Evaluation tool TARVA for estimating current safety and safety effects of road improvements

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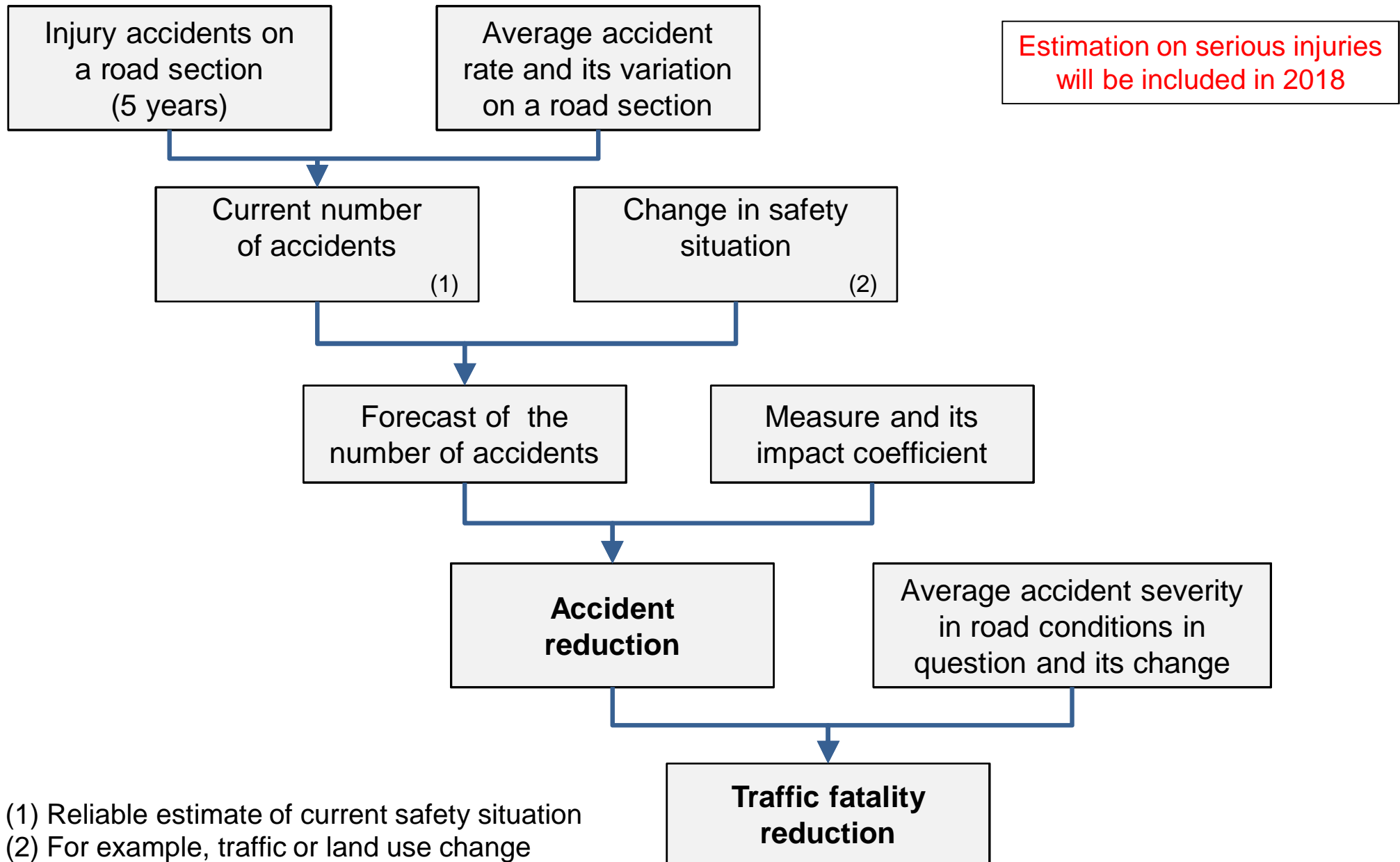**harri.peltola@vtt.fi**

Content

- o Background
- o Tarva principle
- o Benetifs from reliable current safety estimates
- o Results and use of Tarva
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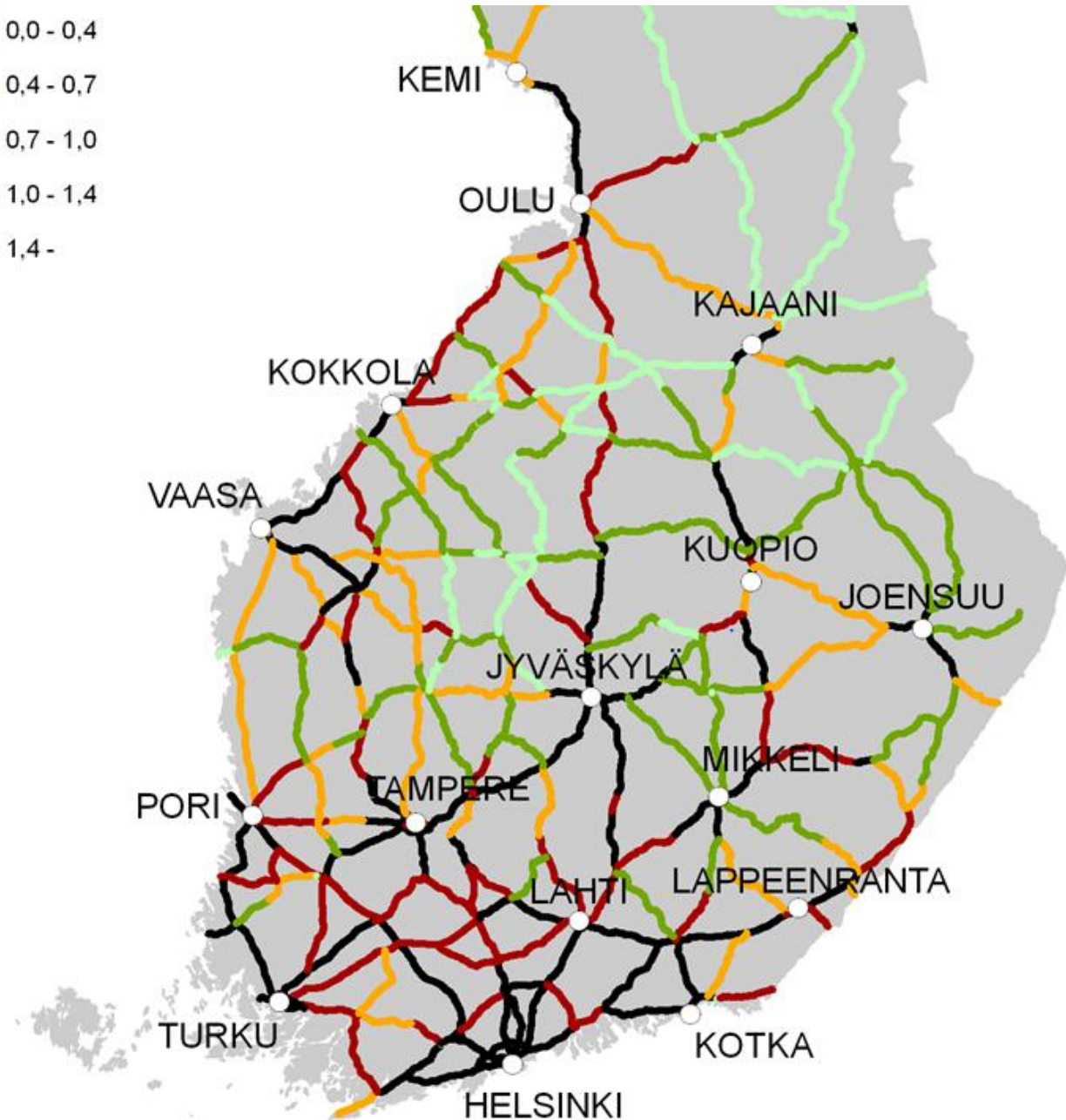- o Acknowledgements and futher information

Background

- Numerous road safety evaluations are carried out worldwide

- Results are often presented as impact coefficients or Crash Modification Factors or Crash Modification Function (CMF):

Expected accidents after measure = Target accidents * CMF

- Proper safety evaluation tools are urgently needed if existing international safety knowledge is to be used well

- Tools should be simple to use and easy to update and understand, versatile and scientifically well founded

- Directive on road infrastructure safety management (2008/96/EC)

- Separate versions for Finnish Roads, Lithuania Roads and Finnis level crossings
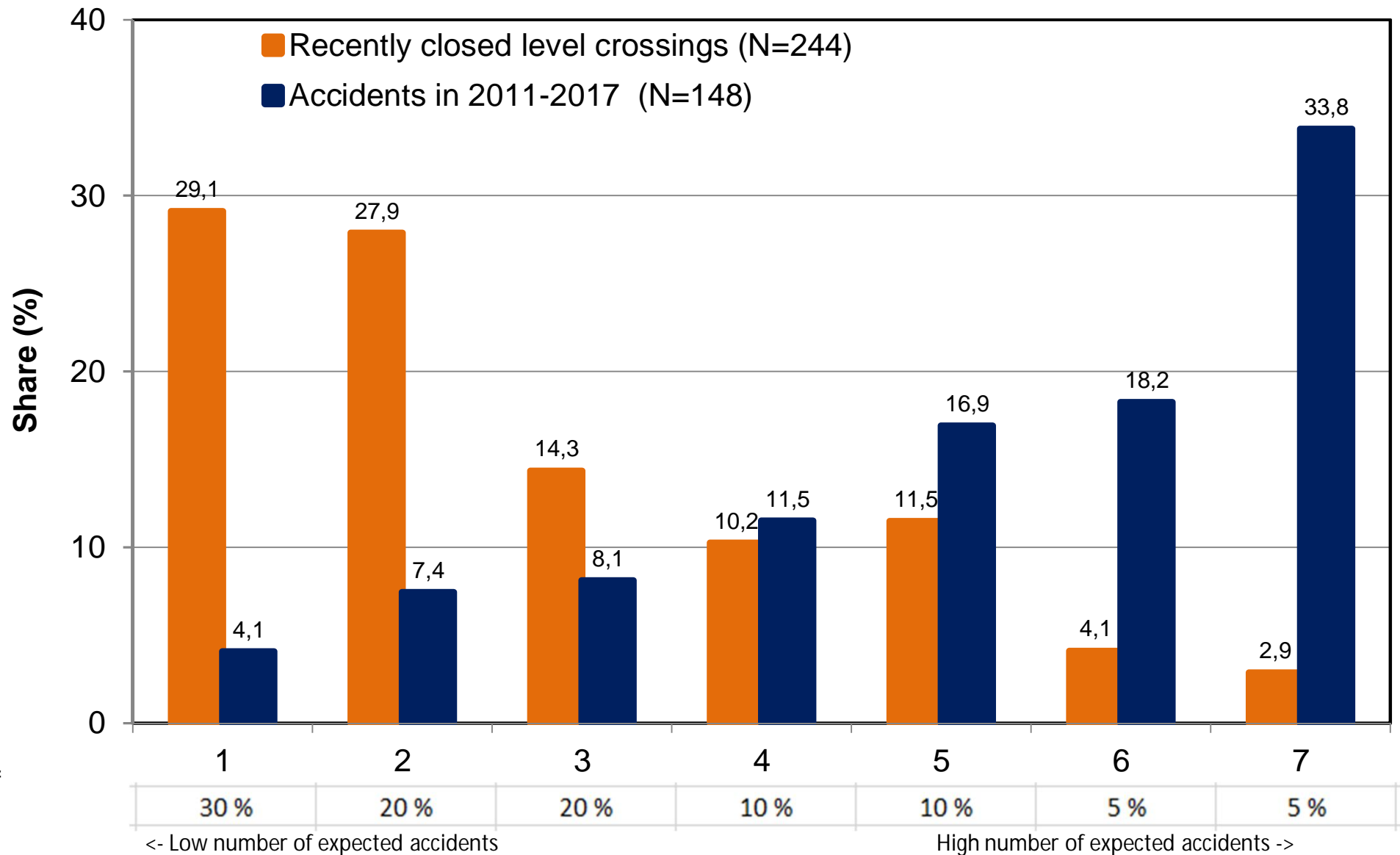
Evaluation of safety effects of road improvements

Injury accidents on
a road section
(5 years)

Average accident
rate and its variation
on a road section

Estimation on serious injuries
will be included in 2018

Current number
of accidents

(1)

Change in safety
situation

(2)

Forecast of the
number of accidents

Measure and its
impact coefficient

**Accident
reduction**

Average accident severity
in road conditions in
question and its change

**Traffic fatality
reduction**

(1) Reliable estimate of current safety situation
(2) For example, traffic or land use change

Current safety – fatality density

How well Tarva LC can predict accidents?

LC's allocated into 7 risk categories based on estimates by accidents in 2000-2010

Yearly avoided injury accidents – an example from 2005 based on TARVA calculations

Measure	Reduced injury accidents /year	Proportion (%)
Automatic speed camera enforcement	13,7	38,5
Renovation of road lightning	4,6	12,8
Rumbling road markings	3,1	8,6
New lightning with breakable poles	2,5	7,0
Building new road side railings	1,8	5,1
More effective crossing markings	1,2	3,4
Improvement of winter maintenance	1,1	2,9
Reflective road side poles	0,9	2,5
Intensified attention to speed limits	0,9	2,5
Speed reducing humps etc.	0,4	1,2
Other measures	4,8	13,6
All measures in total	34,9	100,0

Evaluations done on the internet

Link: http://tarvalt.myapp.info/tarvadb/tarva/tarva.html

Measures in Tarva MT - A

Measure and its reference bumber	CMF (impact coefficient)[1]			Reduction of severity[2]			Implementation[3] costs, 1000€	Expected[4] life time
	Vehicle	Vulnerable	Animal	Vehicle	Vulnerable	Animal		
0 Predicting safety with no measures	1	1	1	0	0	0	0,0	
101 Pedestrian/bicycle way	1	0,9	1	0	0	0	149,0 /km	20
102 Improving ped/bic. way	1	0,95	1	0	0	0	100,0 /km	20
103 Pedestrians/bicyclists to parallel minor road	1	0,9	1	0	0	0	27,3 /km	20
131 Pedestrian/bicycle underpass	1	0,7	1	0	0	0	120,3 /measure	20
132 Pedestrian/bicycle footbridge	1	0,7	1	0	0	0	50,0 /measure	20
133 Cars and unprotected under major road	0,7	0,7	1	0,1	0,1	0	435,9 /measure	20
152 Asphalt pavement to a gravel road	1,1	1,1	1,1	-0,05	-0,05	-0,05	99,9 /km	20
172 Improving delineation, country side	0,85	0,85	0,85	0	0	0	252,5 /km	20
173 Widening road, country side	0,92	0,92	0,92	0	0	0	170,0 /km	20
203 Semi motorway to motorway	0,8	0,73	1	0,7	0	-0,01	1681,9 /km	20
204 Wide lanes to a semi motorway	0,9	1	1	-0,05	-0,05	-0,05	14,9 /km	20
223 Private road arrangements	0,9	1	1	0	0	0	65,4 /km	20
261 Building an extra lane	0,95	0,95	1	0	0	0	362,0 /measure	20
262 Adding an overtaking lane	0,98	1	1,05	-0,02	0	-0,02	136,2 /km	20
263 Wide lanes to a mixed traffic road	1,1	1,1	1,1	-0,05	-0,05	-0,05	118,1 /km	20
265 Separating driving directions physically	0,83	1	1	0,44	0	0	50,5 /km	20
281 Building a central island	0,95	0,95	1	0	0	0	56,0 /measure	20
282 X-crossing to two T-crossings	0,8	0,9	1	0,1	0	0	163,5 /measure	20
283 Moving crossing to a better location	0,9	0,9	1	0	0	0	80,5 /measure	20
284 Channelisation of a 4-arm crossing	0,9	0,9	1	0	0	0	181,6 /measure	20
285 Improving channelisation, 4-arm crossing	0,95	0,95	1	0	0	0	132,6 /measure	20
286 Channelisation of a 3-arm crossing	0,95	0,95	1	0	0	0	135,5 /measure	20
287 Small crossing improvements	0,95	0,95	1	0	0	0	23,4 /measure	3
288 Building a roundabout	0,5	0,85	1	0,5	0,3	0	252,5 /measure	20
289 Building a dodge place into a crossing	0,85	1	1	0	0	0	35,0 /measure	20
290 Central islands to a minor road	0,95	0,95	1	0	0	0	23,4 /measure	20
301 Acceleration lane to a grade sep.cros.	0,9	1	1	0,05	0	0	98,6 /measure	20
302 Improving grade separated crossing	0,85	1	1	0	0	0	199,8 /measure	20
303 Building a grade separated crossing	0,6	0,6	1	0,15	0,15	0	2500,0 /measure	20
305 Improving a railroad crossing	0,95	0,95	1	0	0	0	56,0 /measure	15

[1] CMF by accident type. Unprotected means an accident, where a moped, pedestrian or bicyclist is involved.

[2] Effect of the measure on the severity (fatalities/100 injury accidents) of the injury accidents remaining after the measure.

[3] Default implementation costs to be used in cost-effectiveness calculations

[4] How long time the measure will be producing safety effects. This is used in calculating life time safety effects.

Measures in Tarva MT - B

Measure and its reference bumber	CMF (impact coefficient)[1]			Reduction of severity[2]			Implementation[3]	Expected[4]
	Vehicle	Vulnerable	Animal	Vehicle	Vulnerable	Animal	costs, 1000€	life time
306 Gates to a railroad crossing	0,5	0,9	1	0,1	0,1	0	75,2 /measure	15
307 Grade separated railroad crossing	0,4	0,4	1	0,1	0,1	0	628,5 /measure	20
342 Bus stop, country side	0,95	0,8	1	0	0	0	19,1 /measure	20
361 New lightning, rigid poles	0,95	0,9	0,9	0	0	0	52,7 /km	15
362 New lights, breakable poles	0,9	0,8	0,9	0,15	0,15	0	54,5 /km	15
381 New traffic lights, 4-arm crossing	0,7	0,7	1	0,1	0,1	0	138,6 /measure	15
382 New traffic lights, 3-arm crossing	0,9	0,9	1	0,05	0,05	0	138,6 /measure	15
383 Modernisation of existing traffic lights	0,95	0,95	1	0,05	0,05	0	13,1 /measure	15
481 Elk-fence on motorways, long	1	1	0,6	0	0	0	33,0 /km	20
482 Elk-fence, short	1	1	0,85	0	0	0	35,0 /km	20
501 Flattening road side slopes	0,95	1	1	0,1	0	0,05	54,5 /km	20
502 Rigid to breakable poles	0,95	1	1	0,15	0	0	6,4 /km	15
503 Widening road cuttings	0,95	1	1	0,1	0	0,05	54,5 /km	20
504 Removing road side obstacles	0,95	1	1	0,1	0	0,05	54,5 /km	20
521 Variable speed limit	0,95	0,95	0,95	0,05	0,05	0,05	40,0 /km	15
601 Island sites to a zebra crossing	1	0,8	1	0	0,1	0	15,4 /measure	20
602 Traffic lights on zebra crossing	0,95	0,75	1	0	0	0	44,9 /measure	15
603 Zebra crossing arrangements	0,95	0,9	1	0	0	0	23,6 /measure	20
604 STOP-sign, 3-arm crossing	0,95	0,95	1	0	0	0	1,0 /measure	15
605 STOP-sign, 4-arm crossing	0,85	0,85	1	0	0	0	1,1 /measure	15
606 STOP-sign on railroad crossing	0,6	1	1	0,1	0	0	1,0 /measure	15
607 Signs to a sharp curve	0,8	1	1	0	0	0	1,1 /measure	15
608 Automatic speed enforcement (FTA 50%)	0,91	0,91	0,91	0,08	0,08	0,08	3,6 /km	15
609 Renovation of a street to lower speeds&speed limit	0,65	0,65	0,65	0,3	0,8	0,65	572,2 /measure	20
610 Humps, bumps etc. and speed limits	0,7	0,7	0,7	0,2	0,25	0,2	127,2 /km	20
631 New guard rails	0,85	1	1	0,1	0	0,05	54,5 /km	20
632 Sight improvement	1	1	0,9	0	0	0	4,5 /measure	3
633 Road side reflector posts, 80 km/h	1,1	1,1	1,1	-0,05	-0,05	-0,05	3,2 /km	5
634 Road side reflector posts, 100 km/h	0,95	0,95	0,95	0	0	0	3,2 /km	5
636 Painting new middle and side lines	0,9	0,9	0,9	0	0	0	0,7 /km	2,5
637 Painting new side line	0,95	0,95	0,95	0	0	0	0,4 /km	2,5

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Measures in Tarva MT - C

Measure and its reference bumber	CMF (impact coefficient)[1]			Reduction of severity[2]			Implementation[3] costs, 1000€	Expected[4] life time
	Vehicle	Vulnerable	Animal	Vehicle	Vulnerable	Animal		
638 Improving crossing markings	0,95	0,95	1	0	0	0	4,9 /measure	5
639 Improving guard rails	0,975	1	1	0,05	0	0,025	18,0 /km	20
640 Rumble strips, side line	0,97	1	1	0	0	0	2,0 /km	2,5
641 Rumble strips, middle line	0,97	1	1	0	0	0	2,0 /km	2,5
651 Significant improvement in winter maintenance	0,98	0,98	0,98	0	0	0	10,4 /km	15
653 Speed humps	0,85	0,85	0,85	0,05	0,1	0,05	50,9 /km	20
657 Measures supporting speed limit compliance	0,97	0,97	0,97	0,05	0,1	0,05	66,3 /km	2,5
658 Traffic arrangements on urban roads, no limit changes	0,85	0,85	0,85	0,05	0,1	0,05	465,0 /measure	20
671 Speed limit 30 -> 40 km/h	1,098	1,098	1,098	-0,16	-1,02	-0,64	0,7 /km	20
672 Speed limit 40 -> 30 km/h	0,911	0,911	0,911	0,14	0,51	0,39	0,7 /km	20
673 Speed limit 30 -> 50 km/h	1,205	1,205	1,205	-0,35	-3,17	-1,71	0,7 /km	20
674 Speed limit 50 -> 30 km/h	0,83	0,83	0,83	0,26	0,76	0,63	0,7 /km	20
675 Speed limit 40 -> 50 km/h	1,098	1,098	1,098	-0,16	-1,02	-0,64	0,7 /km	20
676 Speed limit 50 -> 40 km/h	0,911	0,911	0,911	0,14	0,51	0,39	0,7 /km	20
677 Speed limit 50 -> 60 km/h	1,098	1,098	1,098	-0,16	-0,51	-0,64	0,7 /km	20
678 Speed limit 60 -> 50 km/h	0,911	0,911	0,911	0,14	0,34	0,39	0,7 /km	20
679 Speed limit 60 -> 70 km/h	1,098	1,098	1,098	-0,16	-0,22	-0,64	0,7 /km	20
680 Speed limit 70 -> 60 km/h	0,911	0,911	0,911	0,14	0,18	0,39	0,5 /km	20
681 Speed limit 70 -> 80 km/h	1,098	1,098	1,098	-0,16	-0,16	-0,64	0,5 /km	20
682 Speed limit 80 -> 70 km/h	0,911	0,911	0,911	0,14	0,14	0,39	1,1 /km	20
683 Speed limit 80 -> 100 km/h	1,168	1,168	1,168	-0,16	-0,19	-0,81	1,1 /km	20
684 Speed limit 100 -> 80 km/h	0,857	0,857	0,857	0,14	0,16	0,45	0,5 /km	20
685 Speed limit 80 -> 60 km/h	0,83	0,83	0,83	0,26	0,295	0,628	1,1 /km	20
686 Speed limit 80 -> 50 km/h	0,756	0,756	0,756	0,364	0,535	0,773	1,1 /km	20
687 Speed limit Summer 100->120 km/h	1,112	1,112	1,112	-0,11	-0,144	-0,385	1,5 /km	20
688 Speed limit Summer 120->100 km/h	0,899	0,899	0,899	0,1	0,126	0,278	1,5 /km	20
689 Speed limit Summer 100->80 km/h	0,899	0,899	0,899	0,1	0,107	0,321	1,5 /km	20
690 Speed limit Summer 80->100 km/h	1,112	1,112	1,112	-0,11	-0,12	-0,473	1,5 /km	20
691 Speed limit Winter 100->80 km/h	0,947	0,947	0,947	0,05	0,055	0,176	1,5 /km	20
692 Speed limit Winter 80->100 km/h	1,056	1,056	1,056	-0,053	-0,058	-0,214	1,5 /km	20

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Acknowledgements and futher information:

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A tool for safety evaluations of road improvements.
Accident Analysis and Prevention. Elsevier, vol. 60, ss. 277 - 288
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