MORE EFFECTIVE ROAD SAFETY WORK WITH PROPER TOOLS

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ABSTRACT

Developing and using proper road safety evaluation tools is essential to further enhance road safety work. These are also requested e.g. by a directive from the Member States of the European Union. However, science-based safety evaluation tools are not widely available or used.

Comparing different ways of predicting future accidents revealed that accident model estimates combined with accident record gives essentially better predictions than those based on accident history alone. In fact, estimation based on accident record only seems to give in many cases predictions that are not worth more than a guess. Hence, TARVA, one example of tools will be demonstrated. The aim of it is to provide reliable current safety estimates as well as predictions of safety effects of improvements for roads and level crossings. Separate versions have been created for Lithuanian and Finnish roads and Finnish level crossings. Principles and use of the tool will be explained, including Finnish and Lithuanian examples.

Using the tool one can rank the safety of existing road network or level crossings. Ranking is done using the expected accident numbers received by combining accident history data with accident prediction model data. In addition to comparing the safety of individual roads, examples will be presented on comparing road safety among areas.

In addition to selecting roads to be improved, the tool can be used for estimating safety effects of improvements. Crash modification factors (CMF) of about 100 safety measures have been defined based on internationally recognised safety research results. Using the expected accident figures, CMF's and the implementations costs of measures, one can estimate the cost-effectiveness of alternative ways of improving safety.

INTRODUCTION

Road safety ranking and impact assessment of all road infrastructure projects have been requested for the trans-European road network (European Parliament, 2008). However, science-based safety evaluation tools are not widely available or used. Without scientifically justified tools, one cannot expect safety work to be as effective as it should be.

The expected number of accidents after implementing a measure can be calculated as a product of the predicted number of accidents in the future without the measure (target accidents) and a crash modification factor (CMF, also called impact coefficient or accident modification factor) describing the effect of the planned measure. As an example CMF 0.9 corresponds to a 10% reduction in the number of accidents. CMFs are a proper way of transferring information on traffic safety effects if the quality of the safety studies and transferability of effects are properly taken into account (OECD/ITF, 2012).

The expected safety effect depends not only on the CMF estimate but also on the expected future number of target accidents, a quantity that is also insufficiently known. In some cases errors in target accidents can be substantial, even more so than errors in CMF. However, it is far too common to estimate the expected number of target accidents based on accident records with no modelling.

In order to maximise efficient use of existing reliable safety knowledge, scientifically well-founded safety evaluation tools for road improvements are needed. The aim of this paper is to present the use of one such tool, called TARVA (Tool for traffic safety evaluations), which fits those needs. Even its use for network safety management is demonstrated.

Firstly the principles and use of the tool are described and the importance of such a tool is explained. Next, we present a comparison of the traffic safety of road regions and demonstrate how the models can be used in ranking the safety of the road network. Finally, we explain the procedure of network safety ranking of Finnish TERN (Trans European Road Network) roads and how it benefits from the developed analysis tools.

1 TOOL FOR SAFETY EVALUATIONS

1.1 Purpose and principles of TARVA

The purpose of the tool is to provide a common method, database and user interface for (1) predicting the expected number of road accidents for selecting locations for safety treatments, and (2) estimating the safety effects of road safety improvements in order to evaluate the cost-effectiveness of combinations of safety measures.

The underlying logic is combining general safety (accident model) with information from local safety factors (accident record) using the Empirical Bayesian (EB) method. For creating accident prediction models, the road network is divided into homogeneous road sections and crossings.

The estimation of safety effects of road improvements is a four-phase process, shown in FIGURE 1, to which the following numbers refer:

(1) For each entity (homogeneous road section or crossing) the most reliable estimate of the expected accident number is calculated. Information about accident record and accident model is combined into a formula that takes into account the model's goodness of fit and random variation in the number of accidents.

(2) To predict the number of accidents without road improvements, the most reliable estimate of the number of accidents can be corrected by the growth coefficient of the traffic.

(3) The effects of the measures on casualty accidents are estimated based on the predicted number of accidents and planned measures for which the average impacts on casualty accidents have been estimated.

(4) Measures can also affect the severity of accidents still occurring on the road after treatment. The tool takes these effects into account with severity reduction coefficients. Using the available knowledge on the average severity (fatalities per 100 casualty accidents) and its change due to measures, the tool produces an estimate of yearly-avoided fatalities.

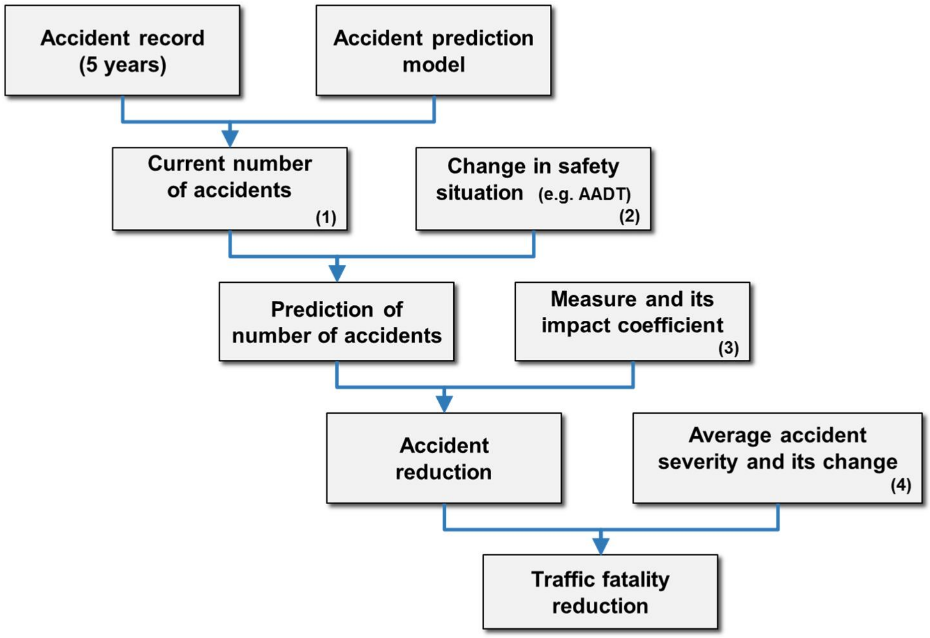


FIGURE 1 Evaluation of traffic safety effects of road improvements, using TARVA (Peltola et al., 2013a).

1.2 Practical use of the tool

The databases for all the TARVA versions are updated yearly. Hence, up-to-date prediction of expected numbers of accidents for any part of the network is always available and safety effects can be estimated using the latest information. The minimum input needed for estimation of safety effect is (1) what the measures are and (2) where they are implemented. There are almost 100 predetermined measures in the both highway safety evaluation versions. Additionally the user can define his/her own measures, provided reliable CMF estimates are available.

The results of the calculations include (1) the expected safety situation on the modified network if no measures are implemented and (2) the safety effects of selected improvements (yearly injury accidents and fatalities).

Estimates of yearly-avoided injury accidents and fatalities caused by road improvements are used to calculate the benefit in accident costs. Because the tool estimates the costs of measures as well, results can be used to calculate what kinds of measures are most effective regarding safety, and where those measures pay off most effectively. Implementation costs can be entered while performing the evaluations, but the average costs for measures (per km or per measure) are used if these values are not entered. A more thorough description of the practical calculations is presented by Peltola et al. (2013a).

2 WHY TOOLS WITH PROPER ACCIDENT PREDICTIONS ARE SO IMPORTANT

To be able to implement cost-effective road safety improvements, reliable safety ranking must be performed in order to allocate the measures optimally. Additionally, proper safety estimates for alternative road improvements are needed – and these must be based on expected number of accidents if no measures are implemented. While preparing the evaluation tool we found out, that huge estimation errors were done especially in estimating the current safety situation.

Based on a comparison of definitions of hazardous road locations (also called black spots or hotspots) in eight countries, Elvik (2008a) argued that "currently applied operational definitions of hazardous road locations in most of the European countries included in this survey are not close to the state-of-the-art and are in need of considerable development in order to approach the state-of-the-art." Furthermore, Elvik (2008b) and Montella (2010) have concluded that the EB method should be a standard in identification of hazardous location. Identification should be based on best estimate of accidents and it should be achieved by combining information from accident records and accident prediction models (Elvik, 2008b).

Peltola et al. (2013a) compared different kinds of accident predictions and found out that in many cases relying on the accident record only is the least accurate option - even the lottery performed better than the accident record. Advanced model-based estimates such as those used by TARVA performed best and should be employed. This change could lead to tremendous consequences for current practices in road safety by substantially improving and strengthening road-safety work and thereby enhancing safety.

3 COMPARING ROAD SAFETY OF AREAS USING ACCIDENT MODELS

In this section, we discuss how the simple accident prediction models used e.g. in Lithuania (Jasiūnienė et al., 2012) and Finland (Peltola et al., 2013a) can be used even for comparing the safety of roads in different road districts. The idea is to provide equal safety conditions to people around the country, and from comparisons with other road districts find ideas of optimal locations and measures for road improvements.

Road safety comparisons between regions are regularly performed in order to learn from the successes of the best performing regions, but without a proper approach the conclusions may be erroneous. Specifically, comparisons seldom take into account disparities between road categories, making it hard to identify where the differences originate. In the following, we demonstrate a comparison that benefits from the simple prediction models. An example is given in FIGURE 2 and TABLE 1 comparing the rates (risks per vehicle kilometres) and numbers of casualty accidents between nine road districts in Finland.

The orange columns in FIGURE 2 show the accident rate variation between Finnish road districts by accident record. The accident rate differences between regions are partly caused by different distributions of vehicle kilometrage among road categories between regions. These effects are taken into account in the blue columns in FIGURE 2. Differences in actual accident rates and their calculations are further reported in TABLE 1.

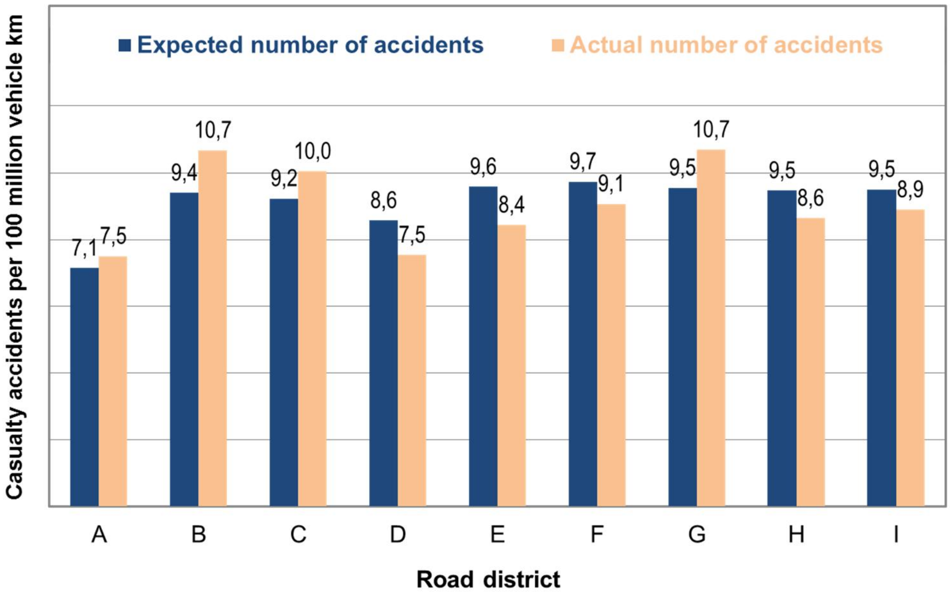


FIGURE 2 Actual and expected injury accident risks of nine Finnish road districts in 2007-2011. Expected risk is based on the assumption of having the same accident risk in every road district in each road group (Peltola et al., 2013a).

If the accident rates were equal on all roads, injury accidents would be distributed according to column 2 in TABLE 1. Differences in the distribution of vehicle kilometrage between road groups with different accident rate cause a difference in the number of accidents; the estimate of this effect is shown in column 3 in TABLE 1. For example, -1146 in district A is caused mainly by the excess proportion of motorway and dual carriageway kilometrage (these road groups being safer than average) compared to the rest of the country.

TABLE 1 Expected and actual number of injury accidents per year in 2007-2011 by road district in Finland (Peltola et al., 2013a)

District	If equal rates [1]	Effects by differences in:		Actual number [4]
		Road categories [2]	Rates [3]	
A	5046	-1146	195	4095
B	1837	207	277	2321
C	823	56	77	956
D	1426	-42	-167	1217
E	1987	187	-259	1915
F	995	119	-76	1038
G	1392	168	187	1747
H	1651	140	-156	1635
I	744	68	-52	760

[1] Injury accident figures if accident rates (accidents/kilometrage) on all roads equal
[2] Effect on number of accidents caused by different share of kilometrage on safer/less safe road groups
[3] Effect on number of accidents caused by higher/lower than average accident rates in area of relevance, including random variation in actual accident numbers
[4] Recorded accidents during 2007–2011 on public roads

The remaining differences in safety derive from the accident rate disparities – road groups do not have the same rates in all districts. Effects of the rate disparities from the rest of the country average are shown in column 4 in TABLE 1. For example, +277 in district B originates from the 21.7 billion vehicle kilometres having an accident rate of 10.7 accidents per million vehicle kilometres in district B compared to average risk 9.4 on respective roads in the rest of the country. These accident rate differences – seen also as the difference between orange and blue columns in FIGURE 2 – are essential from the standpoint of locating high-risk roads or regions. The statistical tests imply that all the accident rate differences, except the one regarding district I, are statistically significant at a 95% significance level.

It is easy to determine from which road groups the differences are emerging by calculating the rate differences and effects caused by them by road category. The above mentioned effect +277 is mainly caused by higher than average risks on narrow main and minor roads with no housing. This kind of analysis revealed exceptionally high fatality risks in one district on wide roads with no housing – and this appeared to indicate safety problems on main roads with exceptionally wide lanes; accidents on these roads tend to be very severe, possibly as a result of easy overtaking and high speeds

For Finland as well as Lithuania, there has been built up an Excel spread sheet that can be used for comparing roads among road districts. Based on this kind of spread sheet calculation, Peltola et al. (2013b) concluded that in Lithuania the national roads in the Marijampolės district have statistically significantly higher accident risk than rest on the Lithuania. There are +207 extra casualty accidents in five years in the Marijampolės district. They are mainly caused by higher than average rates on 9 meter main roads, 6–8 meter minor roads and urban sign roads. Accident rates on these roads are statistically significantly higher than elsewhere in Lithuania (TABLE 2).

From the spread sheet the user can select the study and comparison road districts. Hence, the comparisons can be restricted to similar areas, such as those with the same kind of climate or traffic conditions. The spread sheet also provides a summary of the comparison (FIGURE 3). This helps in obtaining an overview of the study area. In this example (Marijampolės vs. rest of the Lithuania), what is striking is the large number of bicycle accidents in Marijampolės compared to what would be expected based on the safety nationwide.

TABLE 2 Comparison of Lithuanian road districts (2007–2011), Marijampolės vs. rest of Lithuania (Peltola et al., 2013b)

Comparison: Kauno , Klaipėdos , Marijampolės , Šiaulių , Tauragės , Telšių , Utenos , Vilniaus ,

Study: Marijampolės ,

Road group[1]		AADT, veh/day	Kilometrage, share, (%)[2]		Risks / 100M veh km[3]				Killed/5years			Casualty acc./5years		
					Comparison		Study		Equal risks[4]	Risk diff.[5]	Police record[6]	Equal risks[4]	Risk diff.[5]	Police record[6]
			Comp.	Study	Fatality	Accident	Fatality	Accident						
Separated driving directions	12. Four lanes, median, ≤ 90 km/h	< 9000	1,2	0,4	1,9	11	0,0	14	0	0	0	2	0	2
		9000–12000	3,0	0,0	2,9	15	0,0	0	0	0	0	0	0	0
		≥ 12000	3,5	1,0	2,7	10	0,0	20	1	-1	0	4	3	7
Main roads, rural	21. Main road, 9 m	< 3000	1,2	0,0	4,8	21	0,0	0	0	0	0	0	0	0
		3000–6000	7,8	6,6	3,8	14	10,4	24	9	16	25	34	24	58
		≥ 6000	6,6	26,7	4,2	13	3,9	16	40	-3	37	128	25	153
	22. Main road, 8 m	< 4500	3,4	2,4	4,8	17	3,5	25	4	-1	3	15	7	22
		≥ 4500	1,1	0,7	4,8	15	0,0	32	1	-1	0	4	4	8
	23. Main road, ≤ 7 m	< 4500	0,8	0,0	5,7	16	0,0	0	0	0	0	0	0	0
		≥ 4500	1,1	0,4	3,1	20	0,0	7	0	0	0	3	-2	1
Minor roads, rural	31. Minor road, 9 m	< 4500	2,0	0,4	4,6	20	7,1	28	1	0	1	3	1	4
		≥ 4500	2,6	0,4	2,9	14	0,0	14	0	0	0	2	0	2
	32. Minor road, 8 m	< 1500	1,1	0,1	5,8	24	53,2	213	0	1	1	0	4	4
		1500–4500	7,0	7,8	3,8	20	4,7	30	11	2	13	56	29	85
		≥ 4500	2,4	4,4	6,2	24	3,1	27	10	-5	5	39	4	43
	33. Minor road, 7 m	< 1500	7,1	6,8	6,6	29	7,4	33	16	2	18	71	10	81
		1500–4500	8,2	8,1	5,5	21	6,5	26	16	3	19	62	14	76
		≥ 4500	3,3	0,0	4,0	18	0,0	0	0	0	0	0	0	0
	34. Minor road, ≤ 6 m	< 1500	10,6	10,7	6,6	32	9,3	40	26	10	36	123	31	154
		1500–4500	6,2	7,5	4,9	21	8,1	31	13	9	22	58	27	85
		≥ 4500	0,5	0,0	4,5	24	0,0	0	0	0	0	0	0	0
	35. Gravel roads	< 150	1,5	0,9	12,3	57	3,1	59	4	-3	1	18	1	19
		150–300	1,8	2,3	5,5	36	3,6	30	5	-2	3	30	-5	25
		≥ 300	1,2	2,3	2,6	21	2,4	20	2	0	2	18	-1	17
Urban roads	41. Urban sign	< 3000	7,7	7,2	5,5	32	3,5	38	14	-5	9	83	15	98
		3000–6000	3,4	2,0	2,0	25	4,1	33	1	2	3	18	6	24
		≥ 6000	3,6	1,0	2,4	26	2,9	52	1	0	1	9	9	18
	All together		100	100	4,8	23	5,5	27	177	22	199	779	207	986

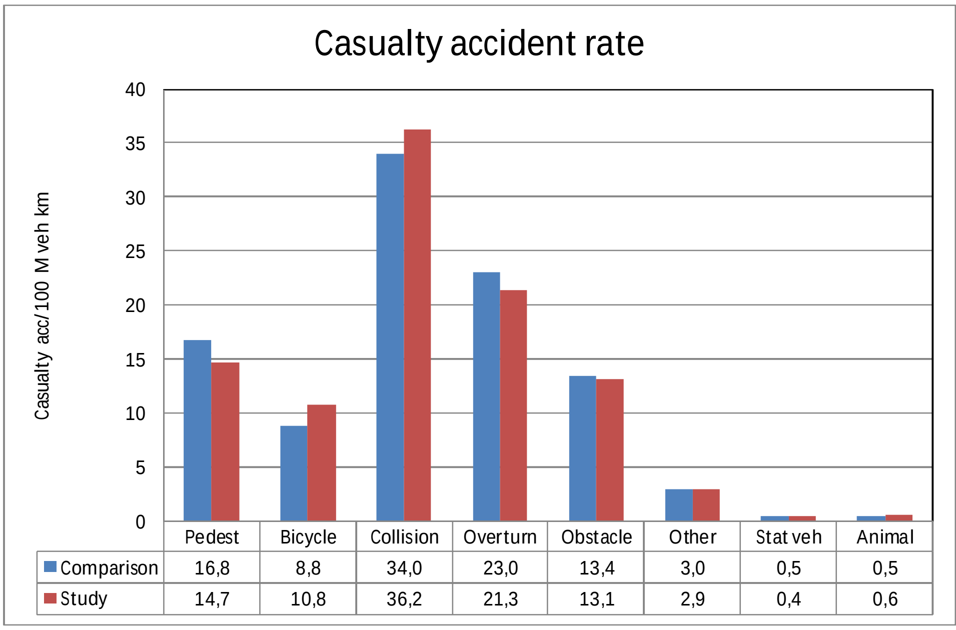
(1) Road group as in Lithuanian evaluation tool.
(2) Share of kilometrage (%) in the study and comparison area. Values under half or over twice that of the comparison area are highlighted.
(3) Risk of casualty accidents and fatalities by vehicle kilometrage in study and comparison areas in 2007–2011
(4) "Equal risks" means the number of accidents/fatalities calculated using kilometrage in the study area and rates in the comparison area.
(5) Effect of the difference in rate between study and comparison areas. In other words: how many accidents/fatalities more or less happened in the study area if the rate was the same as in the comparison area. Hence, negative values means that the rate in the study area is smaller than in the comparison area. Values statistically different from zero are highlighted.
(6) Police record means the actual number of accident/fatalities in five years and equals the sum of the two previous columns (e.g. 779 + 207 = 986)

Basic safety figures:

	Roads, km	AADT, veh/day	Mileage, Mkm/y	Casualty accidents /year	Casualty accidents rate[2]	Casualty accidents density[2]	Fatalities /year	Fatalities rate[2]	Fatalities density[2]	Severity Killed/100 acc.
Comparison[1]	19301	**1091**	7683	155,7	21,6	10,1	35,3	4,90	2,29	22,7
Study	**1544**	**1278**	**720**	**197,2**	**27,4**	**12,8**	**39,8**	**5,52**	**2,58**	**20,2**

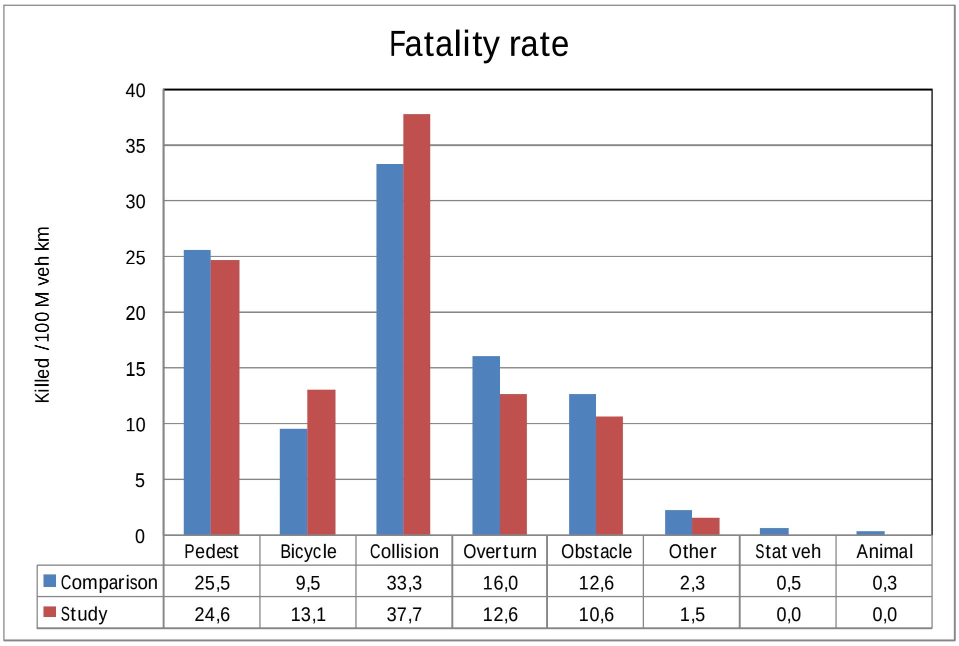
Distributon of accidnts among accident type

	Casualty accidents (number/5 years)						Fatalities (number/5 years)					
	Ped	Bic	Coll	Over	Other	All	Ped	Bic	Coll	Over	Other	All
Comparison[1]	131	68	265	179	135	779	45	17	59	28	28	177
Study	**145**	**106**	**357**	**210**	**168**	**986**	**49**	**26**	**75**	**25**	**24**	**199**
Difference, %	11 %	55 %	35 %	17 %	24 %	27 %	9 %	54 %	27 %	-11 %	-13 %	13 %



The list below shows which areas are included in the study and which ones are in the comparison group.

HINT: To change study and comparison areas, add/remove checks on the Data_Study and Data_comparison -sheets for the filter of cell B2.



Study

Alytaus	-
Kauno	-
Klaipėdos	-
Marijampolės	Yes
Panevėžio	-
Šiaulių	-
Tauragės	-
Telšių	-
Utenos	-
Vilniaus	-

Comparison

Alytaus	Yes
Kauno	Yes
Klaipėdos	Yes
Marijampolės	-
Panevėžio	Yes
Šiaulių	Yes
Tauragės	Yes
Telšių	Yes
Utenos	Yes
Vilniaus	Yes

FIGURE 3 Summary of the comparison of Lithuanian road districts (2007–2011), Marijampolės vs. rest of Lithuania (Peltola et al., 2013b).

4 RANKING OF ROADS BY ROAD SAFETY AND SAFETY POTENTIAL

The idea of the demonstrated evaluation tool is to create a reliable estimate of the expected number for every public road section and crossing in Finland (and respectively in Lithuania). One of the report forms of the tool, the Network Safety Report (NSR), produces up-to-date information on the entire road network: road, traffic and accident data and most importantly estimates on expected numbers of accidents and fatalities. Hence it is possible to produce maps like that in FIGURE 4 from Finland and tables showing the most promising locations for road improvements. Calculations like that presented in Section 3 can be used to help focus on the outstanding safety problems in each area.

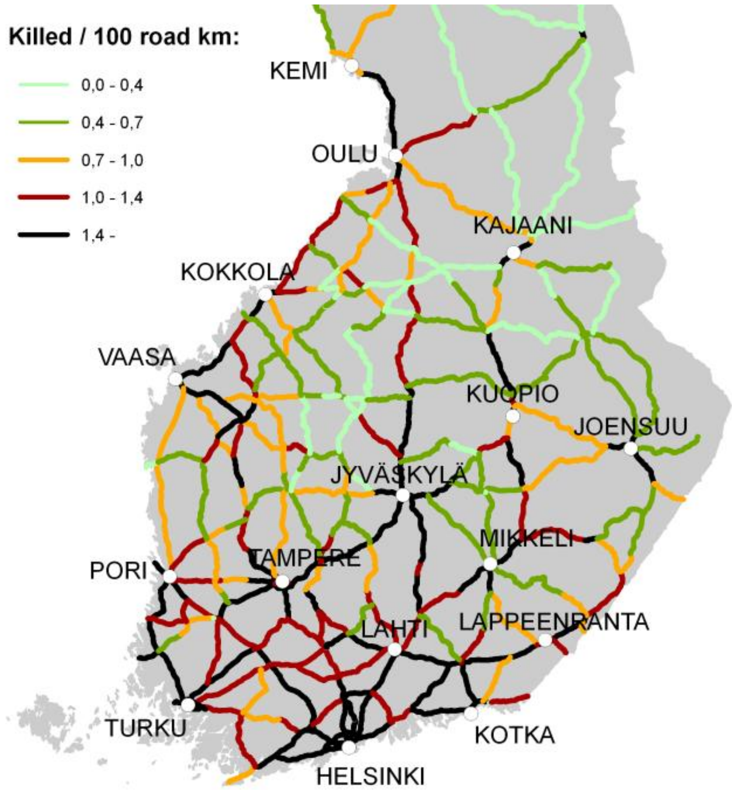


FIGURE 4 Road fatality density (fatalities/100 km per year) map produced from the TARVA accident number estimates, based on data from 2006-2010 in Finland (Peltola et al., 2013a).

Accident model and accident record data are combined separately for crossings and homogenous road sections (Peltola et al., 2013a). One great advantage of using accident models is, that the road sections to be analysed do not need to be very long – while using accident data alone that would be the case to achieve at least somehow stable results. Using the pretty short sections, one can calculate the most interesting safety figure using as long section as best fits the current use. This is very useful e.g. while choosing crossings or road sections for road improvements. As an example an analysis of the Finnish Trans European Road Network (TERN) is presented.

In Finland there are 4567 km of TERN roads. There is lots of variation in the road characteristics but the variation in the traffic volume is even higher – average daily traffic varies from 150 to 71700 vehicles a day. There is no sense in comparing these roads all in the same –

this becomes evident e.g. while comparing the situation on TERN and other main roads taking into account if the traffic into opposite directions are separated physically or not (TABLE 3).

TABLE 3 Length, traffic volume and safety information of Finnish main roads by type of road in 2007–2011

Type of main road	Length, km	AADT, veh/day	Crashes/year Casualties(4)	Crashes/year Fatalities(5)	Risk/100 Mill veh. km Casualties(4)	Risk/100 Mill veh. km Fatalities(5)	Density/100 road km, y Casualties(4)	Density/100 road km, y Fatalities(5)
Separated TERN(1)	1009	20715	290,8	11,6	3,8	0,15	29	1,2
Other TERN(2)	3559	3987	360,4	42,0	7,0	0,81	10	1,2
Non-TERN(3)	8764	3215	792,6	71,3	7,7	0,69	9	0,8
Main roads, total	13332	4745	1443,8	124,9	6,3	0,54	11	0,9

(1) Those parts of TERN-roads that have physically separated driving directions
(2) Those parts of TERN-roads that do not have physically separated driving directions
(3) Main roads that are not part of the TERN road network
(4) Crashes that caused personal damage (fatality or injury)
(5) Killed persons in road traffic accidents

The numbers of casualty accidents as well as fatalities per vehicle kilometrage – accident risks – are much higher on roads with no separation between driving directions. However, much higher traffic volumes on roads with separated driving directions causes, that the fatality densities (killed persons per road length in a year) is equal in these two road categories and the casualty density on roads with separated driving directions is even higher than on roads without separation.

Road safety ranking is done using the expected accident figures. Different kind of rankings can be done for different purposes. E.g. based on what kind of a safety measure is considered, the importance of casualty accident/fatality risk and density may vary. The safety ranking should be done using EB estimates for three to five year data. As soon as ranking has been done, all the relevant accident history should be used to consider appropriate safety measures for each selected location. Even types of accident vary quite a lot based on road type, as can be seen from TABLES 4 and 5.

In Finland, single vehicle accidents are the major casualty accident type on all main roads – especially so for TERN-roads with separated driving directions. Taking into account that those are the roads with lowest risks (TABLE 4), in fact this means that other accident types like turning, crossing and head-on collisions are pretty well prevented on those roads. When looking at the fatalities, the prevention of head-on collision is even more obvious (TABLE 5).

TABLE 4 Share of casualty accidents (%) among accident types in 2000–2010 by type of main road.

Type of main road	Proportion (%) of casualty accidents during 2000-2010: Single	Turn	Overtake	Crossing	Head-on	Rear-end	Moped	Cycle	Pedestr.	Animal	Other	Number (=100%)
Separated TERN(1)	40	4	10	4	3	20	1	3	2	4	8	2791
Other TERN(2)	29	11	5	11	15	7	2	3	2	11	4	3918
Non-TERN(3)	30	11	4	14	10	9	4	5	3	9	3	9189
Main roads, total	31	10	5	11	10	10	3	4	3	9	4	15898

(1) Those parts of TERN-roads that have physically separated driving directions
(2) Those parts of TERN-roads that do not have physically separated driving directions
(3) Main roads that are not part of the TERN road network

TABLE 5 Share of fatalities (%) among accident types in 2000–2010 by type of main road.

Type of main road	Proportion (%) of fatalities during 2000-2010										Number
	Single	Turn	Overtake	Crossing	Head-on	Rear-end	Moped	Cycle	Pedestr.	Animal	Other	(=100%)
Separated TERN[(1)]	42	0	9	2	16	5	0	1	14	2	9	169
Other TERN[(2)]	12	4	7	6	54	1	1	2	7	3	2	557
Non-TERN[(3)]	16	7	5	11	42	2	1	6	6	3	1	797
Main roads, total	18	5	6	8	43	2	1	4	7	3	2	1523

(1) Those parts of TERN-roads that have physically separated driving directions
(2) Those parts of TERN-roads that do not have physically separated driving directions
(3) Main roads that are not part of the TERN road network

When considering appropriate safety measures, this kind of accident type distributions can be considered as comparison values – keeping in mind that there is always lots of random variation in accident records.

For Finland and Lithuania we have even developed an accident analysis tool called ONHA (Management and analysis of accident data). One example of the analyses done using the tool tells that in 18,1 % of casualty accidents on Finnish main roads there is at least one heavy vehicle involved (a lorry or a bus). However, even 45,6 % of the fatalities on these road happen in accidents where at least one heavy vehicle is involved. The problem of heavy vehicles is even more obvious in accidents on TERN-roads without separated driving directions – there more than half of all fatalities have at least one heavy vehicle involved.

5. CONCLUSIONS

We demonstrated a safety evaluation tool called TARVA. This provides EB safety predictions as the basis for selecting locations for implementing road-safety improvements. In addition, it provides estimates of the safety benefits of selected improvements. The EB estimation method used by the tool superior to the simple methods using the accident record only (e.g. accident black spots), which is currently quite a common estimation method. Relying on the accident record only is the least accurate option for estimating future accidents – at least on low accident frequency segments, where even the lottery performed better than the accident record. This finding suggests that advanced model-based estimates such as those used by TARVA should be employed. This would lead to tremendous consequences for current practices in road safety by substantially improving and strengthening road-safety work and thereby enhancing safety.

We demonstrated how comparisons of road safety between regions benefit from taking into account the differences in road categories. Comparisons between road districts revealed statistically significant differences that can be used in selecting roads to be improved.

Reliably predicting the number of accidents if no measures are implemented is highly crucial for selecting the locations to be treated in an optimal way. Additionally it is essential for estimating the safety effects of road improvements. Estimates on Crash Modification Factors might be transferred from other countries but their benefit is greatly limited if the number of target accidents is not properly predicted. Without proper knowledge and tools one can end up making huge errors in cost-effectiveness estimates, and traffic safety work is ineffective.

The tool has been used to evaluate all the safety effects of road improvements on public roads in Finland for over 15 years, and enhanced versions have recently been released for Lithuanian roads and Finnish level crossings. Our experience suggests that making predictions and evaluations using the same principle and tools will remarkably improve the quality and comparability of safety estimations.

Road safety impact assessments and network safety ranking are requested in general, and the EU directive on road infrastructure safety management makes them compulsory for Member States. However, science-based safety evaluation tools have neither been widely used nor available. Without proper tools for safety evaluation of road improvements, safety work is not sufficiently effective. We demonstrated how safety ranking of TERN-network is done in Finland.

Furthermore, the use of proper tools does not necessarily result in higher cost – conversely, road safety could frequently be improved at no extra cost if the safety measures were properly selected and allocated. In addition, commonly used safety evaluation tools could provide benefits in terms of transfer of safety knowledge. For example, it would be much more effective if the development and use of Crash Modification Factors were more common.

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