,4	53,3 p/km
Maintenance	9,0	Fixed
Capital depreciation	42,2	share
Capital interest	26,5	77,7 p/km
Total	131,0	

Insurance fee (12,9 p/km) is not included into vehicle costs, because accident costs have been defined separately.

1 Average prices in gas-stations in Finland 1.2.1989

Bus

The basic data for the estimation of vehicle costs are:

- Fuel consumption	30,5 l/100 km
- Average annual kilometrage	70 000 km
- Purchase price	790 000 FIM
- Depreciation time	13 years
- Price reduction	20 %/a
- Rate of interest	11 %/a
- Fuel prices[1]	2,53 FIM/l (diesel)

Table 17: Annual average vehicle cost of a bus (p/km)

Cost factor	*p/km*	
Fuel	76,9	Variable
Lubrication	11,5	share
Repair, service	64,7	164,5 p/km
Tyre-wear	11,4	
Maintenance, overhead costs	23,8	Fixed
Capital depreciation	87,5	share
Capital interest	74,2	185,5 p/km
Total	350,0	

Insurance fee (18,3 p/km) is not included into vehicle costs, because accident costs have been defined separately.

1 Average gas-station prices in Finland 1.2.1989

Trucks

The vehicle costs have been separately estimated for a truck, tractor with semi-trailer and trailer. The average figure for truck's vehicle cost has been calculated by weighting according to the traffic performance of different types of trucks.

The basic data for the estimation are:

		Truck	*T with semi-tr.*	*T with trailer*
- Fuel consumption	(l/100 km)	26	37	43
- Annual kilometrage	(km)	34 000	75 000	94 000
- Purchase price	(FIM)	340 000	745 000	880 000
- Depreciation time	(a)	10	10	10
- Price deduction	(%/a)	20	20	20
- Rate of interest	(%/a)	10	10	10

- Price of diesel oil: 2,34 mk/l[1]

Table 18: Average annual vehicle costs of truck (p/km)

Cost factor	*T1*[2] *0,50*	*T2* *0,08*	*T3* *0,42*	*T_{AV}*[3] *1,00*	
Fuel	65,5	93,2	108,4	85,7	Variable
Lubrication	11,1	15,9	18,4	14,6	share
Service, repair	53,0	52,7	49,7	51,6	186,6
Tyre-wear	23,5	39,7	47,0	34,7	p/km
Motor vehicle tax, maintenance, administr. exp.	48,3	49,1	46,3	47,5	Fixed share
Capital depreciation	89,3	88,7	83,6	86,9	195,0
Capital interest	62,3	61,9	58,3	60,6	p/km
Total	353,0	401,2	411,7	381,6	

Insurance fee is not included into vehicle costs, because accident costs have been defined separately. The share of the fee would be: T1 **19,1**, T2 **22,3** and T3 **22,1** p/km and the weighted average 20,6 p/km.

1 Average gas-station price 1.2.1989
2 T1 = truck w/o trailer, T2 = tractor with semi-trailer, T3 = tractor with trailer
3 Weighting according to the share in the total traffic performance

3.2 Time costs

The value of time is quite a common topic in the international literature of transport economics. There is no generally accepted solution to the problem. So it has to be admitted that finally the value of time must be based on an agreement. Or then the time factor must be dealt with time units only (e.g. by hours).

The values of time in this publication are partly based on the recommendations of a task group by Ministry of Communications, partly they are evaluated in RWA. In this report the value of time has a somewhat broader meaning than usually.

The saved time has not been thought to have direct value in alternative use, but 'the time saving' is considered to show the consequences of a road project to the accessibility and **driving comfort** (as far as it is connected to the shortened time of a trip).

* *Passenger car* *p. 29*
* *Other cars* *p. 30*

Passenger car (driver and passengers)

The value of time is connected with the average hourly wage of an industrial worker (male)[1]. The value of time varies according to the purpose of trip :

- **work time trips**: the value of time is the gross hourly wage and social security costs

- **business trips** (to/from work/personal): 35% of the average hourly gross wage

- **leisure and holiday trips**: 20% of the average hourly wage.

Table 19 shows the time values for a passenger car. If the purpose of trip is not known, the combined value has to be used (time costs per kilometre is based on the combined value). In evaluating of road projects the combined value is generally used.

Table 19: Time values for passenger car (FIM/h)

Purpose of trip	*Av. number of persons /vehicle*	*FIM/hour*	
		/person	*/vehicle*[2]
Work	1,9	70,65	134,25
Business trip (work/person)	1,8	15,75	28,35
Leisure and holiday	2,3	9,00	20,70
Combined value[3]	2,055	(17,12)	35,20

[1] 45,00 FIM, estimated 1/89
[2] Value of time for the average number of persons in car (incl. driver).
[3] Combined value weighted according to estimated division of vehicle kilometers: 10, 41 and 49 (work/business/leisure).

Van, bus and truck

In table 20 there are unit costs of time for different vehicles in commercial use. The calculations of the price of an hour are based on the average wage of driving personnel and corresponding social costs. The time value of passengers in busses is according to the combined value in table 19.

Table 20: Time values for commercial road traffic (FIM/h)

Vehicle	*Av. number of persons /vehicle*	*FIM/hour*	
		/person[1]	*/vehicle*[2]
Van	1,0	57,90	57,90
Truck	1,1	72,60	79,90
Bus	1+13,5[3]	(30,75)	445,70

1 Based on estimated wages on 1/1989
2 Time value for persons in cars only
3 On public roads

In commercial traffic the freight has no time value. The time value in transport is a problem which still has no acceptable solution.

3.3 Accident costs

Internationally there exists no generally accepted rules to calculate costs of road traffic accidents. Principles of calculations vary greatly from country to country. The main problem is how to valuate the human losses.

The accident cost calculations in Finland are based on *the method of the social willingness-to-pay*. The same kind of valuation method is in use in Sweden and Denmark. In these countries the level of traffic safety (measured by fatalities/100 000 persons) is about the same as in Finland.

The social willingness-to-pay-method tries to include the total loss of well-being in the society: the real economic costs and human sufferings. The society is willing by investments in traffic safety to minimize the costs of traffic accidents and also to diminish the probability of accidents and by this way to increase the non-material well-being in the society.

Thus the accident costs are valuated higher than the real monetary costs alone would be.

According to this method accident costs include:

1. **Monetary values of**
   - lost work contribution
   - hospital care
   - administrative expenses (police etc.)
   - (funeral)
   - damages to vehicles
   - damages to road constructions

2. **Loss in well-being**
   - This includes the human losses due to the accident and the diminished well-being due to the probability of a road accident.

Monetary valuation of loss in human values is very difficult or impossible, so finally there must be an agreement of the proper value and method.

In this report the lost human values are evaluated for three types of accidents:

- **Fatality:** The value is the cost of hospital care of a fully handicapped victim under the average expected lifetime.

- **Permanently injured:** The value of the lost well-being is based on the average rate of handicap and is 20% of the value of a fully handicapped person.

- **Temporarily injured:** The value has to be evaluated by comparing the number of days in hospital and inability to work with the consequent days of the permanently injured. The value of the loss is about 2,5% of the loss of the permanently injured.

Table 21: Unit cost values of traffic accidents in public roads

Type of accident	*Unit cost value (FIM)*		
	Economic loss	*Loss in well-being*	*Total*
Fatality	1 500 000	2 000 000	3 500 000
Permanently injured	800 000	450 000	1 250 000
Temporarily injured	28 500	10 000	39 500
Injured, average	75 000	22 000	98 000
Material damages per personal damage	9 000	0	9 000

Table 22: Average costs of accidents in public roads

Accident	*Cost (FIM)*
Fatal	4 000 000
Injurious	150 000
Injury accident, average	625 000
Material damages	22 000
Road accident on average	155 000[1]

The costs are evaluated by the price level of January 1989 and they are based on RWA's accident statistics.

A great deal of minor accidents with material damages avoids the accident statistics. The number of accidents with personal damages in statistics is on the contrary quite realistic. So the evaluated average price of personal accident is more reliable than the price of a road accident on average (which is probably too high).

1 The average cost has declined from the previous year because proportional share of serious accidents has decreased.

Costs for different accident classes

The unit cost values of accidents has made it possible to calculate costs in different accident classes. Included are the consequences of accidents (for the present inaccurately) and their influence on costs. Costs in different accident classes differ considerably. The consequences of pedestrian and cycle accidents are more serious and therefore costs will be higher.

By the price level of January 1989, the costs in different accident classes were:

Accident class	*Costs FIM*
Single	133 000
Turning	97 000
Overtaking	160 000
Intersection	145 000
Head-on collision	440 000
Head-to-tail collision	75 000
Moped	300 000
Cycle	350 000
Pedestrian	700 000
Elk	45 000
Other animal	25 000
Others	105 000
Average	*155 000*

Accident costs have further been calculated for different road classes. For main roads and higher speeds costs are greater than for local roads and lower speed limits. There is a special report of accident costs on roads with one driveway[1].

Cost per kilometre: notes on principles

The accident costs per vehicle kilometre are based on the rate of accidentss in different classes of roads. The speed is thought to be according to the speed limit, except in urban area conditions, where the speed is the actual speed of vehicles. The costs are divided to passenger cars and trucks according to their share in accidents[2].

Accident costs per vehicle kilometre are the average costs of a certain road class in summer conditions. The traffical properties of a road class will be reflected by the speed limit.

The decrease in accident costs when the speed increases is due to the better characteristics of a road, e.g. the geometry of the road. High accident costs at low speeds (50 and 60 km/h) on main roads (I/II) are partly result of different division of traffic modes in urban areas: the number of accidents of the pedestrian and cycle traffic is higher and so is also the density of intersections.

It has to be noticed that on the same road the higher speed adds to the accident costs and makes the rate of accidents also higher.

1 "Accident costs on one-carriageway roads", RWA 741860, Helsinki 1988

2 From the year 1988 the costs is divided to trucks according to their share in accidents with fatalities. This is why the accident costs of trucks have been increased considerably from the previous years.