iRAP Road Attribute Risk Factors

Number of Lanes

This factsheet describes the road attribute risk factors used in the iRAP methodology for Number of Lanes. Number of Lanes records the total number of lanes in the direction of travel.

About risk factors

Risk factors, sometimes called crash modification factors (CMF), are used in the iRAP Star Rating methodology to relate road attributes and crash rates. Risk factors (or CMF) are described by the Crash Modification Factor Clearing House as follows:

> *A crash modification factor (CMF) is a multiplicative factor used to compute the expected number of crashes after implementing a given countermeasure at a specific site.*
>
> *For example, an intersection is experiencing 100 angle crashes and 500 rear-end crashes per year. If you apply a countermeasure that has a CMF of 0.80 for angle crashes, then you can expect to see 80 angle crashes per year following the implementation of the countermeasure (100 x 0.80 = 80). If the same countermeasure also has a CMF of 1.10 for rear-end crashes, then you would also expect to also see 550 rear-end crashes per year following the countermeasure (500 x 1.10 = 550).*

Related documents

This factsheet should be read in conjunction with:

- *Star Rating Roads for Safety: The iRAP Methodology.*
- *Safer Roads Investment Plans: The iRAP Methodology.*
- *Star Rating and Investment Plan Coding Manual.*
- *Road Safety Toolkit (http://toolkit.irap.org).*

Risk factors

Risk factors by road attribute category, road user type and crash type

Number of lanes	Vehicle occupant and motorcyclist head-on	Pedestrian crossing the road
One	1.0	1.0
Two	0.02	2.8
Three	0.01	5.2
Four or more	0.01	8.0
Two and one	0.5	1.8
Three and two	0.02	4.0

Selection of risk factors

Vehicle occupants and motorcyclists

iRAP has estimated how an increase in the number of lanes reduces the probability of a head-on crash with an opposing vehicle. It is an estimate of the risk of harm from opposing vehicles, related to the relative amount of time spent in opposing lanes, based upon the road's profile.

If, for example, there is one lane in each direction, any overtaking places a vehicle in the opposing carriageway and puts its occupants at risk. Based on this demand model, the risk is assumed to be greatly reduced if there is more than one lane in each direction. Following this logic, risk is assumed to be halved if there are 2-lanes in one direction and only one in the other since it is assumed that only half the vehicles (the vehicles travelling in only one of the two directions) will move into the opposing lane when overtaking. Risk has been estimated for a variety of scenarios (table below). It is recognised that there will be variation in this risk, and in behaviour, from country to country.

Pedestrians

Corben et al (2008, cited in Turner et al, 2009) found that the risk of a pedestrian being hit by a vehicle while crossing a road is proportional to the road width, such that: crash risk $\propto$ (road width) ^ 1.5. The reasons for risk increasing with road width include:

- gap selection is difficult for pedestrians, partly because it is more difficult to predict where on the cross-section of the road the pedestrian will be when the approaching vehicle intersects with their path
- it takes longer to cross from one side to the other, increasing exposure to crash risk
- lateral position of the approaching vehicle(s) can be more uncertain
- mean speeds are generally higher on wider roads
- there may be higher traffic volumes.

The risk factors for Number of Lanes were set using this relationship and based on an assumption that lane width is 3.5m (it is noted that the risk factors are relative to the baseline case of 1 lane in each direction). When there is a pedestrian refuge or median, the risk is calculated by adding the risk scores for crossing two separate 'roads', rather than calculating a single risk for the whole road.

Background research and model development

The work described above for pedestrians was also used within earlier versions of the iRAP methodology. "Number of Lanes" was not used for other road users in previous versions of the model, but for vehicle occupants the associated risk was incorporated within the attribute "Overtaking Demand".

Risk factors in earlier versions of the iRAP model

Number of Lanes	Pedestrians
One	1.0
Two	1.5
Three	2.5
Four or more	4.0
Differs/other	1.25

References

The following publications are the primary references used in the selection of the iRAP road attribute risk factors. A complete list of citations is available in: *iRAP Road Attribute Risk Factors: Full Reference List.*

Elvik, R, Hoye A, Vaa, T, and Sorensen, M. (2009). *The Handbook of Road Safety Measures, Second Edition.* Emerald Group Publishing Limited. ISBN 978-1-84855-250-0.

Lynam, D (2012). Development of Risk Models for the Road Assessment Programme. RAP504.12 *and TRL Report*

CPR1293, Published by iRAP and TRL and available at: http://www.trl.co.uk and at http://www.irap.org.

Mak, K. and Sicking, *D. (2003). Roadside Safety Analysis Program* – Engineer's Manual. Transportation Research Board (TRB) National Cooperative Highway Research Program (NCHRP) Report 492. ISBN 0-309-06812-6.

Turner, B. Steinmetz, L., Lim, A. and Walsh, K. (2012). Effectiveness of Road Safety Engineering Treatments. AP-R422-12. Austroads Project No: ST1571.

Turner, B., Affum, J., Tziotis, M. *and Jurewicz, C. (2009). Review of iRAP Risk Parameters*. ARRB Group Contract Report for iRAP.

Turner, B., Imberger, K., Roper, P., Pyta, V. and McLean, J. (2010). *Road Safety Engineering Risk Assessment Part 6: Crash Reduction Factors*. Austroads AP-T151/10. ISBN 978-1-921709-11-1.

University of North Carolina Highway Safety Research Center and U.S. Department of Transportation Federal *Highway Administration (2013). Crash Modification Factors* Clearing House: http://www.cmfclearinghouse.org/.

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