iRAP Road Attribute Risk Factors
Road Condition

This factsheet describes the road attribute risk factors used in the iRAP methodology for Road Condition. Road Condition records the degree to which the road has an even surface that does adversely affect the travel path of vehicles, motorcycles and bicycles.

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

Road condition	Vehicle occupant		Motorcyclist		Pedestrian	Bicyclist	
	Run-off	Head-on LOC	Run-off	Head-on LOC	Along *	Along *	Run-off
Good	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Medium	1.2	1.2	1.25	1.25	1.2	1.2	1.25
Poor	1.4	1.4	1.5	1.5	1.4	1.4	1.5

*LOC: loss of control. * Risk of being struck by a vehicle or motorcycle.*

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Selection of risk factors

A robust linear relationship was found between crash rate and roughness (see figure below).   The risk factors used by iRAP are based on the difference between 25 and 35 crashes per million vehicle kilometres travelled (VKT). It is recognised that roads in Victoria, Australia (where the study was conducted) might not experience the extreme low standard of some roads in low- and middle-income countries, but it is not clear that such conditions will consistently raise crash rates. The road condition risk to two-wheeled road users (motorcyclists and bicyclists) is considered greater than for 4-wheeled vehicles. Elevated risk levels are assumed for these two user groups because of the inherent lower stability of two-wheeled vehicles and greater likelihood of loss of control.

Casualty crash rate for different roughness categories, Victorian rural roads (Cairney and Bennett, 2009)
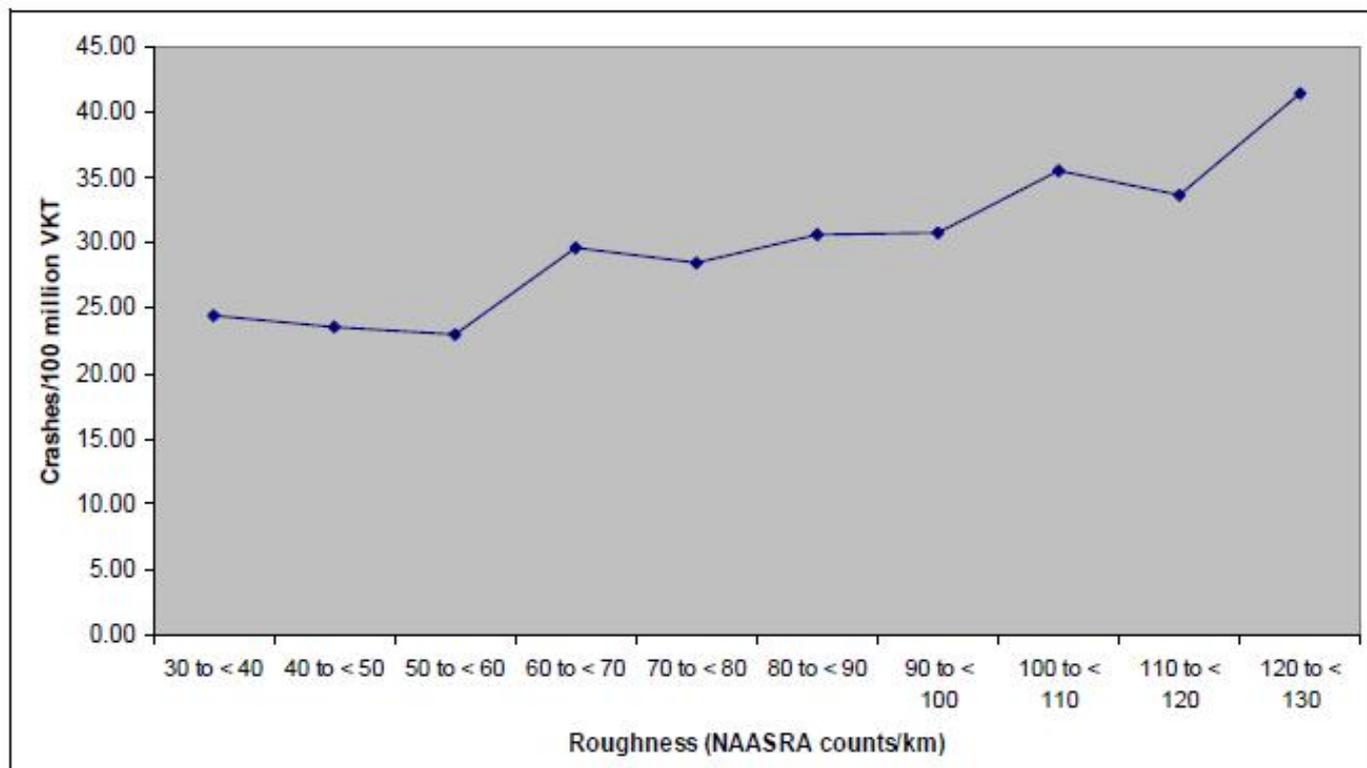
Background research and model development

Lynam (2012) explained the research background to the values used in earlier versions of the iRAP methodology and said that the influence of road condition is not straightforward. If road condition is very poor, reduced speeds may reduce crashes. Elvik and Vaa (2004) suggest that reconstruction, rehabilitation and resurfacing of roads can reduce the number of injury crashes by about 20% in rural areas, but by less than 10% in urban areas. Improving surface friction can reduce crashes by up to 40% on wet roads, but can also affect driving speeds.

The Crash Modification Factors Clearing House website lists 76 studies if "road surface" is entered (October 2012). Many resurfacing studies show benefits in the region of halving crashes but it is far from clear that they are as relevant to the iRAP model as the Cairney and Bennett (2009) work.

Risk factors in earlier versions of the iRAP model

Road condition	Vehicle occupants, motorcyclists and bicyclists run-off and head-on
Good	1.0
Medium	1.1
Poor	1.25

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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/.

30 May 2013