The Safe System

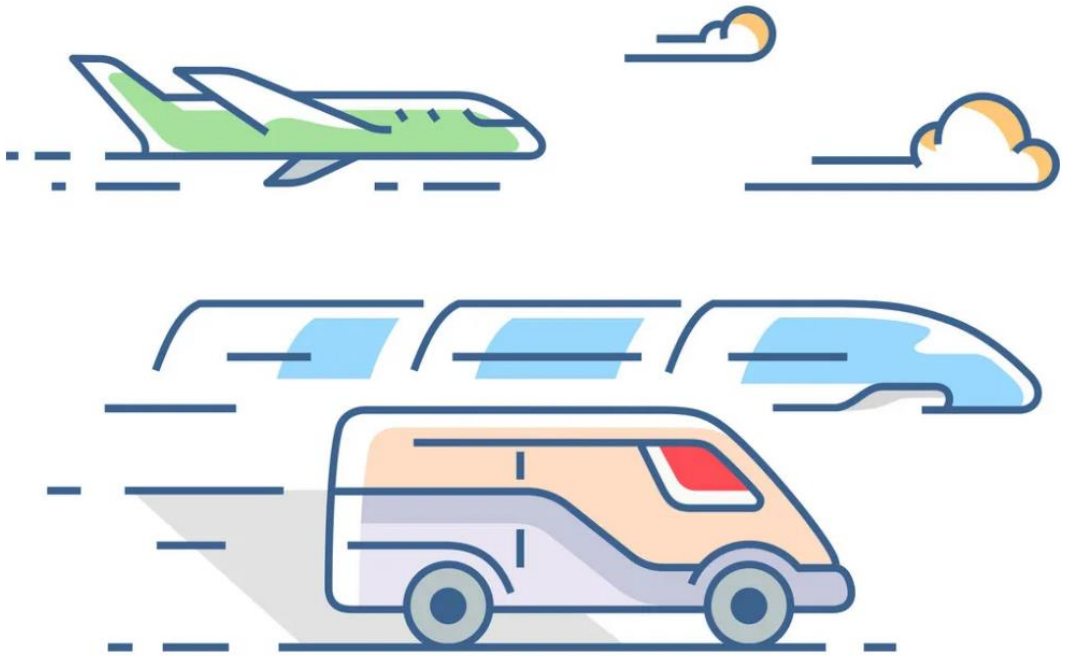
Dr Suzy Charman, Executive Director, Road Safety Foundation

UNITED KINGDOM RAP
LED BY THE ROAD SAFETY FOUNDATION

ROAD SAFETY FOUNDATION

Road Safety Foundation

- Charity established in 1986
- Making road travel as safe as rail and air



Agenda

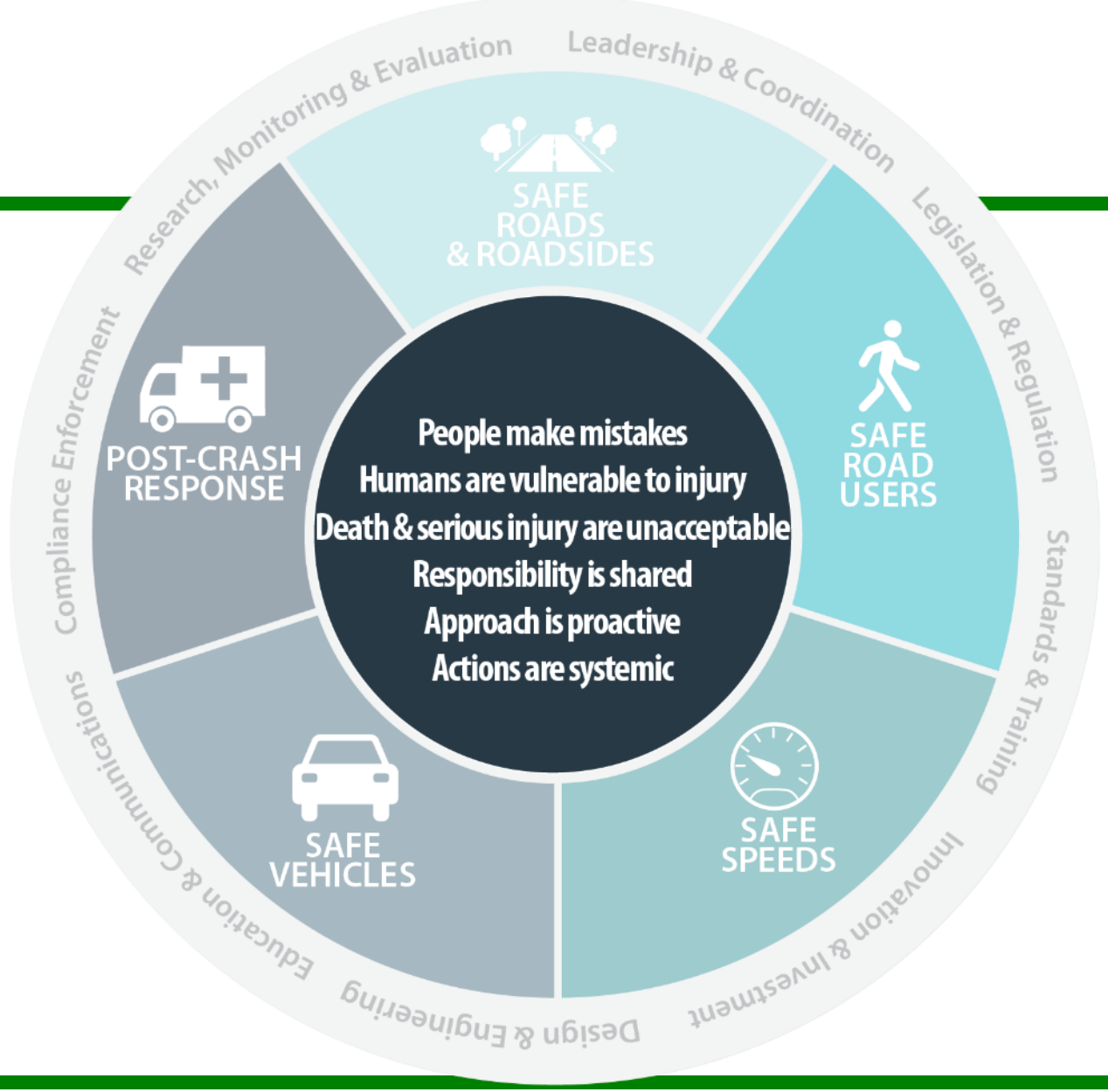
What is a Safe System?
What does the Safe System mean for Road Safety Auditors/Audit?
Speeds, Roads and the Safe System matrix
iRAP and the Safe System
Can iRAP help RSA?

What is a Safe System?

Vision Zero and the Safe System

Vision zero comes from a moral viewpoint that death and serious injury on our roads should not be seen as an **unavoidable byproduct** of mobility

A safe system is where we have designed out the **potential** for fatal or serious injury **completely**



Safe System Key Principles

Shared Responsibility

To err is human - people make '*mistakes*' but death should not be the penalty from normal human behaviour/processing limitations

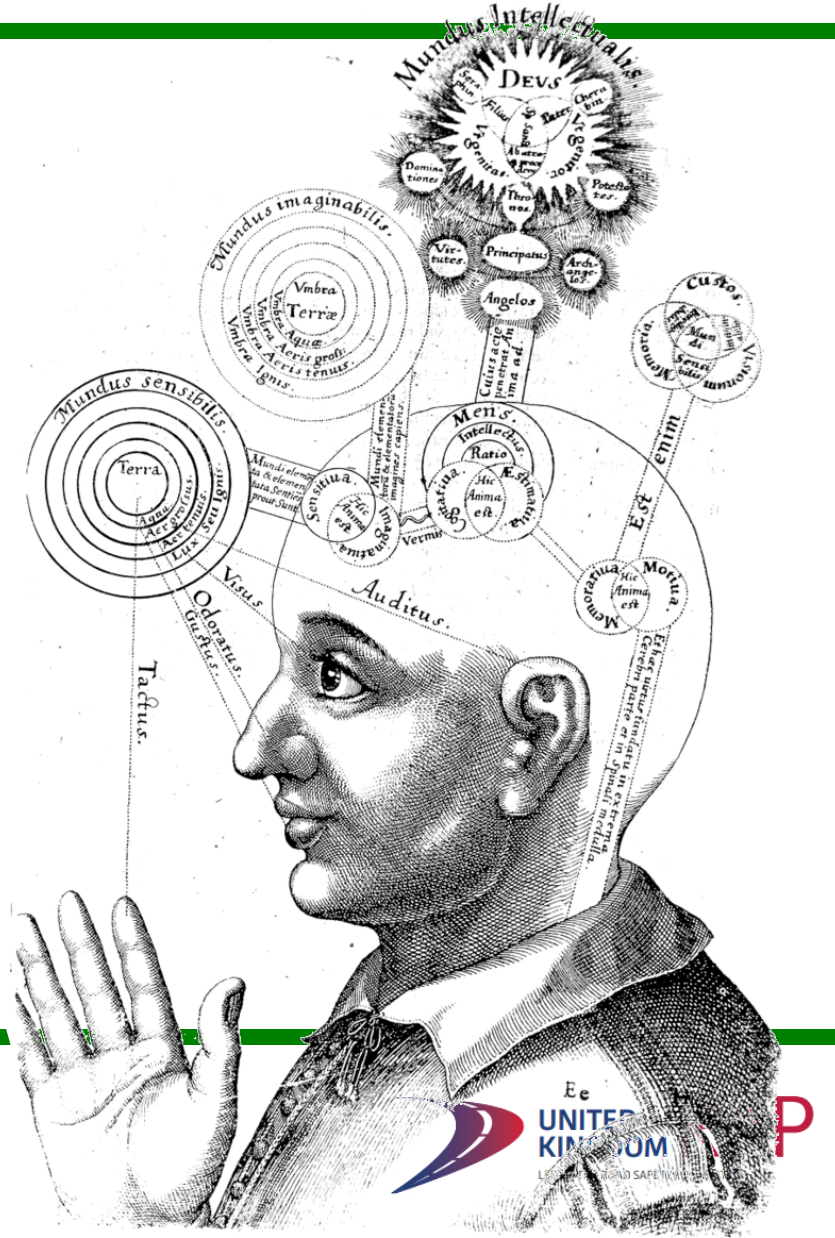
System design that reflects the *fallibility* of humans

The human body has a limited physical ability to tolerate crash forces

System design that reflects the *frailty* of humans

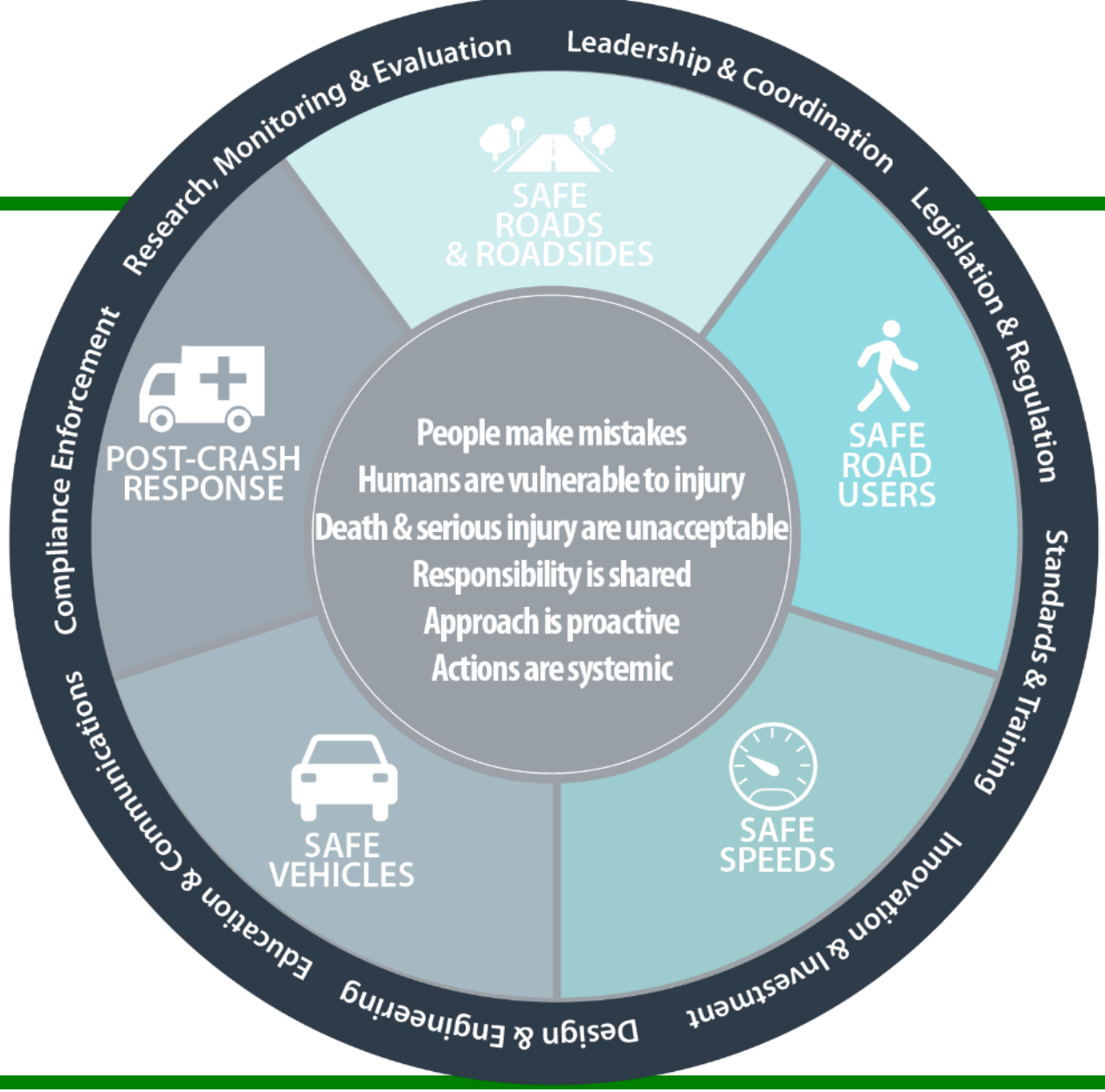
All parts of the road system must be strengthened in combination to multiply the protective effects and if one part fails, the others will still protect people

System design that has *redundancy* built in



Vision Zero and the Safe System

Vision Zero and the Safe System



Based on Survivability

Table 1. Delta-v and Impact Speed with a 10% risk for serious and severe injury for different crash types.

Crash Type	10% Risk for Serious Injury		10% Risk for Severe Injury	
	Delta-v km/h	Impact Speed km/h	Delta-v km/h	Impact Speed km/h
Car to Pedestrian crash	No impact allowable	No impact allowable	20	20
Car to powered two-wheeler (PTW)	No impact allowable	No impact allowable	30	30
PTW to wide object	N/A	25	N/A	50
PTW to narrow object	No impact allowable	No impact allowable	No impact allowable	No impact allowable
PTW to ground	N/A	N/A	N/A	75
Car to bicyclists	No impact allowable	No impact allowable	20	20
Side Impact–Car to Car (of equal mass)	20	40	30	60
Side Impact–Heavy Vehicle into Car	20	20	30	30
Head On Impact–Car to Car (of equal mass)	25	25	50	50
Head on Impact–Car to Heavy Vehicle	25	10	50	25
Rear End–car to car	10	20	20	40
Rear End–heavy vehicle into car	10	10	20	20

Table based on risk curves on relatively modern vehicles and belted occupants, rounded to the nearest 5 km/h.

Truong, J., Standroth, J., Logan, D.B., Job, R.F.S., Newstead, S. (2022). Utilising Human Crash Tolerance to Design an Interim and Ultimate Safe System for Road Safety, Sustainability, 14, 3491

Key Principles of Approach

Systematic elimination of potential for crashes (that will occur) to result in death and serious injury

Proactive treatment – removing risk before crashes have the chance to accumulate

Survivability becomes a central concept …

What does the Safe System mean for Road Safety Auditors/Audit?

Do Road Safety Audits normally comment on survivability as a general principle?

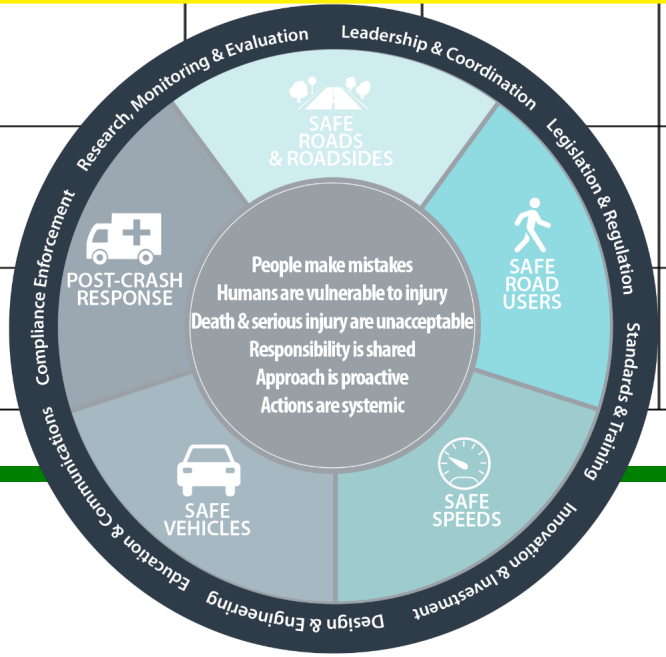
Road Safety Audit as a proactive methodology

Discussion

Speeds, Roads and the Safe System matrix

The Matrix

	Leadership and coordination	Legislation and regulation	Standards and training	Investment	Design and engineering	Education and communications	Compliance and enforcement	Research monitoring and evaluation
Safe speeds								
Safe roads								
Safe road users								
Safe vehicles								
Post collision response								



Speed – Leadership and Coordination

Clear leadership on the role of speed management to tackle road deaths and serious injuries.

Clear articulation of the positive impact (road safety and other!) of slightly slower, smoother journeys.

Establish a shared understanding of a Safe System across professions, through communications and training, and establish coordinated practice across the sector.

Correction of the mismatch of the value of journey time versus values of prevention.

Adoption of the General Safety Regulations and direct engagement with vehicle manufacturers.

Speed – Legislation and Regulation

Align national speed limits to (more) survivable speeds.

Start with lower national speed limits and ‘exception up’ where safety has been assessed and provisions made for the road to operate at higher speed.

The digital speed map project (underway) is critical to success, allowing digital Traffic Regulation Orders (TROs) to be applied accurately and in a timely manner.

Adopt the General Safety Regulations

Speed – Standards and Training

Review DMRB and update it to take account of survivability.

Review the process for decision making and when each benefit/disbenefit is considered.

Training series for all those actors in the safe speed space.

Establish a functional hierarchy/classification for roads with an idealised speed at which each road type should function based on the role of the road and what road users it needs to support.

Align guidance for setting local speed limits to accord with survivability.

Develop suitable training for all actors in the safe speed element of the system. This will include the highway authority, the supply chain, designers, transport/development planners, police, parish councils etc.

Speed – Investment and Innovation

Hypothecation of revenue from speed enforcement to be reinvested in road safety interventions.

Exploration of innovative funding mechanisms such as social impact bonds for investment.

Maximising social value obligations of contractors to implement schemes.

Making a better case for road safety investment, ensuring robust business cases are established, but also that the most promising political arguments are made for investment e.g. impact on NHS and productivity.

Use the European Data for Road Safety project to make connected vehicle data on speed available to all road safety practitioners.

Create guidelines for the use of such data by practitioners and how it can be ingested into other broader contextual systems like iRAP and how it can be interpreted.

Speed – Design and Engineering

Guidance specifically for speed management for the rehabilitation of existing roads is needed to complement design standards for new roads and any national approach to speed limit setting/functional classifications. Road safety engineering measures that influence vehicle speeds and what is appropriate for different road types and speed limits should be specified

Training and approach necessary for design teams and Road Safety Auditors to be developed and deployed.

Speed – Education and Communications

Governments to work with the press to promote understanding of safe speeds and setting of speed limits.

Run campaigns designed to educate on survivability.

Myth busting about the impact of slightly slower speeds on journey time.

Governments to consult with/partner with civil society on how best to communicate with wider public.

Communication should be coordinated across different priorities such as Net Zero, active travel and public health ensuring consistency in messaging.

Develop a better understanding of the relationship between speed and other potential benefits. Effective communication about the co-benefits generally as well as for individual schemes.

Communications campaigns designed to address cultural acceptance of speeding.

Speed – Compliance and Enforcement

Provide access to police forces to speed limit and telematics speed data to allow them to prioritise routes with high numbers of fatal and serious crashes and those routes where compliance is poor.

Create guidelines for the use of such data and the evaluation of different strategic approaches to speed enforcement.

Reduced enforcement thresholds; Prompt justice response.

Combine enforcement with educational initiatives i.e. with fire and rescue/speed awareness courses.

Increase back-office capacity to ensure all those violating speed limits receive a penalty/speed awareness course.

DfT 2007 circular on guidance on speed cameras requires revision.

Consistent use and processing of dashcam evidence.

Insurance industry engagement.

Speed – Research Monitoring and Evaluation

Establish Safe System fatal review panels & data sharing approach; strengthen coroners system.

Conduct in-depth crash investigations for all fatal and severe crashes, ensuring that injury causation and survivability is better understood.

Review published literature and reach consensus on safe road operation parameters for different layouts/traffic mix for the present.

Undertake analysis to determine the future gains that various technologies will bring.

Make telematics speed data available to road safety practitioners, ensuring data sources are representative and correctly interpreted.

Complete digital speed limit map project.

Provide a system whereby all road authorities can record any speed management measures (engineering, enforcement, TROs etc.) for combined evaluation.

Roads – Leadership and Coordination

Promotion of the meaning of the safe system and key principles to politicians and decision makers.

Draw inspiration from the Dutch Sustainable Safety initiative where roads are categorised by function and a clear long-term ambition for each road type has been established.

Establish a shared understanding of a Safe System across these professions, through communications and training, and establish coordinated practice across the sector.

Roads – Legislation and Regulation

The statutory duty of the Highway Authority is to “Ensure the Highway is not dangerous for traffic”. The definition of ‘dangerous’ should be expanded to include survivability and likelihood. Implementation will take time and so under legislation it will be necessary to provide for a road authority working towards a Safe System in a systematic and proactive manner.

Legislation should accommodate the normal fallibility and frailty of humans. (e.g. legislation should define a careful driver as fallible).

Supportive regulations could require to require a particular level of safety to be provided for the main user groups.

Roads – Standards and Training (1)

Amend standards for wooden boundary fence and propose a passively safe alternative design.

Replace ramped end terminals on vehicle restraint systems with passively safe alternatives.

Test barriers using SUV style vehicles and heavier electric vehicles. Ensure accepted VRS are suitable for today (and tomorrow's) vehicle fleet.

Review DMRB and update it to take account of survivability.

Training series for all those actors in the safe speed space.

Develop suitable training for all actors in the safe road element of the system. This will include the highway authority, the supply chain, designers, transport/development planners, police, parish councils etc.

Roads – Standards and Training (2)

Undertake iRAP surveys of strategic and major local roads. Proactively assess higher priority A roads.

Training on iRAP as a critical safe system proactive approach for highway authorities, network managers, project clients, legal departments (HA), designers, developers, transport planners, utility companies, contractors (project, term maintenance and in house), police

Updating RSA to link RSA and safety governance (GG104) with a Safe System approach (understanding survivability, fallibility etc.).

Updating the Controls over how RSA is conducted (price, no. of auditors, need for GG119 review).

iRAP should be required at every stage of scheme development as per RSA, using a standard set of hazards included in iRAP assessment.

Collaborate with bodies who have a public health or sustainable/ active travel agenda - investment in segregated infrastructure contributes to these other objectives

Introduce into standards the requirement for early conceptual stage RSA and Road Safety Impact Assessment.

Roads – Investment and Innovation

Hypothecation of revenue from speed enforcement to be reinvested in road safety interventions.

Exploration of innovative funding mechanisms such as social impact bonds for investment.

Maximising social value obligations of contractors to implement schemes.

Making a better case for road safety investment, ensuring robust business cases are established, but also that the most promising political arguments are made for investment e.g. impact on NHS and productivity.

Establish further Safer Roads Fund style investments for strategic, major and local roads.

Determine what sensors and cars of the future require in terms of lining systems.

Understand future survivability and safe operational parameters for different road configurations.

Determine how crash types are likely to change in the future to ensure tailoring of investment plans accordingly.

Roads – Design and Engineering

Remedial treatment guides on the typical ways that different roads can be treated should be developed and utilised. Example treatments of different road types can be used as blue prints for rehabilitation schemes.

Ensure quantifiable safe system road safety impact assessments and Road Safety Audits are done right at the start of scheme development so that risks that become impracticable or too costly to treat later on can be mitigated at relatively low cost early

Ensure that better intelligence is used to schedule maintenance whether that is a flexible maintenance schedule for gullies or sensors that detect water levels, or use of connected vehicle data to identify areas where surface friction is severely diminished following rainfall.

An inventory of telegraph poles, mobile phone masts and signal cabinets should be made and risk assessed according to their type and distance from the running lane.

Roads – Education and Communications

Education and promotion to the sector is needed.

Create examples of how consultation material can emphasise the Safe System and the way concepts have been developed to fulfil survivability requirements, and the shared responsibility with the public to ensure that roads are used safely. Possible use of iRAP analytics for this purpose.

Guidance and training for road authorities on how to move towards Safe System implementation in a strategic and proactive manner is necessary.

Then road authorities should be expected to develop their approach based on this for communication with the public on how they are implementing a safe system.

Roads – Compliance and Enforcement

?

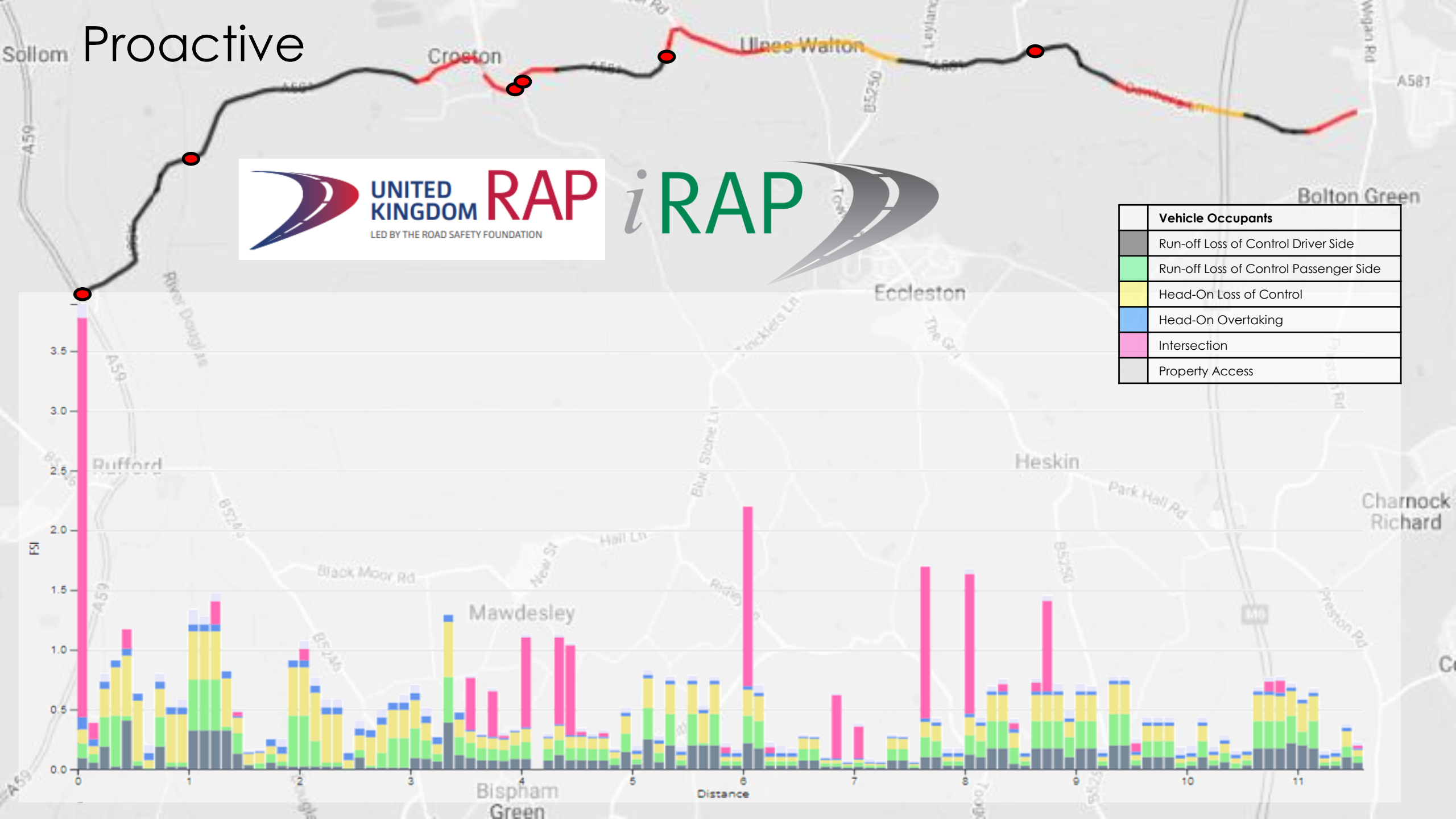
Roads – Research Monitoring and Evaluation

Establish a system for logging information about schemes that can be used to support research into the impact of different interventions/combinations of interventions

Invest in iRAP star ratings for monitoring the safety performance of (at least) all Strategic Road Network (SRN) and Major Road Network (MRN roads).

iRAP and the Safe System

Proactive



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iRAP

	Vehicle Occupants
	Run-off Loss of Control Driver Side
	Run-off Loss of Control Passenger Side
	Head-On Loss of Control
	Head-On Overtaking
	Intersection
	Property Access

iRAP Star Ratings

- iRAP provides star ratings for:
  - Vehicle occupants
  - Motorcyclists
  - Pedestrians
  - Bicyclists

PARTNERSHIPS FOR 2030 IMPACT

A WORLD FREE OF HIGH-RISK ROADS – PROGRESS BY DECEMBER 2023

126 COUNTRIES ASSESSED

178 COUNTRIES INFLUENCED

USD$ **101** BILLION OF INFRASTRUCTURE INVESTMENT MADE SAFER

69 THOUSAND PEOPLE TRAINED

1.8 MILLION KM ROADS AND DESIGNS STAR RATED

1.8 MILLION KM RISK MAPPED

1,356 SCHOOLS STAR RATED USING SR4S IN 70 COUNTRIES

7.3 MILLION KM OF ROAD IN VIDA

DECADE OF ACTION FOR ROAD SAFETY 2021 - 2030

iRAP

30 THOUSAND PARTNERS

iRAP ACCREDITED **235** PRACTITIONERS

117 INNOVATION PARTNERS

★★★+

76 3-STAR OR BETTER POLICIES

iRAP partners with governments, mobility clubs, funding agencies, development banks, industry, research institutes and NGOs around the world to make roads safer

FIA FOUNDATION

irap.org irapsavinglives iRAPfb

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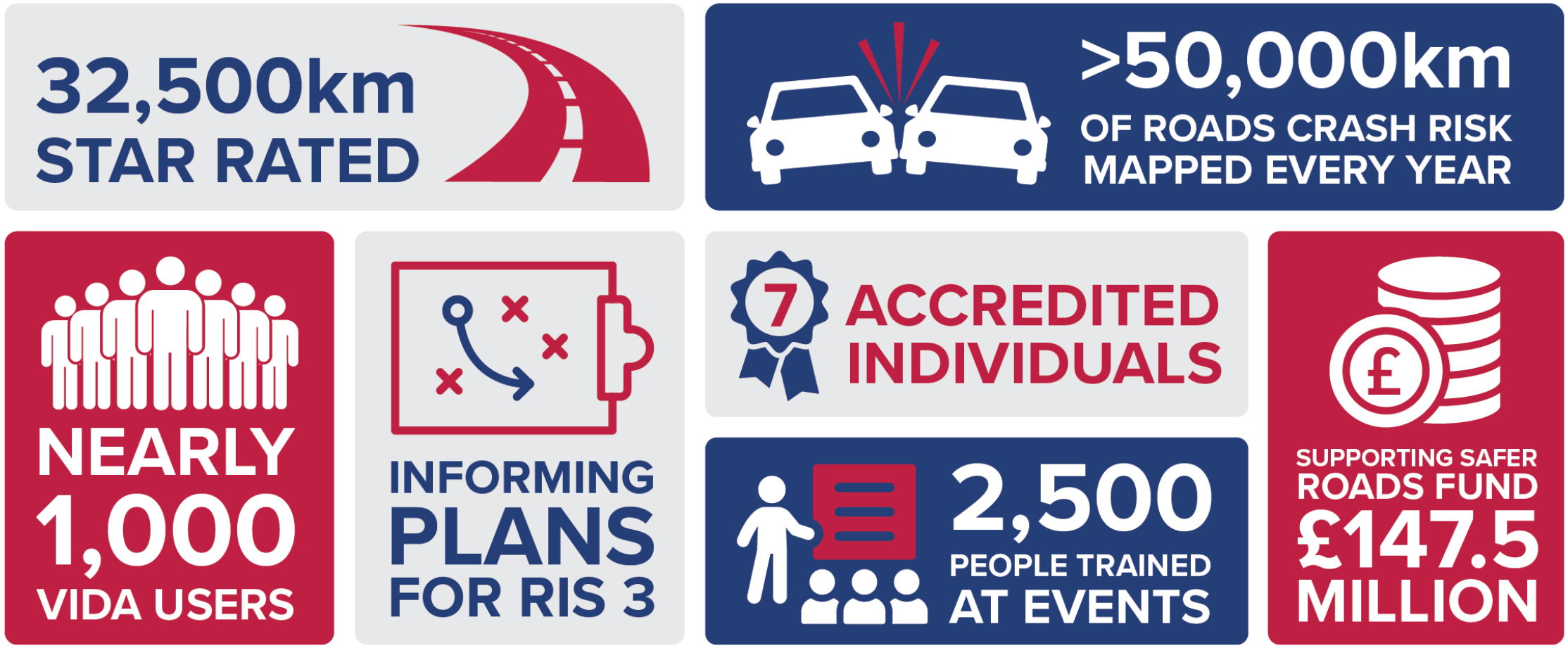
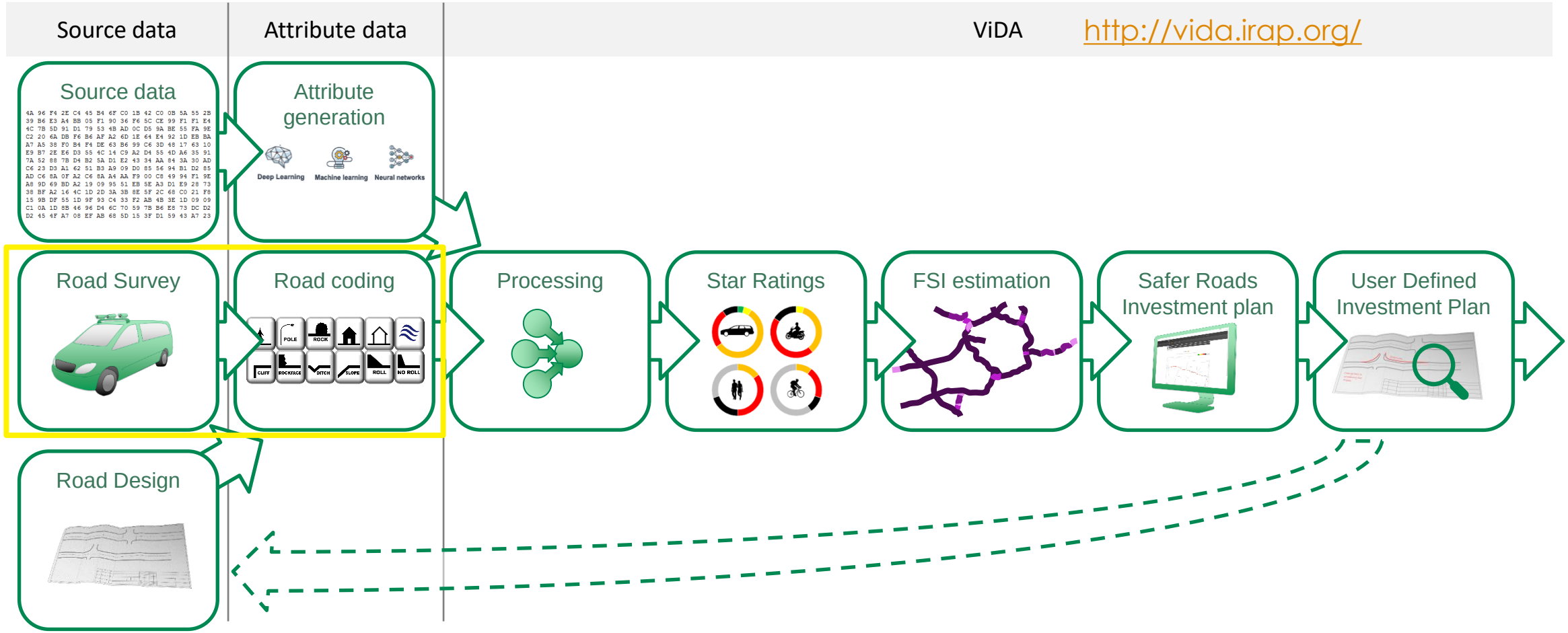
United Kingdom RAP



The iRAP Process



iRAP Coding

Posted, 85th percentile and mean speeds
Vehicle flows
Pedestrian and cycle flows

Junction type
Junction quality
Channelisation
Intersecting road flows

Median treatment – lining or barrier system
Delineation

Number of lanes
Lane width
Road condition
Skid resistance

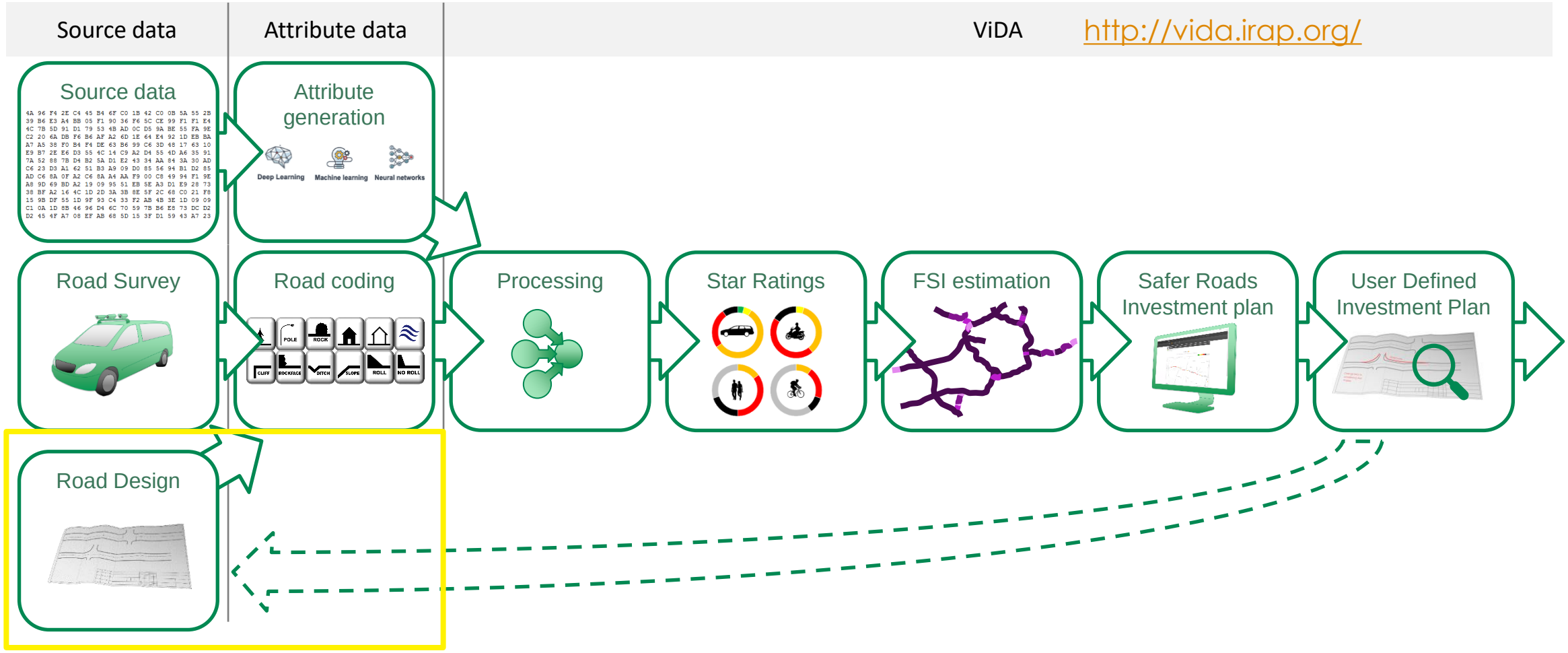
Curvature
Curve quality
Grade
Sight distance
Speed management

Roadside severity and distance
Raised profile edge lines
Paved shoulder

Roadworks
Street lighting
Vehicle parking
Service road

Area type and land use
Pedestrian crossings
Crossing quality
Footway provision
Cycleways
School zone warning

The iRAP Process



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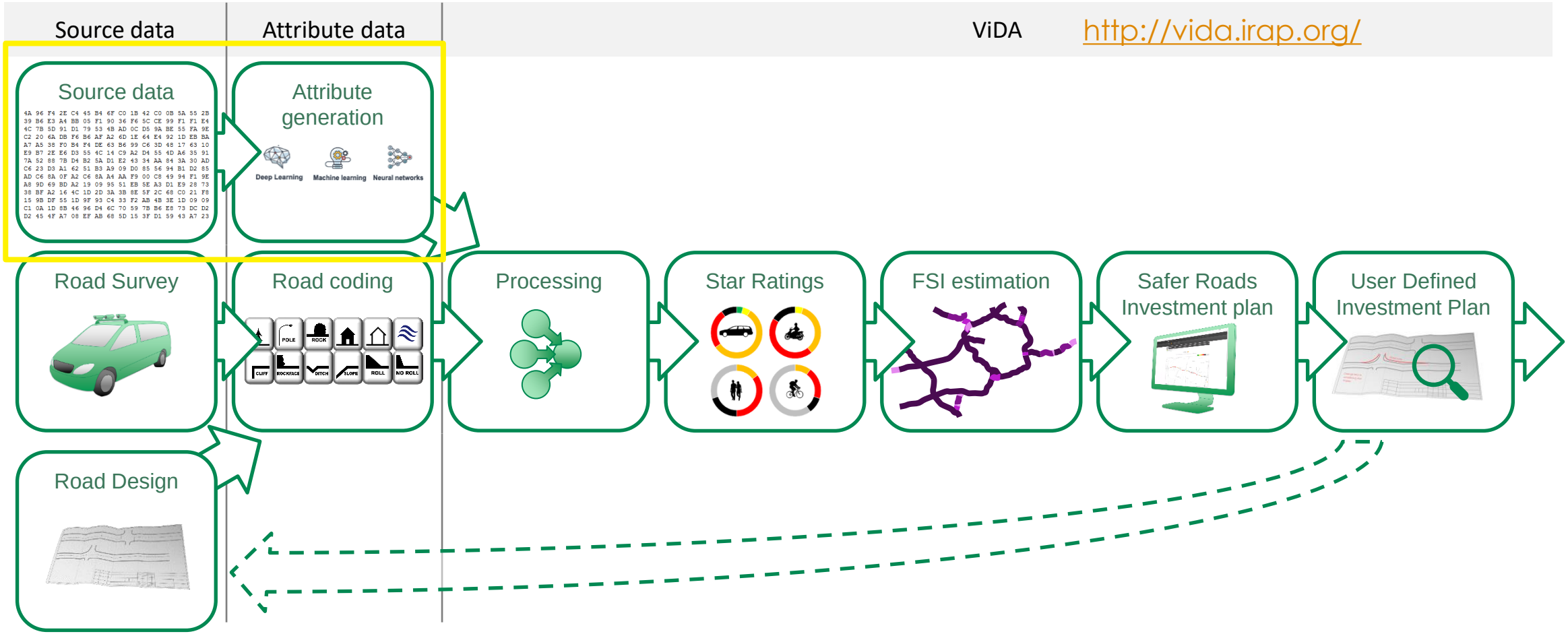

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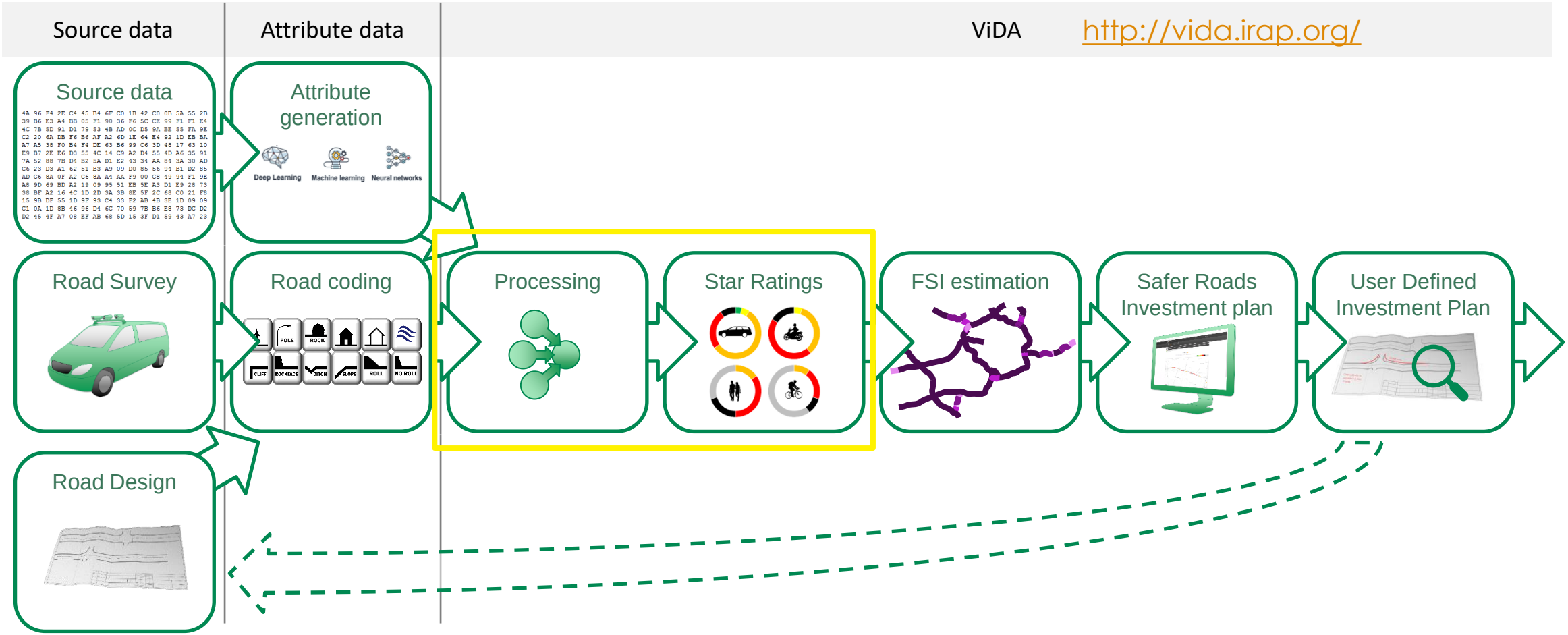
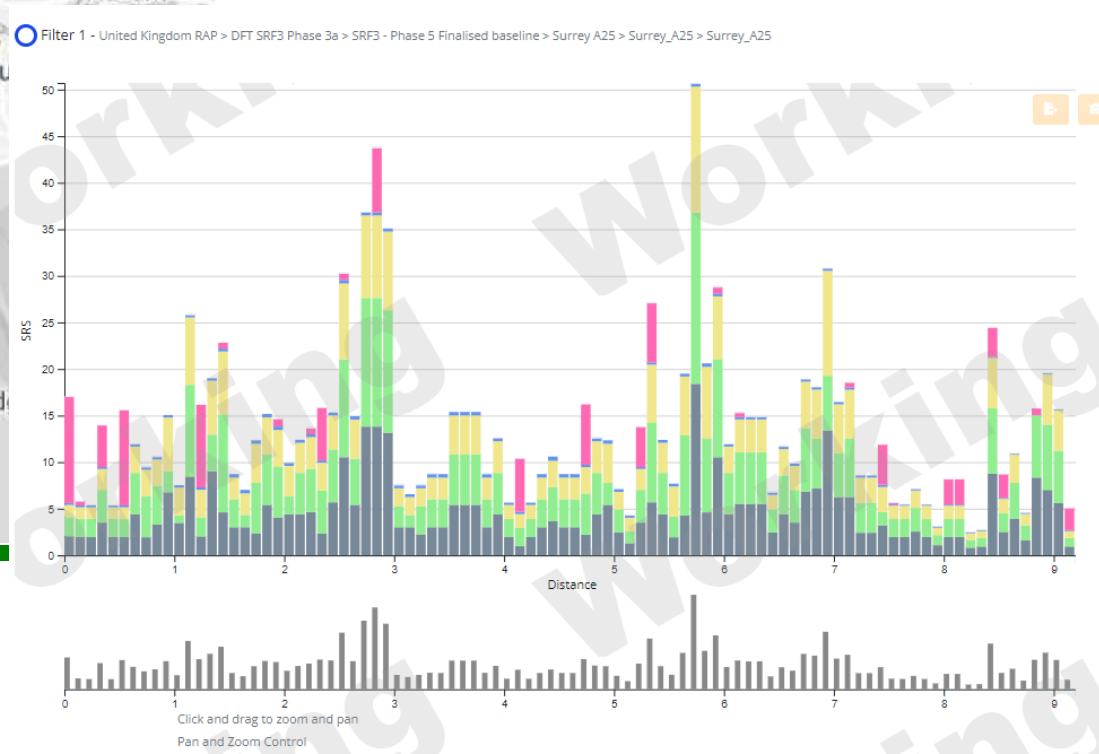


Modelling risk



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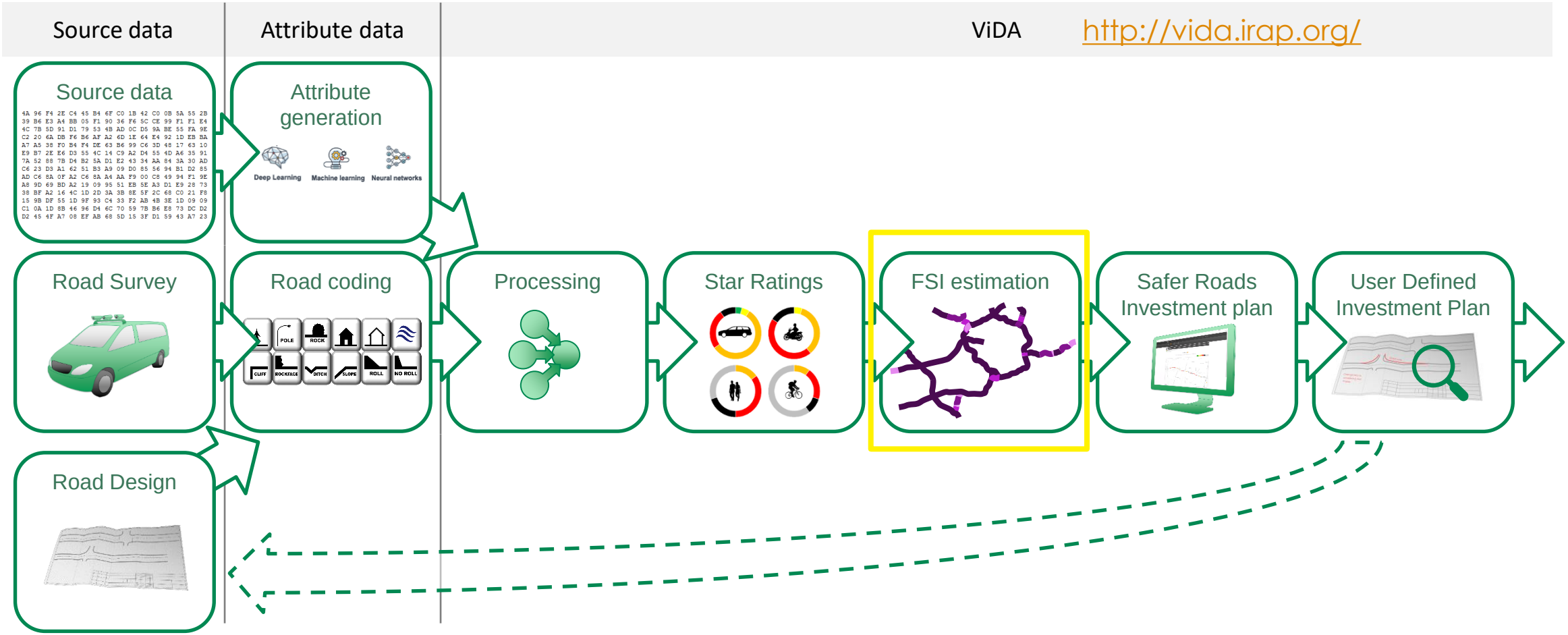
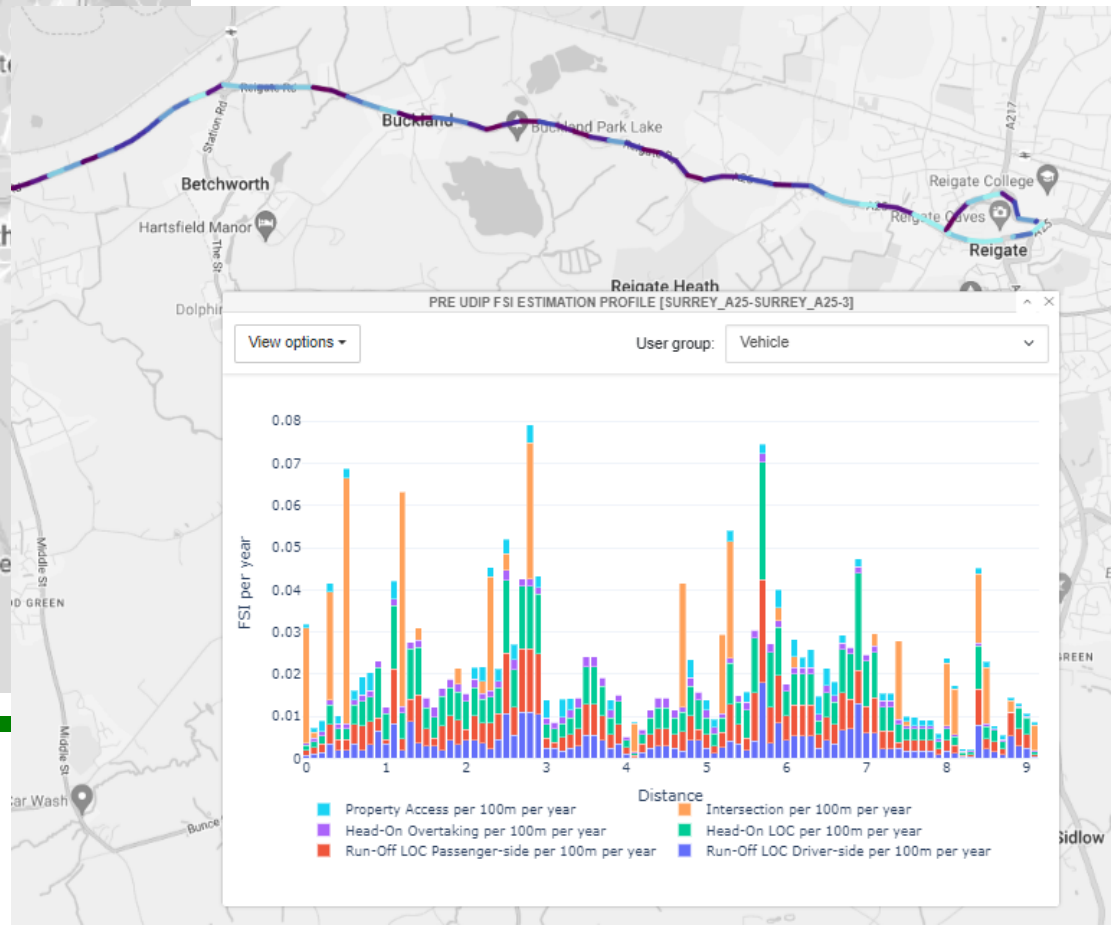
The iRAP Process



Estimating Fatal and Serious Injuries



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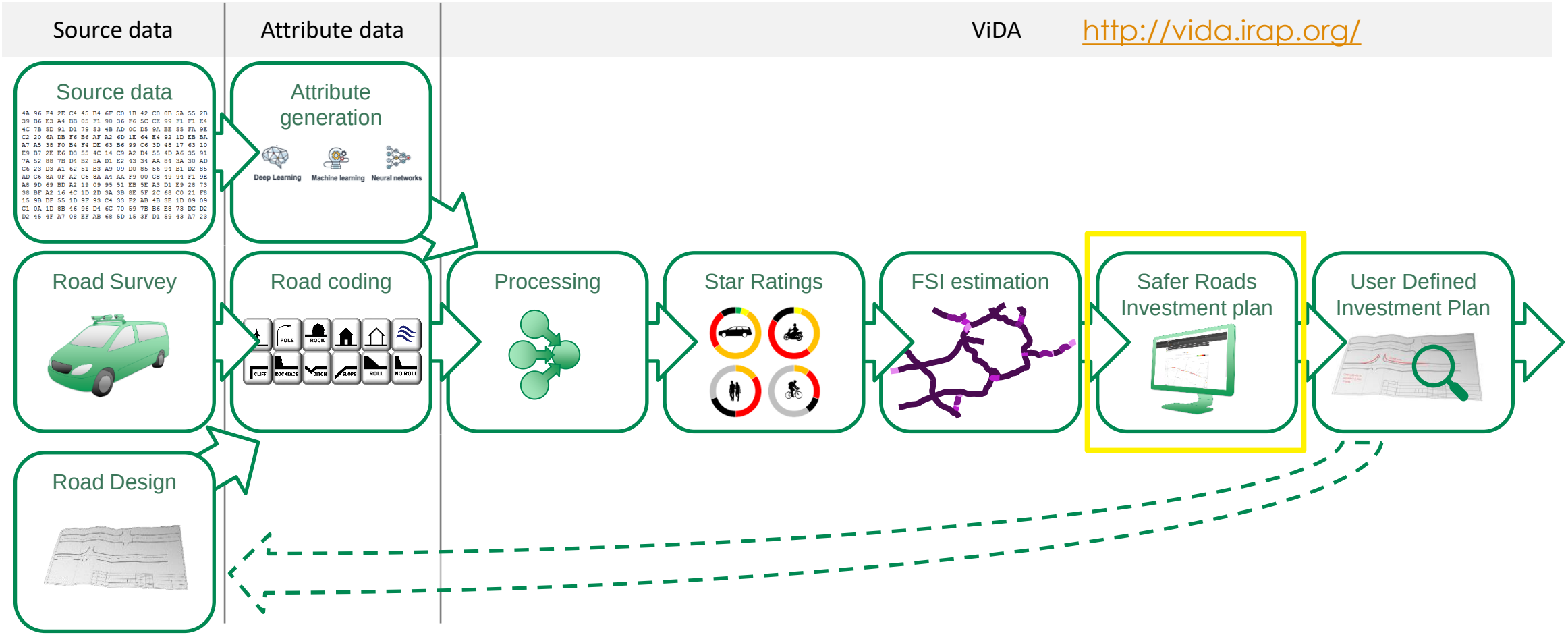
The iRAP Process



Safer Roads Investment Plans

Total FSIs Saved	Total PV of Safety Benefits	Estimated Cost	Cost per FSI saved	Program BCR
1,550	366,000,000	138,000,000	88,800	2.65

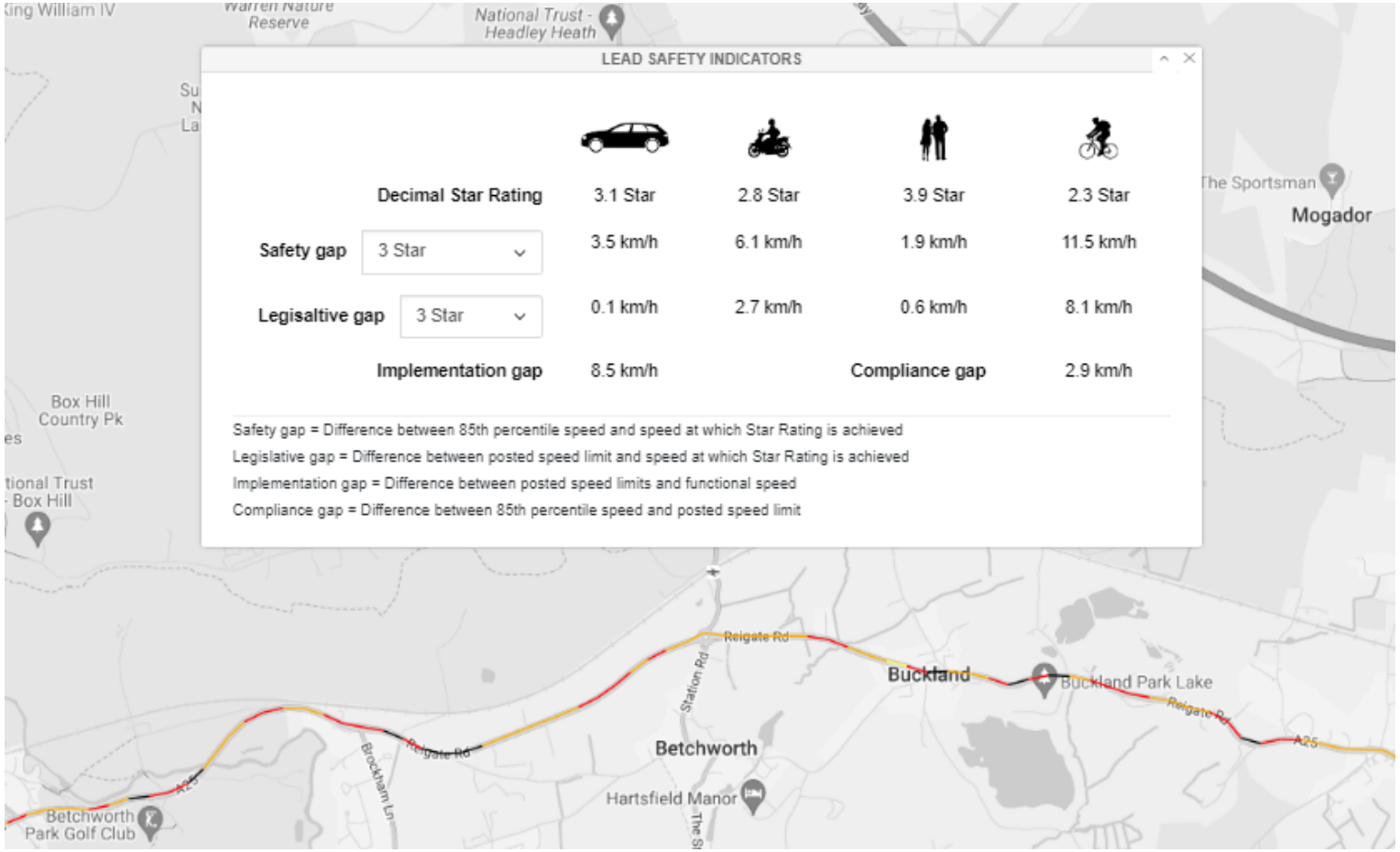
Countermeasure	Length / Sites	FSIs saved	PV of safety benefit	Estimated Cost	Cost per FSI saved	Program BCR
Speed limit reduction - Safe system compliance - Strong enforcement (km/h)	35.9 km	371	87,400,000	[illegible]0,000	9,760	24.2
Traffic calming - Target speed (30 km/h)	9.8 km	57	[illegible]	[illegible]8,000	10,300	23
Parking improvements	4.0 km	4.95	[illegible]000	[illegible]0	10,500	22.5
Traffic calming - Target speed (40 km/h)	0.7 km	9[illegible]	[illegible]	[illegible]	11,300	21
Traffic calming - Target speed (50 km/h)	4.9 km	18	4,36[illegible]	372	20,100	11.7
Improve curve delineation	[illegible] km	2.7[illegible]	650,000	69,300	25,000	9.39
Central hatching	[illegible]09.1 km	[illegible].6	[illegible]700,000	1,700,000	28,600	8.26
Shoulder rumble strips	[illegible]m	15.9	4,180,000	595,000	37,300	7.02
Improve Delineation	20.8	26.3	6,190,000	888,000	33,800	6.97
Pedestrian fencing (Rural)	1.2 km	2.59	672,000	102,000	39,400	6.59
Centreline flexi-post	22.3 km	8.65	2,000,000	419,000	48,500	4.77
Shoulder sealing passenger side (<1m)	18.8 km	13.5	3,150,000	784,000	58,100	4.02
Pedestrian fencing (Urban)	43.0 km	110	25,800,000	6,440,000	58,300	4

DRAFT
Working

Applying iRAP

- Whole networks
  - Performance tracking and performance indicators
  - Prioritisation
  - Mass action modelling

Leading Safety Indicators and Prioritisation

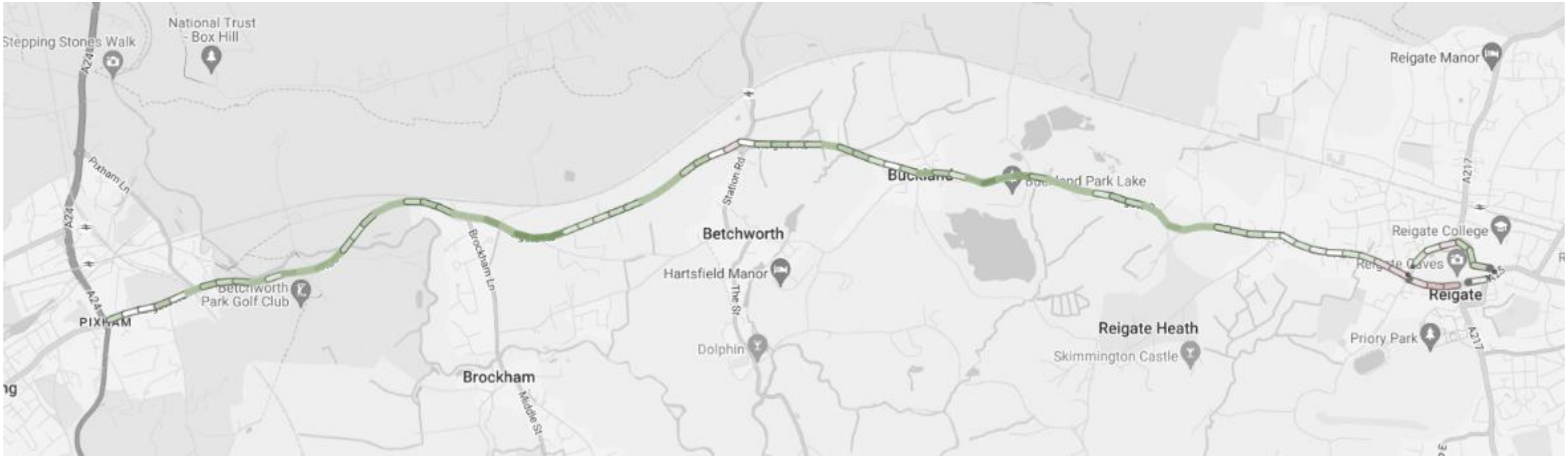


Leading Safety Indicators & Prioritisation

- Compliance gap: 85th percentile speed vs speed limit

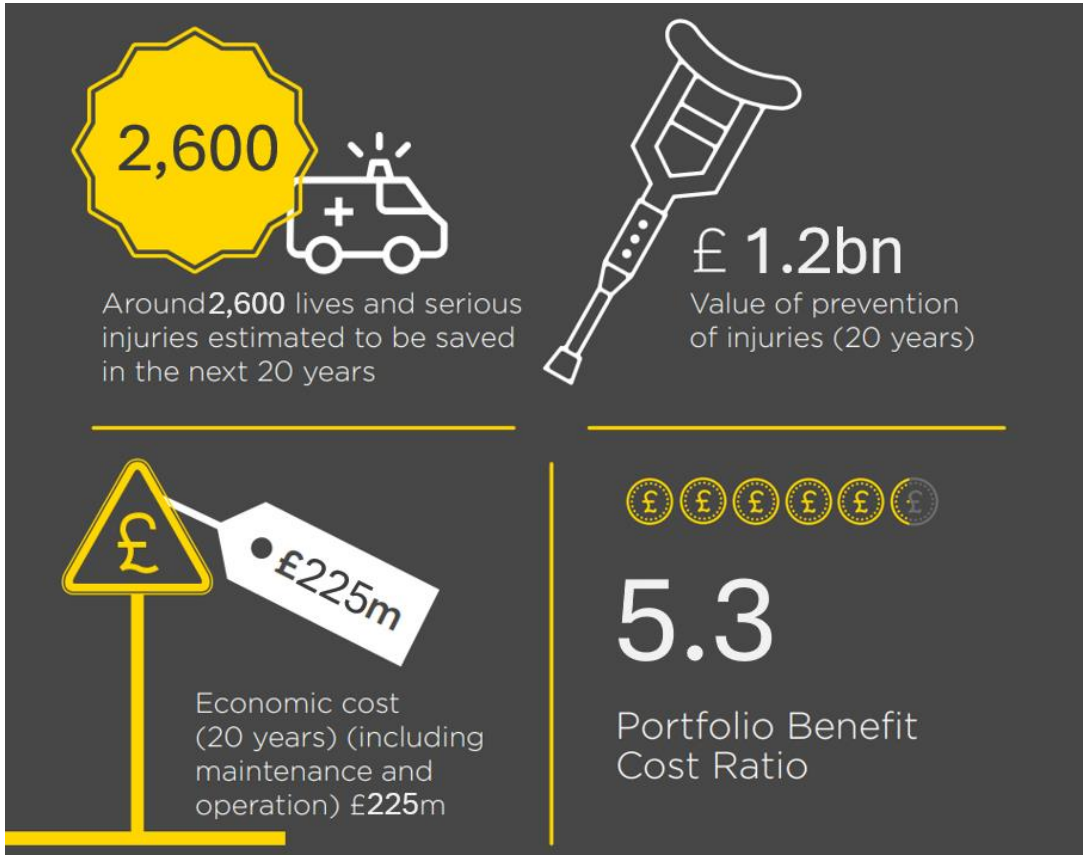
Leading Safety Indicators & Prioritisation

- Safety gap: 85th percentile speed vs 3, 4 or 5 star speed



Applying iRAP

- Locations – trialled in the RCIP project
- Route review for individual routes



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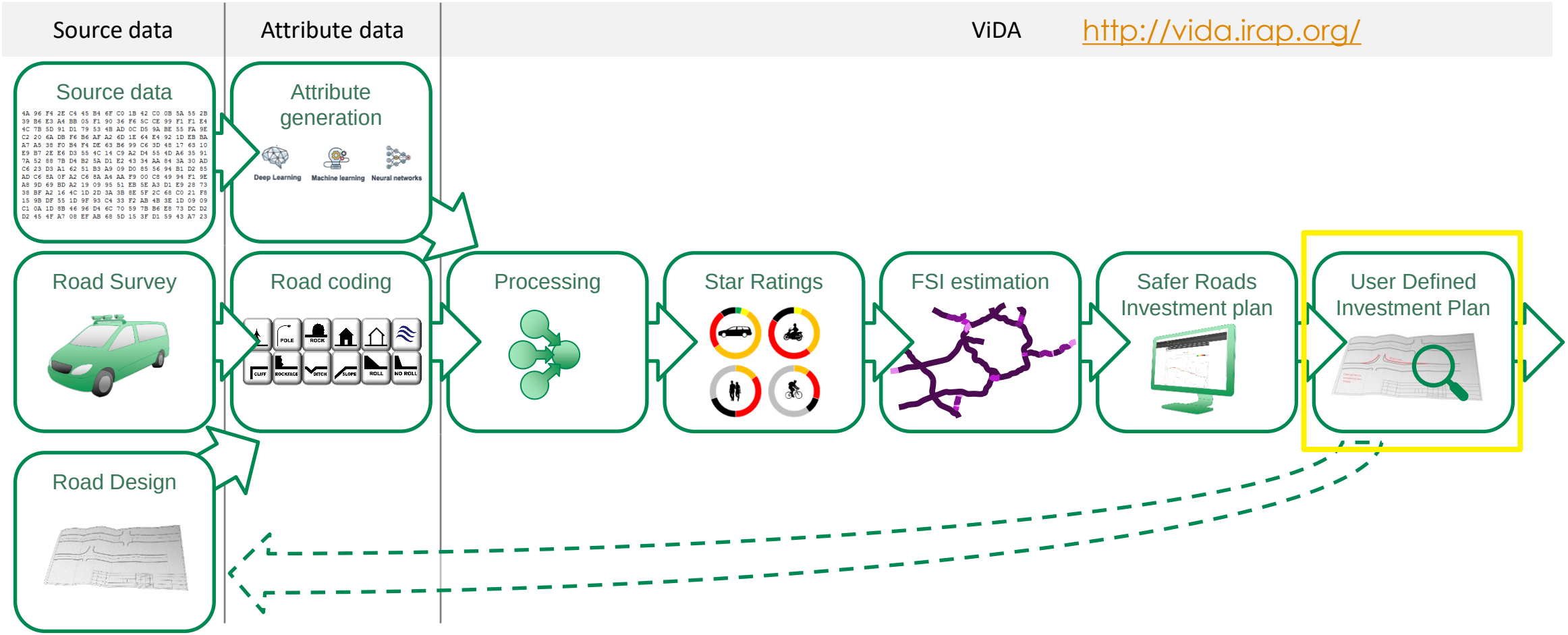

Speed and engineering countermeasures

Speed and engineering countermeasures

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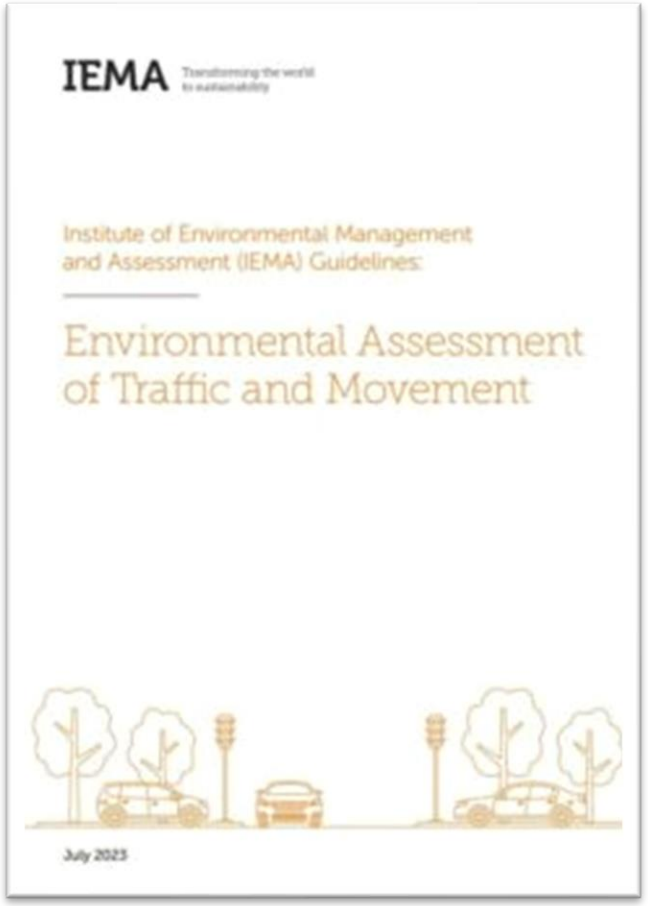
Demonstrator

https://demonstrator.vida.irap.org/

iRAP and Development Planning



3.45 The 'Safe System' is considered to be international best practice in road safety by the World Health Organization and the Organisation for Economic Co-operation and Development. Both organisations recommend that all countries, regardless of their level of road safety performance, follow a Safe System approach. In line with this emerging road safety policy, a Safe System approach could be taken to the assessment of road safety impacts of a project. The Safe System approach broadly follows the staged approach set out below:

- Identify the study area using historic crash data.
- Undertake evidence-led, objective modelling techniques to establish a baseline road safety level for the roads within the study area on which the impact thresholds are exceeded in relation to either non-motorised users or motorised user traffic. This analysis can be carried out using tools such as the iRAP Star Ratings protocols[20] or similar tools produced by individual highways authorities.
- Assess the effects of additional development traffic for all users (including vulnerable groups[21]), across the whole width of the highway corridor. This model should also assess the effect of any changes to the baseline road network, such as the provision of access junctions.

3.46 The final impact assessment should present calculated changes in levels of the roads' intrinsic safety and the estimated annual reduction in fatal or serious injuries. The final impact assessment should be based on the proportionate changes in fatal and serious injuries and the proportionate change in roadside hazards, which can be calculated using iRAP Star Ratings scores or their equivalent from other models.

To provide practitioners with good practice advice on the assessment of traffic and movement for statutory EIA

iRAP (or similar) now included in the guidance

Planning inspectors already requesting iRAP

OCC could request this?

Other RAP tools/initiatives

CycleRAP

Star Rating for Schools

YEA!

Star Rating for Designs

Can iRAP help RSA?

Thanks for listening

suzy.charman@roadsafetyfoundation.org