Adopting the 3-Star minimum safety rating

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The world is poised to adopt a *Sustainable Development Goal* committing to halve road deaths by 2030. Achieving that goal means that all countries will need to apply known solutions much more systematically than previously to achieve safer roads, vehicles and behaviour. This is especially the case in developing countries that are now investing heavily to overcome a lack of basic infrastructure, including providing for the nearly one billion people in rural areas that lack access to all-weather roads [1].

Consistent with the 'safe system' approach, countries leading in road safety are increasingly examining ways to ensure that people do not come to serious harm on their networks. The use of star rating targets is becoming more prevalent as a mechanism for managing safety on major roads and guiding investment. Highways England, a newly established government corporation for national roads, has a goal that 90% of travel on its network will be at 3-star or above by 2020. The Netherlands is now within 25km of achieving its 3-star target for national roads. Sweden's administration aims for better than 75% by 2020 and near

100% by 2025. New Zealand has completed a review of design standards to ensure that Roads of National Significance (RoNS) will be implemented with a minimum 4-star KiwiRAP rating. In Australia, the Australian and Tasmanian Governments have released a 10-year, $500 million action plan to improve the Midland Highway to at least 3-stars.

There is good evidence that better star ratings are associated with lower crash costs. Most recently, the Road Safety Foundation reported that re-surfacing, improvement of road markings, lowering the speed limit, and improvement of pedestrian crossings on a stretch where pedestrians were especially vulnerable allowed a section of the A404 in Buckinghamshire, UK, to rise from 2-stars to 3-stars overall and this helped cut crashes by 90% [2]. A study on the Bruce Highway in Queensland, found that: crash costs on 2-star roads are 40% lower than on 1-star roads; crash costs on 3-star roads are 61% lower than on 2-star roads; and crash costs on 4-star roads are 43% lower than on 3-star roads (see Figure 1) [3].
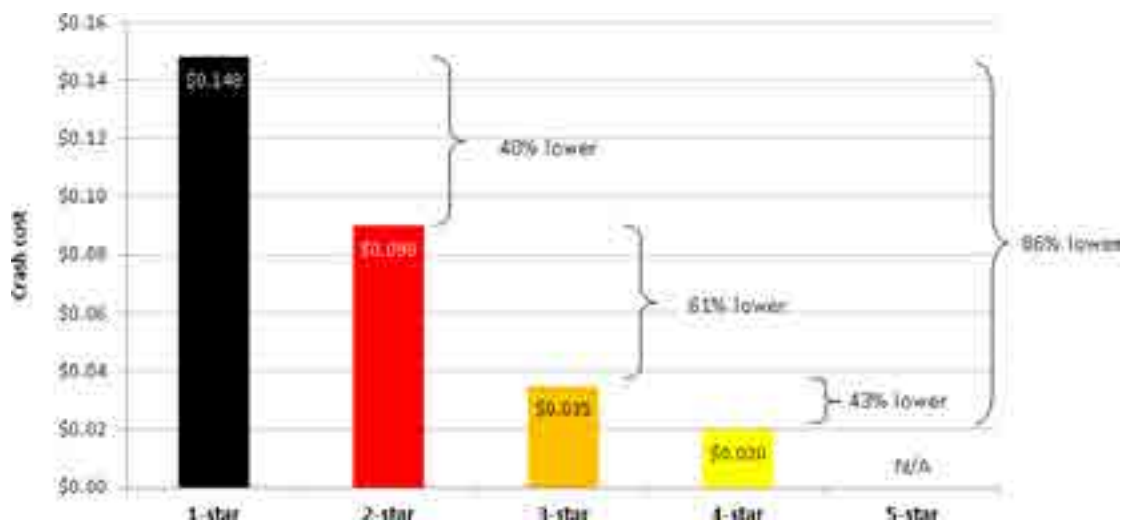

Figure 1. Smoothed vehicle occupant Star Ratings and fatal and serious injury crash costs per vehicle kilometre travelled

Star rating targets are also being taken up by developing countries, where the large majority of the road trauma burden lies. The World Health Organization (WHO) estimates that around 800,000 people are killed in road crashes in the Asia Pacific region each year, accounting for 65% of global road deaths [4]. Roads in this region have alarmingly high rates of trauma and extremely high rates on particular stretches. As just one example, crash scene investigations conducted as part of iRAP assessments on a

53km stretch in Karnataka, India recorded nine deaths and 17 serious injuries during a period of just 45 days [5]. That equates to an annualised death rate of 1.4 deaths per km, around 20 times higher than the average annual death rate on the Lapstone to Katoomba section of the Great Western Highway in NSW, which was identified by AusRAP as a particularly high-risk section of Australian national highway network [6].

The impact of serious road crashes on individuals and families is well documented. A high proportion of households report 'catastrophic expenditure' following a road death or injury [7]. After a serious crash, households often need to borrow money, sell an asset, give up study or take on extra work just to survive. We estimate that across Asia Pacific, road deaths and serious injuries cost US $820 billion per year, or about 4% of Gross Domestic Product (GDP) [8].

The iRAP assessments, which involve road surveys and recording road attribute details for each 100 metre segment of a road, are helping to explain why levels of trauma can be so high in the Asia Pacific region [9]. Roads where billions of kilometres of travel occur each year often have fundamentally unsafe designs (see Figure 1). It is common for roads that carry significant pedestrian and bicycle flows to have no footpaths and bicycle paths. Dedicated motorcycle lanes in countries like Vietnam, where the majority of vehicles are motorcycles, are uncommon. Roadside hazards are common, intersections often lack basic safety elements and roads that carry relatively high-speed traffic often do not have any median separation. Problems with safety are not limited to old roads – newly
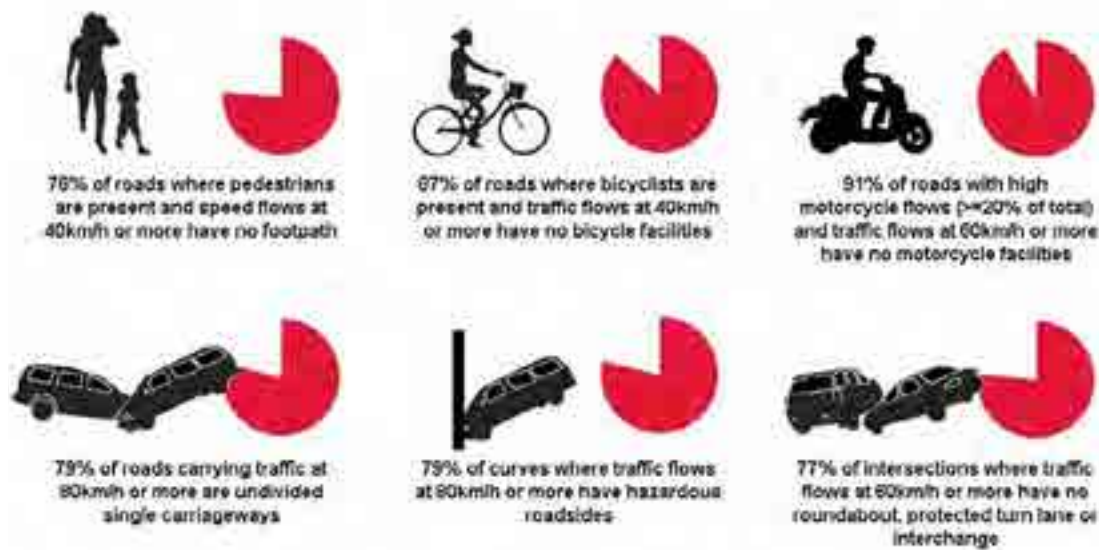

Figure 2. Key road attributes for a sample of 30,000km of roads in 11 low-income and middle-income countries in the Asia Pacific region

built roads often have risk built-in. For example, despite the International Road Federation (IRF) recommending that "road authorities in all countries immediately prohibit new installations of 'Fishtail' or 'Spoon' terminals…", these hazardous design safety barrier ends are still included in design standards in numerous countries and continue to be installed on upgraded and new roads [10]. This type of problem is often compounded by the fact that new, smoother pavements invariably lead to higher speeds that significantly increase risk unless ameliorated with safety countermeasures.

The iRAP star ratings are based on road inspection data and provide a simple and objective measure of the level of safety which is 'built-in' to the road for vehicle occupants, motorcyclists, bicyclists and pedestrians. Five-star roads are the safest while one-star roads are the least safe. Importantly, Star Ratings can be completed without reference to detailed crash data, which is often unavailable in low-income and middle-income countries. Figure 3 illustrates star ratings for roads in the Asia Pacific region, and lists road attributes that influenced the ratings.

In China and India, which the WHO estimates account for a combined 40% of global road deaths, iRAP is working closely with governments and development banks to develop a long-term, large-scale approach to infrastructure safety. The China Road Assessment Program (RAP) team, a partnership between iRAP and the Ministry of Transport Research Institute of Highway (RIOH), is using star ratings to promote practical, localised road safety improvements. As just one example, the ChinaRAP team helped local road designers to almost double the percentage of road rated 3-stars or better in the US $400 million Asian Development Bank (ADB)-financed Shaanxi Mountain Road Safety Demonstration project [11]. It is estimated that the targeted use of roadside safety barriers, paved shoulders, realignments, enhanced skid resistance, traffic calming and pedestrian crossings will reduce deaths and serious injuries by 25%. The ChinaRAP team is now rolling out large-scale assessments across 12 provinces as part of the national "Highway Safety to Cherish Life" project. In its first 10 years, the program invested some US $5 billion in safety facilities on 366,000km of roads.

Figure 3a. Examples of roads and star ratings in Asia Pacific

Figure 3b. Examples of roads and star ratings in Asia Pacific

Figure 3c. Examples of roads and star ratings in Asia Pacific

Figure 3d. Examples of roads and star ratings in Asia Pacific

Figure 4. Targeted improvements to designs in Shaanxi, China

During the past five years, iRAP has also worked in India with the Ministry of Road Transport and Highways (MoRTH), public works departments, research institutes, local engineering firms and motoring clubs to assess risk on more than 10,000km roads in Andhra Pradesh, Assam, Gujarat, Haryana, Karnataka, Kerala, Rajasthan, Tamil Nadu, Telangana and Uttar Pradesh. It is estimated that almost 60 million people live within three kilometres of these roads, and that as many as 75,000 deaths and serious injuries occur on the roads each year.

The iRAP investment plans have helped to make solutions to the enormous safety challenge in India clearer. It was estimated, for example, that by giving people a safe place to walk for instance, new footpaths on 440km of roads in Kerala could prevent 4,600 deaths and serious injuries over 20 years and save INR 3.4 billion (USD $55 million) in crash costs. Much of this cost would otherwise be borne by an already stretched health sector.

Importantly, investments to improve many of the roads have already been locked in. The iRAP assessments are now being used in World Bank-financed projects worth more than USD 5.3 billion, and many of these projects now specify targets for improved Star Ratings. For example, in the Second Karnataka State Highway Improvement Project (KSHIP) the government specified that demonstration corridors shall achieve a minimum of 3-stars for safety. In the Second Kerala State Transport Project, safety countermeasures that improve star ratings particularly for vulnerable road users have been written into designs (see Table 1). To date, designs for around 25% of the roads assessed across India have been star rated; helping to ensure that safety is built-in to the plans prior to construction. At the same time, hundreds of local engineers have taken part in training on the use of iRAP tools and road infrastructure safety.

Table 1. Safety countermeasures in the World Bank financed Kerala State Transport Project II (KRSP-II)

Item	Kasargod - Kanjangad	Pilathara – Pappinesserry	Thalaserry - Valavupara	Chenganoor – Ettumannoor	Ettumannoor - Muvattupuzha
Signalised junctions	9	4	8	12	2
Pedestrian crossings	24 table top 35 at-grade	14 table top 26 at-grade	26 table top 38 at-grade	36 table top 70 at-grade	30 table top 108 at-grade
Sidewalk	20.5km	22.9km	78.4km	77.8km	57.8km
Parking areas / ox-bow land development	12 parking areas 4 oxbow land	3 parking areas 4 oxbow land	1 parking area 27 oxbow land	13 parking areas 1 oxbow land	8 parking areas 1 oxbow land
Length of barriers	1.2km crash barriers 5.8km hand rails	3.5km crash barriers 5.4km hand rails	2.8km crash barriers 7.9km hand rails	5.9km crash barriers 15.4km hand rails	13km crash barriers 8km hand rails
Slow traffic segregation	13.2km	19.6km	77.9km	79.1km	78.1km

However, there remains an urgent need to scale up road safety efforts. In India for example, the Planning Commission foresees that 66,000km of new roads will be built at a rate of 30km per day. US $32 billion will be invested in 2015-16 alone [12]. It is crucially important that new investment, not just in India, but globally, is not simply geared towards accommodating larger volumes of faster moving traffic, but that it is effective at improving safety for the billions of people of who drive, ride and walk on roads each year. To help accelerate investment in safety, the Asian Development Bank (ADB) has floated wide use of iRAP star rating targets in development projects, suggesting:

1. all new or rehabilitation road designs should always have a higher safety rating than the existing road and have at least a 3-star rating standard for all road users

2. roads with more than 50,000 vehicles per day should have a minimum of 4-stars for all users

3. roads or sections of roads passing through linear settlements should have a minimum 4-star standard for pedestrians and cyclists [13].

The Africa Transport Policy Program, which is hosted by the World Bank, has similarly explored the potential benefits of setting a target of at least 3-stars for all road users [14]. In the United States of America, a coalition

that includes the Institute of Transportation Engineers (ITE), AAA, the Insurance Institute for Highway Safety (IIHS) and American Society of Civil Engineers (ASCE) is advocating for roads in developing countries to be built to a minimum 3-star safety standard for all road users [15].

The moral and economic case for scaling-up investment in safe infrastructure is compelling. As we approach the Second Global High-Level Conference on Road Safety, we have an unprecedented opportunity to build on the growing momentum; to tackle the road crash epidemic; and leave a legacy of safe travel for future generations.

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Developing a curve risk prediction model for a safe system signature project

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Abstract

The Safer Journeys Action Plan 2013-2015 identifies safe system signature projects as a strategic action to achieve the Safer Journeys vision. The rural roads of New Zealand's Eastern Bay of Plenty (EBoP) region were identified as an area where a signature project has the potential to make demonstrable advances in reducing road trauma for all road users.

This paper describes a new risk prediction methodology that identifies high-risk curves independent of crash history. Using geospatial data and innovative analysis techniques, existing methodologies for identifying curves and calculating vehicle operating speeds were modelled and automated to undertake a network-wide assessment of high risk curves.

The new methodology extracted and classified almost 7000 curves across 1,500km of road network. When compared to the location of loss-of-control crashes, it was found that 66.6% of crashes occurred on 20.3% of curves classified as 'high risk' in at least one direction. These results have been shared with road controlling authorities and will support prioritised road safety improvements targeting high risk curves.