



Planning for local network
highway upgrades using
iRAP Star Rating assessment
for safer road investment plans

in conjunction with



A road safety audit to meet all obligations

National Highways uses iRAP to assess the condition of the UK's strategic road network every five years.

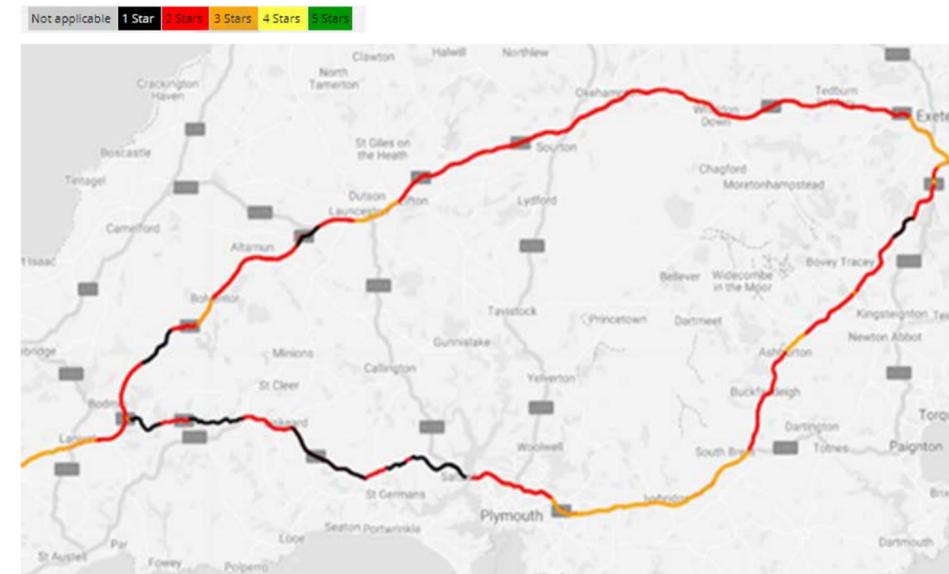
Local Authorities have an obligation under the Road Safety Act of 1988 to conduct regular safety audits across their networks, be they on dual carriageways, in towns and cities, or on undivided rural roads.

Many councils have also pledged to support the UN Global Plan for the Decade of Action for Road Safety 2021-2030 in which safe road infrastructure by design is a key focus.

UN Global Road Safety Performance Targets 3 and 4 apply to all countries. The targets include ensuring all new roads are built to a 3-star or better standard for all road users (Target 3), and more than 75% of travel is on the equivalent of 3-star or better roads for all road users by 2030 (Target 4).

As Local Authorities work to re-prioritise road use in favour of active travel modes, the Star Rating, and predicted reductions in casualties on their roads is a key factor in unlocking funding for road safety improvements.

iRAP models whole routes, not just black spots, across network boundaries, to provide a holistic assessment of risk, and recommend mitigations.



The casualty rate is 6.8 times greater on 'local' roads than on motorways.



The International Road Assessment Programme is an international charity with a vision for a world free of high-risk roads

Active in 100+ countries, it provides the tools and training to road authorities, mobility clubs, development banks, industry and road safety stakeholders to make roads safer.

To date, over 1.3 million+ kms have been Star Rated and 1.5 million km Risk Mapped across the world.



About iRAP

iRAP is an infrastructure safety management system, a core pillar of a Safe Systems approach to road safety.

Applying the iRAP model initially involves surveying the road network by capturing video footage of the pavement. The model contains 50+ key safety critical road features which are 'coded' according to the risk they pose to different types of road users. The model identifies the features in the images and calculates the risk for every 100m section of route. This risk score is translated into a Star Rating.

The Star Rating is initially presented on a high level map or a road network. These maps indicate the general risk state of road sections in a very visual way that can be used to explain the current risk to less technical audiences such as budget holder, politicians or members of the public.

The iRAP model then generates a range of countermeasures, along with their economic viability, which form the basis of a Safer Roads Investment Plan.

The iRAP model also automatically links improvement programmes to estimated reductions in Killed/Seriously Injured casualties. This makes it simple to compare and contrast the impact of interventions.

The Star Rating

The Star Rating assesses the risks from infrastructure to road users along 100m road sections. The models produce a numerical estimate for the degree of risk in these road sections relating to the features. The resulting risk metrics are called Star Rating Scores.

The Star Rating Scores are assigned to colour coded bands which go from 1 Star (black), which represents very high risk, through to 5 Stars (green) which is very safe. The lower the risk score, the higher the Star Rating.

By having an independently assessed metric of risk, it is then possible to have policy and investment decisions linked to a target to improve that metric. The iRAP Star Rating has proved to be a powerful visual mechanism for bringing teams together to reduce casualty numbers.

STAR RATING	STAR RATING SCORE FOR VEHICLE OCCUPANTS AND MOTORCYCLISTS
5 star Low risk	0 to < 2.5
4 star Low medium risk	2.5 to < 5
3 star Medium risk	5 to < 12.5
2 star Medium high risk	12.5 to < 22.5
1 star – high risk	22.5+



The UK was one of the four countries that founded the global RAP programme. 770,000km of roads have been assessed for their intrinsic safety quality so far, and every year the Road Safety Foundation publishes a crash risk map of all motorways and A roads in Great Britain. Based on this analysis, the Government launched a £100 million Safer Roads Fund to address safety on England's 50 highest risk local A roads. This should prevent over 1,450 fatal and serious injuries over the next 20 years, with a benefit of £550 million. Annual crash risk mapping shows a £1.4billion investment in safer roads in Great Britain could prevent over 11,000 fatal and serious injuries over the life of recommended treatments.

Research shows that a person's risk of death or serious injury is approximately halved for each incremental improvement in Star Rating.



Pro-actively safer roads by design

The primary purpose of the iRAP model is to identify the financially attainable infrastructure upgrades that will allow a network operator to pro-actively fix a road before casualties are caused by its design.

A road used to be considered "safe" based on its crash history. It was quickly appreciated that only using statistics from reported incidents was an inadequate method of appraisal and that additional risk factors had to be taken into consideration. Particularly in the UK, as the volume of killed and seriously injured (KSI) road users has reduced, so this data becomes less helpful as an indicator of road safety. The modern approach to road safety is more holistic, with a high degree of focus on physical risk management for all road users.

iRAP Star Rating is fundamentally a better way to identify cost effective packages of infrastructure improvements targeted at longer route sections than the traditional reactive crash management approach. It leads to an understanding of the specific road features that are subjecting road users to risks. It identifies to what extent cost-effective changes may be made to improve inherent road safety in the high-level schemes it produces.

The model is also sensitive to speed and flows of road users present in the road sections in calculating the risks.



iRAP in action — — —

Route 55 in the State of Qatar used iRAP Star Rating to improve its safety from 2 to 4 Star .

Road attribute coding: 50+ safety critical road features assessed for risk

Major roads have been designed to reduce risks to road users. Most local roads have not, they have accumulated features "organically" such as street lamps, pedestrian crossings, centreline rumble strips, an adverse camber, narrow lanes, poor skid resistance road surface, changes of speed limit, typical usage and flow rate, the addition of a bicycle lane... and many more.

Each feature presents a degree of risk to different road users in different conditions. The iRAP model scores the risk as a contributing factor in the likelihood and severity of a collision. This produces a Star Rating for every 100m section of road.

Each feature presenting a risk has a corresponding countermeasure and the cost of its implementation within the model.

Example Risk Factors for a run off road hazard



Unprotected tree = 60



Wire rope barrier = 9



Steel barrier = 12



Concrete barrier = 15



A unique service: compelling evidence for investment

The combined service from TRL and Gaist results in a powerful set of visualisations to demonstrate that appropriate investment in infrastructure changes will reduce the risk to road users and lead to a reduction in casualty figures. To reach these simple communication devices, the service comprises a series of steps:

1. **Agree overall route** i.e. number of miles to be surveyed or modelled, and specific sections to be Star Rated
2. **Agree which data to add to the model** e.g.
 - Traffic flow
 - Speed
 - Motorcycles
 - Countermeasures set (not all may be appropriate for the route)
 - Stats19 data

3. Obtain survey imagery

The imagery may already be held by the asset management team, collected for condition network monitoring, or by another team within the local authority. Alternatively, Gaist may already hold the imagery in its own library, for immediate access. Only if the imagery does not already exist will survey vehicles need to be sent out to capture video footage of the route using Gaist's specialist equipment.

4. Apply road attribute coding

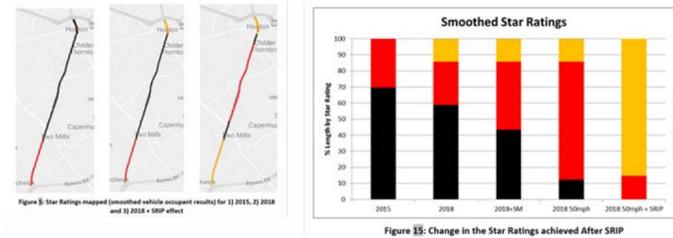
This process identifies all elements of infrastructure presenting risk to the road user and is a fundamental component of the modelling process.

Outputs from the modelling result in evidence suitable for budgeting and funding applications:

Star Rating maps

Initially, a map is generated for the whole route, aligned to a Star Rating table.

Star Rating maps covering sections for improvement are also generated with related Star Rating table.



Safer Roads Investment Plan (SRIP)

SRIPs give the detail of what infrastructure elements can potentially be changed or upgraded to reduce the risks present. These schemes are also economically appraised based on the cost of the suggested countermeasures, the values of saving lives/serious injuries and the estimated impact of the change on casualty occurrence.

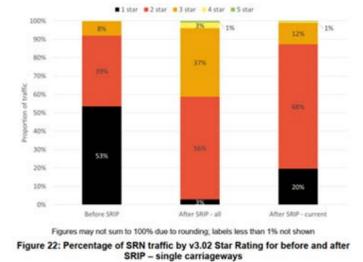
The SRIPs are a high-level starting point from which to develop viable schemes; the detailed suggestions need to be checked by local engineers and formulated into realistic schemes.

Table 15: Single carriageway SRIP countermeasures with BCR>3 (v3.02) 2020 (all countermeasures)

Countermeasure	Length / Sites	FSIs saved	PV of safety benefit (£mil)	Estimated Cost (£mil)	Cost per FSI saved (£k)	BCR
Improve curve delineation	5.7 km	6	2.1	0.2	29	11.9
Pedestrian fencing	51.9 km	12	4.2	0.4	34	10.2
Central hatching	653.3 km	134	45.9	5.4	40	8.6
Centreline rumble strip / flexi-post	54.4 km	13	4.6	0.8	61	5.6
Sight distance (obstruction removal)	4.8 km	2	0.7	0.1	63	5.4
Traffic calming	3.3 km	2	0.7	0.1	74	4.6
Improve Delineation	2.5 km	1	0.3	0.1	76	4.5
Parking improvements	17.8 km	3	1.0	0.2	80	4.3
Shoulder rumble strips	731.2 km	127	43.7	11.9	93	3.7
Central median barrier (1+1)	146.6 km	279	95.5	28.9	104	3.3

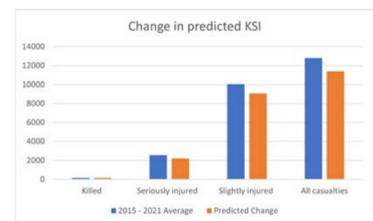
Predicted change in Star Rating

Based on the selected mitigations, the sections identified for improvement are scored for their contribution to upgrading the Star Rating. This is where training is essential to understand how the model works and apply local knowledge, balanced with policy needs and budget restraints to find the most robust combination.



Predicted reduction in KSI figures

The final output from the iRAP model will indicate the potential lives saved if the SRIP is implemented. This is vital evidence for funding and investment applications.





iRAP

in action — — —

iRAP was deployed by National Highways for a stretch of the A550 in Chester that was rated mostly 1 Star in 2015. By using iRAP to model the impact of a range of speed management and speed limit changes on Star Ratings and risk, a SRIP was produced and a range of countermeasures introduced over the following five years, resulting in an improvement up to a mostly 3 Star Rating by 2020.

A unique service: costed £ per mile

The actual cost per mile depends on the availability of imagery of the route to be assessed.

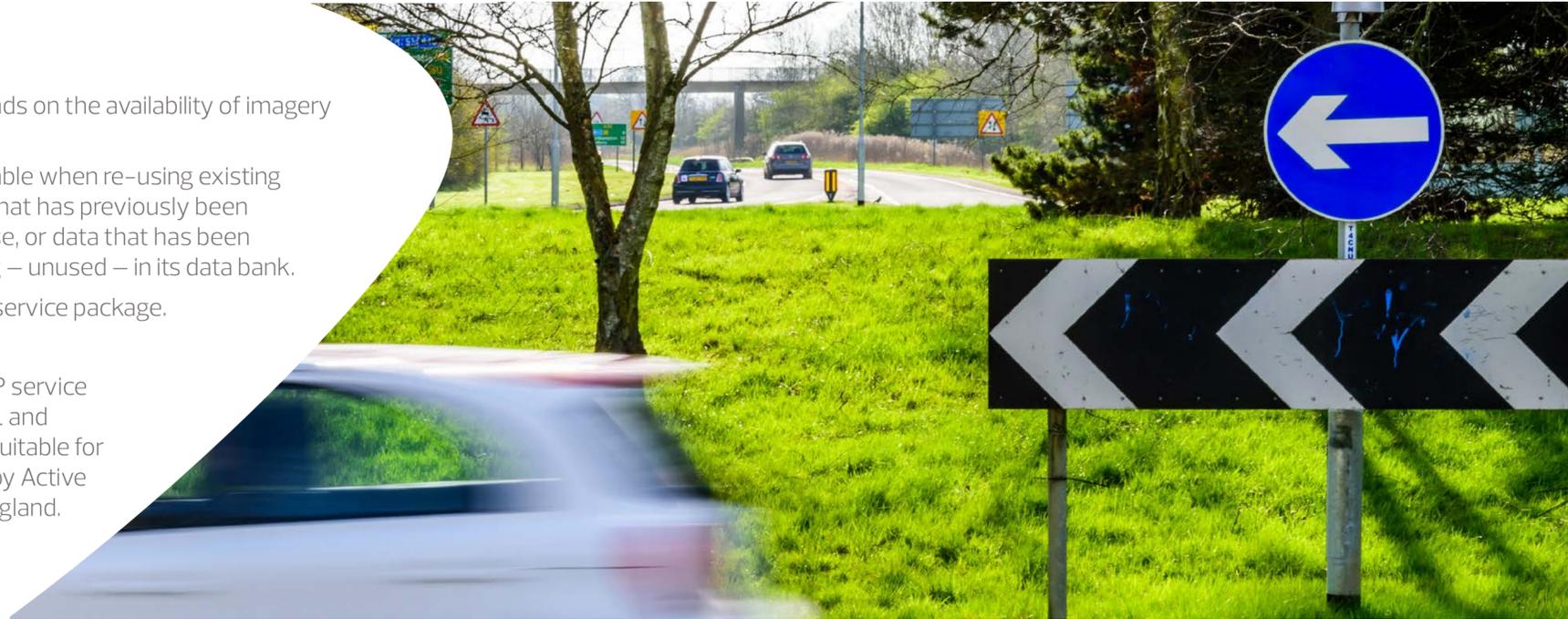
Significant savings are achievable when re-using existing Gaist image data, either data that has previously been captured for a different purpose, or data that has been captured by Gaist and is sitting – unused – in its data bank.

Training is included within the service package.



Active
Travel
England

This iRAP service from TRL and Gaist is suitable for funding by Active Travel England.



A unique service: ongoing support

iRAP UK Road Authority User Group

The Road Safety Foundation has created an iRAP User Group to provide a forum for exchange of best practice, a place to share challenges and help each other overcome them. The group is a way for different road authorities to collaborate on initiatives as much as possible.

The iRAP tools frequently suggest safety interventions which appear to contradict other policies e.g. the removal of trees or the erection of new barriers may be seen as environmentally controversial; reducing speed limits or introducing speed management may be a challenge because of political pressures or because of pressure on road policing resource.

The iRAP UK Road Authority User Group meets no more than three times a year and is aimed at road authorities across UK who are either undertaking iRAP surveys, using the data or planning their future iRAP activities.



Training (standard or customised)

iRAP Star Rating is aimed at a wide group of stakeholders, from highly technical design engineers, to decision makers, to local politicians and members of the public. It indicates graphically where personal risk on the network is highest. Training can help people involved in road safety understand the basis for Star Rating and how to communicate about it clearly.

Awareness training

– 1 hour presentation delivered remotely

This will introduce Safe Systems, cover IRAP's remit and origins, explain Star Rating at a high level and what the system does to reduce Killed and Seriously Injured casualties.

About iRAP

– A half day workshop

This is an in-depth session for staff who are likely to be actively involved in IRAP. It will go into technical detail about the model, the data used and its outputs.

The training is based on "train the trainer" modules developed for National Highways, but can be customised on request.



National Highways undertakes an iRAP Star Rating assessment every 5 years. Recently published results showed the performance indicator for 90% of travel to be on 3-star or better roads by 2020 was surpassed, with 96% achieved. National Highways is using the iRAP approach throughout the organisation for strategic planning of investment, for prioritisation of routes to be treated, to help analyse routes and determine the best return options, and to ensure new designs are as safe as they can be.



A unique service: unique talents

TRL is the only UK Centre of Excellence to support users of the iRAP model. TRL does core model development, coding, and independent quality control of coding for client projects. TRL have been contributing to its design since 2006.



The Road Safety Foundation (RSF) is the licence holder for the iRAP Star Rating model in the UK. The RSF provides quality assurance that iRAP projects are implemented properly and can provide additional advice to clients; importantly they represent iRAP and are ultimately responsible for the outputs from the model.

TRL are currently delivering iRAP for the state of Himachal Pradesh, India. This two-year project involves modelling iRAP Star Rating on 9,000km of roads.

A unique service: unique solutions

Gaist : Affordable imagery

Gaist operates a panoramic, high-resolution image capture system that creates a visual record of the features contained within the roadscape. Wherever the Gaist survey vehicles go, the cameras are always on. After collecting data for a decade, Gaist believe they have 1/3rd of all local network roads already "in the bank". Local authorities may have already commissioned a visual survey for another purpose and can re-use the same data for iRAP.

A Gaist survey collects high resolution imagery (4k) from 2 sources: a 360 degree camera captures images at 2m – 5m intervals, and a carriageway camera captures survey-grade images every 1m.



Gaist imagery can be used multiples times for a number of other surveys, significantly offsetting the cost for each. These include:-

- Ash die back surveys
- Road condition surveys
- Footway condition surveys
- Cycle/bus lane surveys
- Inventory surveys
- Scheme design and planning
- Operational resilience

Gaist cameras are optimised to supply high quality images of the roadscape at speeds up to 70mph and in a wide range of lighting conditions.

All imagery is geolocated with the highest level of positional accuracy for matching the features in the imagery to their location on the defined route.

Advantages of Gaist's survey system over a dash cam solution:

Constantly clear footage

- Inferior dashcam lens and aperture technology leads to under or over exposed imagery which is unusable for surveys. Gaist cameras are highly responsive to changes in light levels, even at speed.

Hi-fidelity individual pictures

- Gaist imagery is made up of individual high resolution images that do not lose any fidelity when viewed as a single frame or "freeze-frame". Dashcam footage produces blurred individual images.

Wide angle - clear view

- Gaist cameras are mounted externally approx 3.5m above the road surface allowing a long and broad field of view. This higher vantage point also reduces the incidence of glare. Dashcam cameras mounted internally have a restricted field of vision and can be easily blinded by low sun.

Full situational context

- Dashcams only face forwards, missing objects and features directly parallel or behind the camera. Gaist's 360 degree camera allows the user to view and understand the complete context of any location.



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