iRAP Road Attribute Risk Factors

Delineation

This factsheet describes the road attribute risk factors used in the iRAP methodology for Delineation. Delineation is a measure of the road attributes that inform drivers of road conditions to keep them within the driven lane and aware of road ahead.

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

Delineation	Vehicle occupants and motorcyclists		Pedestrians	Bicyclists	
	Run-off	Head-on loss of control	Along	Along	Run-off
Adequate	1.0	1.0	1.0	1.0	1.0
Poor	1.2	1.2	1.2	1.2	1.2

Selection of risk factors

Lynam (2012) explained the research background to the values used in the model. It is assumed that good general signing and marking along a route would reduce risk of head-on and run-off accidents by 20%; a similar effect on intersection accidents is represented by the "quality of intersection" factor associated with each intersection. AusRAP assumed rather higher risk values, but some of this effect is taken in iRAP through quality of bend and junction scores. He also notes that Elvik and Vaa (2004) conclude that the majority of markings have very little effect on risk.

Turner et al. (2009) comment "Delineation encompasses all of the road attributes which inform drivers of road conditions to keep them within the trafficable lane and aware of road ahead. It includes a number of treatments such as advance warning signs, chevron alignment markers, intersection warning signs, advance direction signage, painted edge and centre lines, guideposts, and pavement markers. Many of these treatments are used in combination, although published literature generally only reports on the effectiveness of individual treatments. Signing is perhaps one of the most commonly used treatments. There is a surprising lack of objective information on the effectiveness of curve warning signs. Only two studies specifically refer to curve warning signs, and they suggest reductions of 30% and 35%. However, they do not appear to be based on objective analysis. More robust research is available on the effectiveness of vehicle activated signs (with Winnett and Wheeler (2002) showing a 34% reduction), it could be assumed that a lower figure would be more appropriate for static signs. A figure of 25% reduction is suggested, but this requires further research as there is a low level of confidence in this.

Again, there is a surprising lack of objective information on Chevron warning signs. Only one study specifically refers to chevron signs suggesting a 40% crash reduction. As noted above, a static sign would not be expected to perform better than a vehicle activated sign; therefore, this figure appears to be high. It is recommended that an appropriate figure of 30% be used (less than a vehicle activated sign, but better than a single static sign) with low confidence is this value.

Information on advance direction signage was also scarce. Two studies produced an estimate of a 15% crash reduction, but confidence is low in this figure. There is an extensive literature on line markings to aid in delineation. In the review for Austroads (Austoads, 2004) all studies that relate to 'all crashes' were included for consideration, and assessed for outliers. The remaining reduction factors for edgeline installations averaged a 19.5% (rounded to 20%). For centreline installation, the selected reduction factors resulted in a 29% reduction (rounded to 30%).

Given the types of reductions seen for delineation devices, a maximum reduction from their use of around 30% could be expected – a relative risk of about 1.43. It should be noted that within the iRAP methodology, quality of delineation at curves, intersections and crossings are recorded under other attributes so a relative risk score of 1.2 for poor delineation is appropriate for this variable."

Risk factors in earlier versions of the iRAP model

Curvature	Risk factors
Adequate	1.0
Poor	1.2

Primary 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 (2009) 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/.

27 June 2013