EuroRAP
EUROPEAN ROAD ASSESSMENT PROGRAMME

A Europe Free of High Risk Roads

Presentation at TransAID - Operational Design Domain & Road Classification

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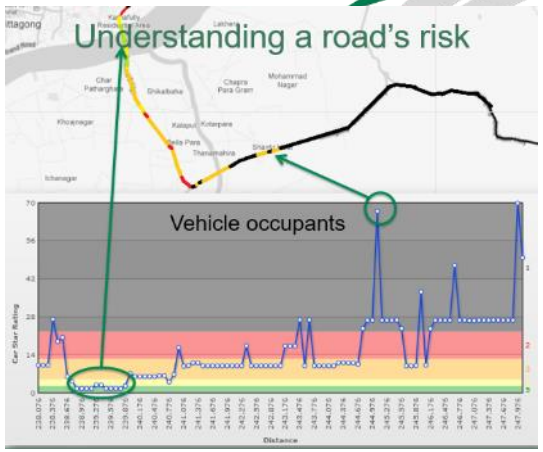
www.eurorap.org

EuroRAP's core protocols

RISK MAPS

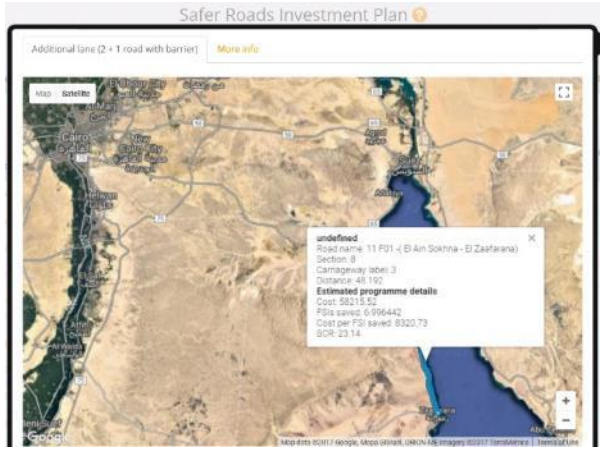
- Colour coded map showing the where people are dying and where their crash risk is greatest
- Can inform priorities across all pillars of road safety action (management, infrastructure, vehicles, road users and post-crash care)

STAR RATING



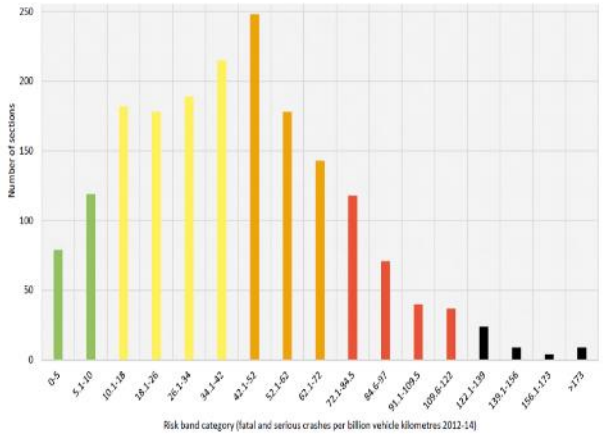
- Based on road inspection data
- Simple and objective measure of the level of safety which is 'built-in' to the road
- Can be completed in the absence of crash data
- Five-star road segments are the safest while one-star are the least safe

INVESTMENT PLANS



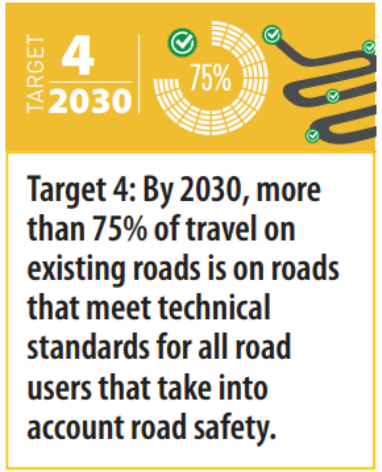
- Considers 90 proven road improvement options
- A Safer Roads Investment Plan (SRIP) prioritises and costs improvement options can improve Star Ratings and save lives

PERFORMANCE TRACKING



- Regular risk mapping or star rating enables performance monitoring
- Enables celebration of success and action to be taken to address persistently high risk roads

iRAPs international protocols- UN



- The UN has adopted iRAPs international protocols within Targets 3 and 4 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).
- RAP metrics are recommended for use by the United Nations (as RAP metrics is a UN Target 3 and 4), World Health Organisation, and FIA Foundation and other leading institutions.
- They are applied in projects by the World Bank and regional development banks worldwide including the European Investment Bank and EBRD in Europe.
- Every year the inclusion of RAP metrics are reported in the 2018 WHO Global Road Safety Status Report.

iRAP Innovation Partnerships

Product Innovation

https://www.irap.org/innovation/

Star Rating for Schools

Status: Phase II development

Star Rating for Designs

Status: Live

User Defined Investment Plans

Status: In progress

Road Safety Big Data

Status: In progress

Star Rating Demonstrator

Status: Live

Model Innovation

Light Star Rating Model

Status: In progress

iRAP Urban CycleRAP

Status: In progress

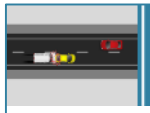
iRAP Urban Pedestrians

Status: In progress

iRAP Urban Intersections

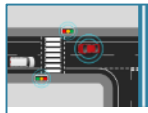
Status: In progress

Modelling Shunt Crashes



Status: In progress

ITS Enhanced Model



Status: In progress

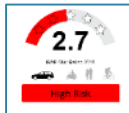
Speed Management

Status: Concept

Infrastructure for Autonomous Vehicles

Status: In progress

Decimal Star Rating

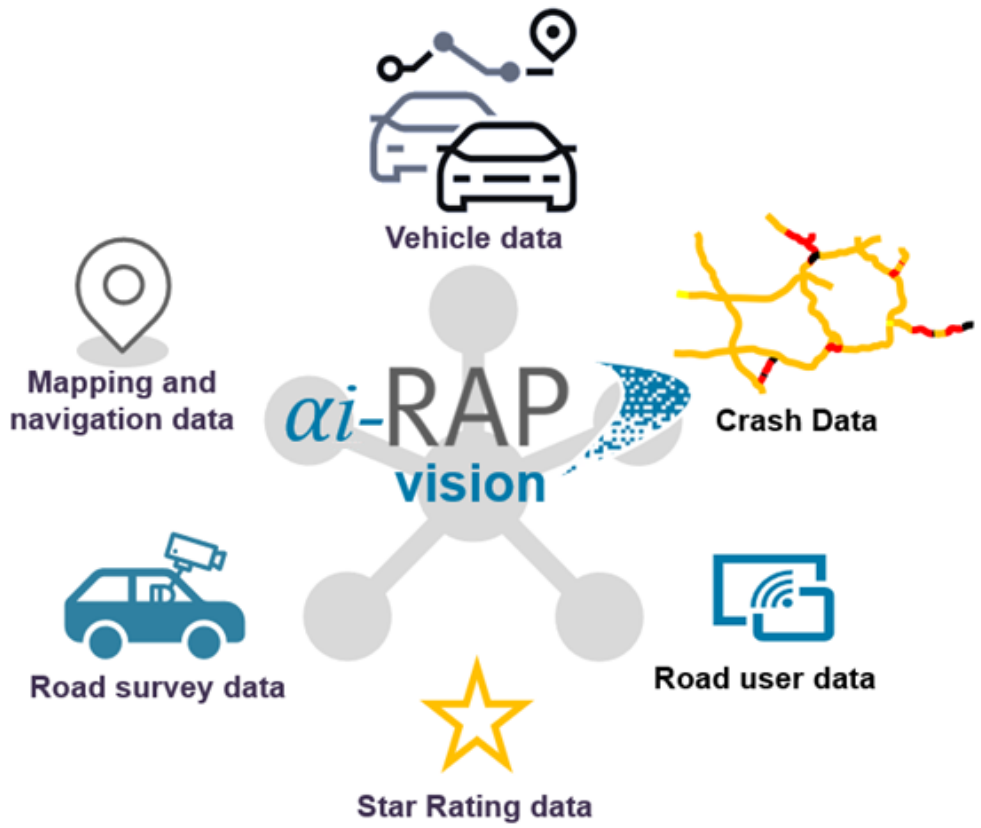


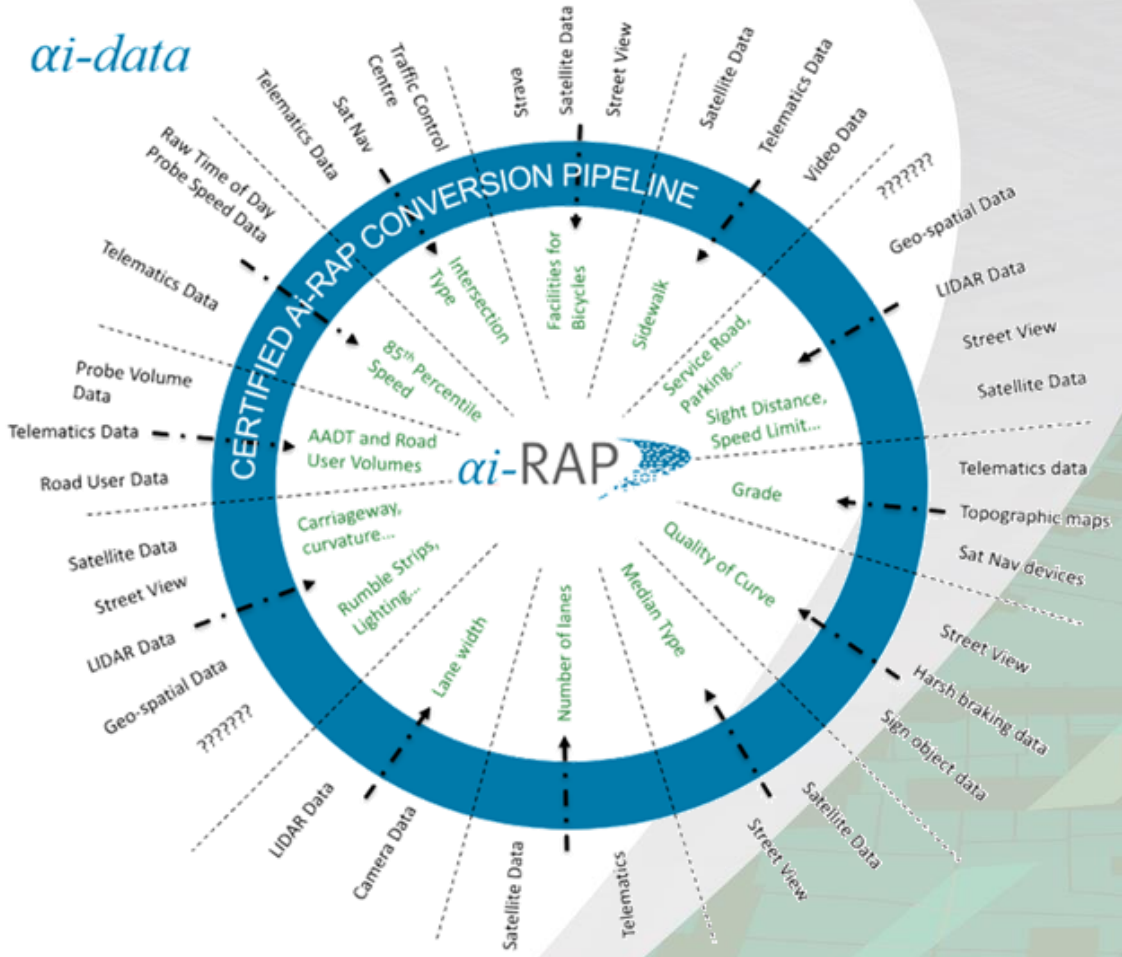
Status: Technical Review

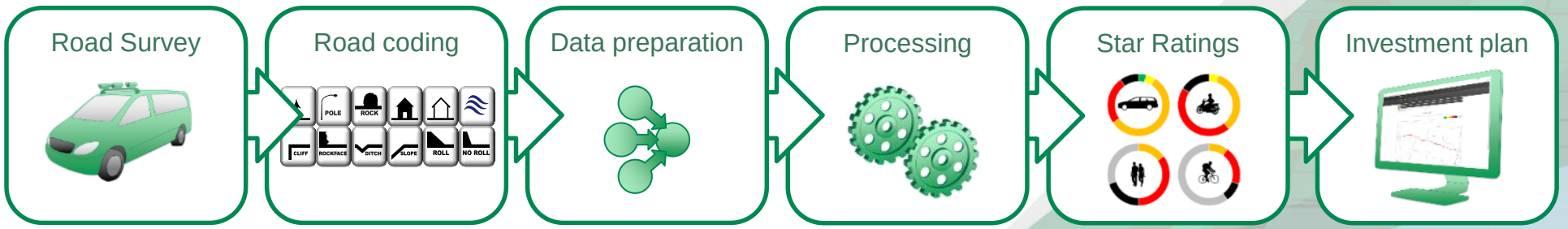
Safe System Star Rating Module

Status Concept

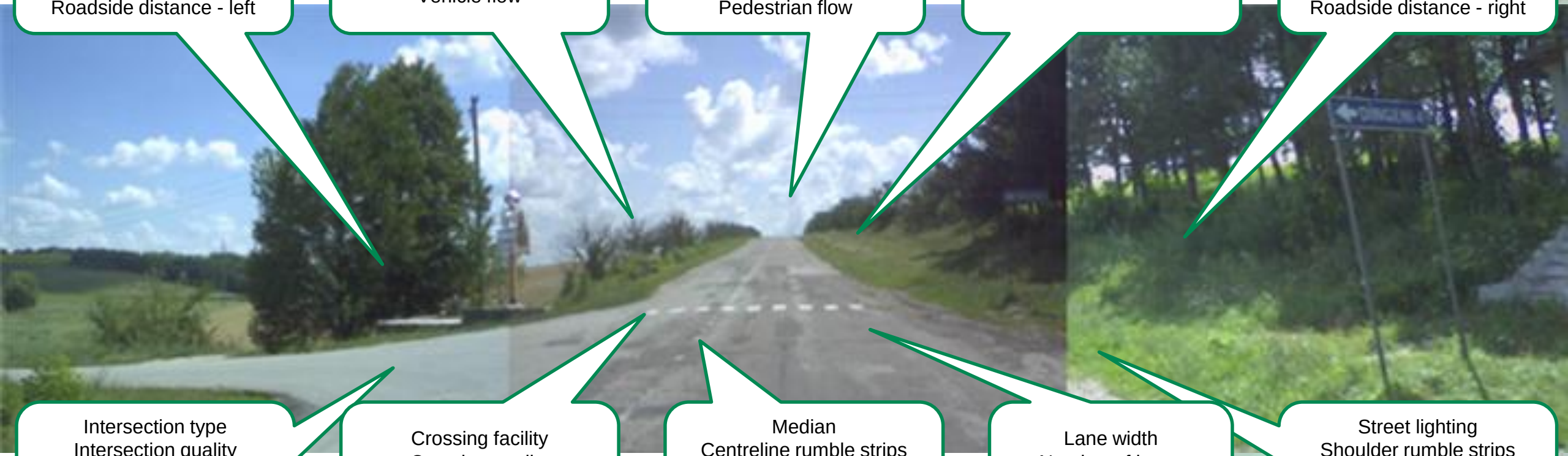
aiRAP Star Rating Process







Physical Road Attributes



Paved shoulder – left
Side walk provision – left
Roadside object – left
Roadside distance - left

Area type
Speed
Vehicle flow

Motorcycle facility
Bicycle facility
Bicycles flow
Pedestrian flow

Curvature
Quality of curve

Paved shoulder – right
Side walk provision – right
Roadside object – right
Roadside distance - right

Intersection type
Intersection quality
Intersecting volume
Channelisation
Property access point

Crossing facility
Crossing quality
Speed management
Roadworks

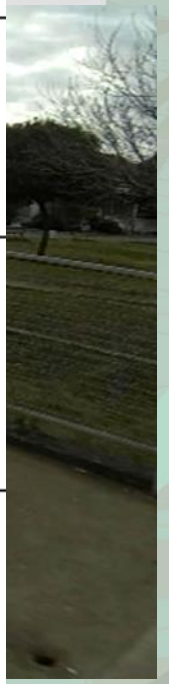
Median
Centreline rumble strips
Sight distance
Delineation
Grade

Lane width
Number of lanes
Road condition
Skid resistance

Street lighting
Shoulder rumble strips
Vehicle parking
Service road
Pedestrian fencing

Signing/lining important in the AV transition

ROAD SIGNS	Germany (D)	Great Britain (GB)	Greece (GR)	Netherlands (NL)	Poland (PL)	Serbia (SRB)
Slippery road						
Steep hill downwards (or upwards)						
Falling or fallen rocks	 Only for extraordinary situations			 In under plate description for danger type		



2015 – **4,869** crossings, 14 countries in south-east Europe – **2,151 (44%)** described as **poor quality-**

SENSOR Interreg project

Crash patterns and infrastructure needed

Crash partners	Potential changes in risk	Examples of infrastructure needed
AV vs conventional vehicle	**Head-on** – better lane-keeping **Intersection** – presence detection and road positioning enhanced; increased connectivity **Shunt** – distance-keeping and early autonomous emergency braking improved Lower likelihood of crash severity from speed control and speed limit compliance but may increase conventional vehicles striking autonomous cars	Signing and lining; median barriers Priority intersections or roundabouts or signals – which will be best for AVs?
AV vs AV	Similar to above but with risk reduced due to AV increased control and connectivity – eg shunt crashes eliminated	Signing and lining; connectivity with roadside infrastructure and with vehicles
AV vs infrastructure	AV – better lane-keeping, speed adjustment on curve, barriers required but less often (speed reduction, reduced threat from roadside hazards), V-2-I connectivity with roadside and traffic information	Signing and lining – verge measures such as a revision of roadside crash restraint policy (ie provision of barriers). Connectivity
AV vs motorcycle	Similar to AVs versus conventional vehicle but also dependent on ability of AV to detect motorcycle and of rider to interpret manoeuvres of car and *vice versa*	Signing and lining, median barriers; which is best for road-users: priority vs roundabouts vs signals? Motorcycle recognition by other vehicles and infrastructure
AV vs bicycle	Similar to AV versus conventional vehicle but also dependent on ability of AV to detect bicycle and of rider to interpret manoeuvres of car and *vice versa*	Signing and lining; median barriers, nearside segregation, priority vs roundabouts vs signals; bicycle recognition as above
AV vs pedestrian	Ability of AV to detect pedestrian and of pedestrian to interpret manoeuvres of car and *vice versa*	Pedestrian recognition as above; nearside segregation; crossing designs and priority

Maintenance of infrastructure will be a key factor in the AV transition phase and maintenance will become a road authority higher-priority obligation.

Roads that Cars Can read– Recommendations

- **Understanding of:**
  - Behavioural interactions of conventional and autonomous vehicles
  - Conflicts and near-miss involving autonomous vehicles
  - Effectiveness of crash countermeasures
  - Assessment of changes in crash patterns
- **To do:**
  - Provide consistent signing and lining
  - Keep existing crash countermeasures for conventional vehicles during the transition
  - Continue to save lives with adding existing countermeasures

The high -quality line marking coupled with the lanekeeping attributes of the vehicle may mean that it would contribute to a 4-star rating for an AV. That same road may only rate 2-star for a conventional vehicle.

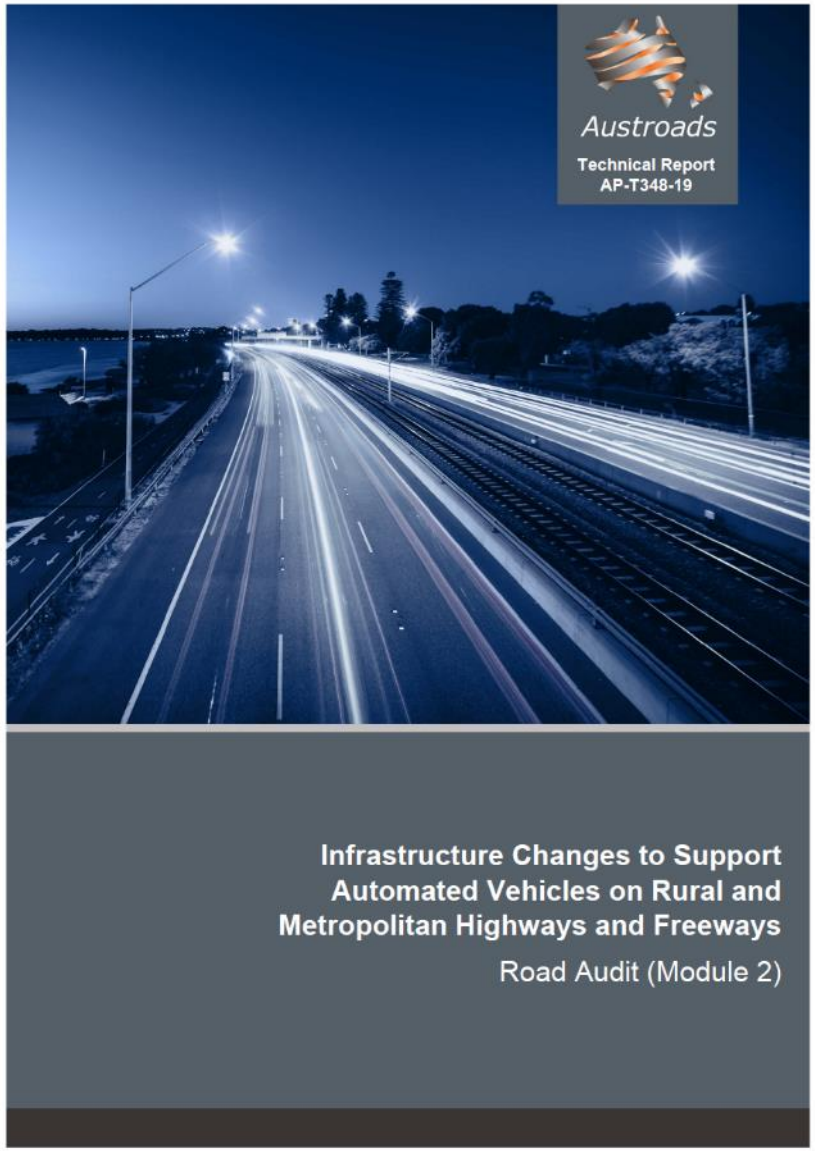
CAV Readiness for the physical Infrastructure

- Connected and Autonomous Vehicle line readability will be assessed across 500 km of CORE-Ten roads in each of the four selected countries, those being Croatia, Greece, Italy and Spain (i.e. 2000 km in total).
- MoMa data consists of mobile LiDAR which has been captured at approximately 150 points/m2 using a Velodyne 32E scanner and 360-degree imagery that has been captured at approximately 7 m intervals along the road system using a Ladybug 5 camera.
- Anditi will generate maps of sign locations for each road segment and compare this with the CAV readable sign maps generated from MN-R net. Locations where signs are detected in the mobile LiDAR but not in TomTom's MN-R sign data set is an indication of a sign that has not been detected by TomTom sign detection process. This is an indication that the sign may not be CAV readable (i.e. not able to be detected from imagery).
- Where signs are detected in mobile LIDAR and not the imagery, Anditi will analyse the 360 degree imagery for that location firstly to determine that a sign exists at this location and secondly that it is a sign that should be CAV readable. The likely reason for the sign not being detected (i.e. covered by vegetation or damaged) will also be recorded.

Table 1 List of MN-R sign information extracted from MoMa 360-degree imagery

Sign Type	Sign Type
Children	Icy conditions
Cross Wind	Left lane ends
Cyclist	Movable bridge sign
Dangerous Curve	Overtaking lane
End of all restrictions	Pedestrian crossing at grade
End of overtaking restriction	Pedestrian crossing
End of Speed restriction	Pedestrian overpass
Fog Area	Pedestrian underpass
Guarded Railway Crossing	Right lane ends
Icy conditions	Sharp curve left
Left lane ends	Sharp curve right
Movable bridge sign	Slippery road
Children	Speed
Cross Wind	Stop
Cyclist	Traffic light ahead
Dangerous Curve	Unguarded railway crossing
End of all restrictions	Variable traffic
End of overtaking restriction	Wildlife crossing
End of Speed restriction	Winding road starting left
Fog Area	Winding road starting right
Guarded Railway Crossing	Yield sign

Key findings from Austroads technical report

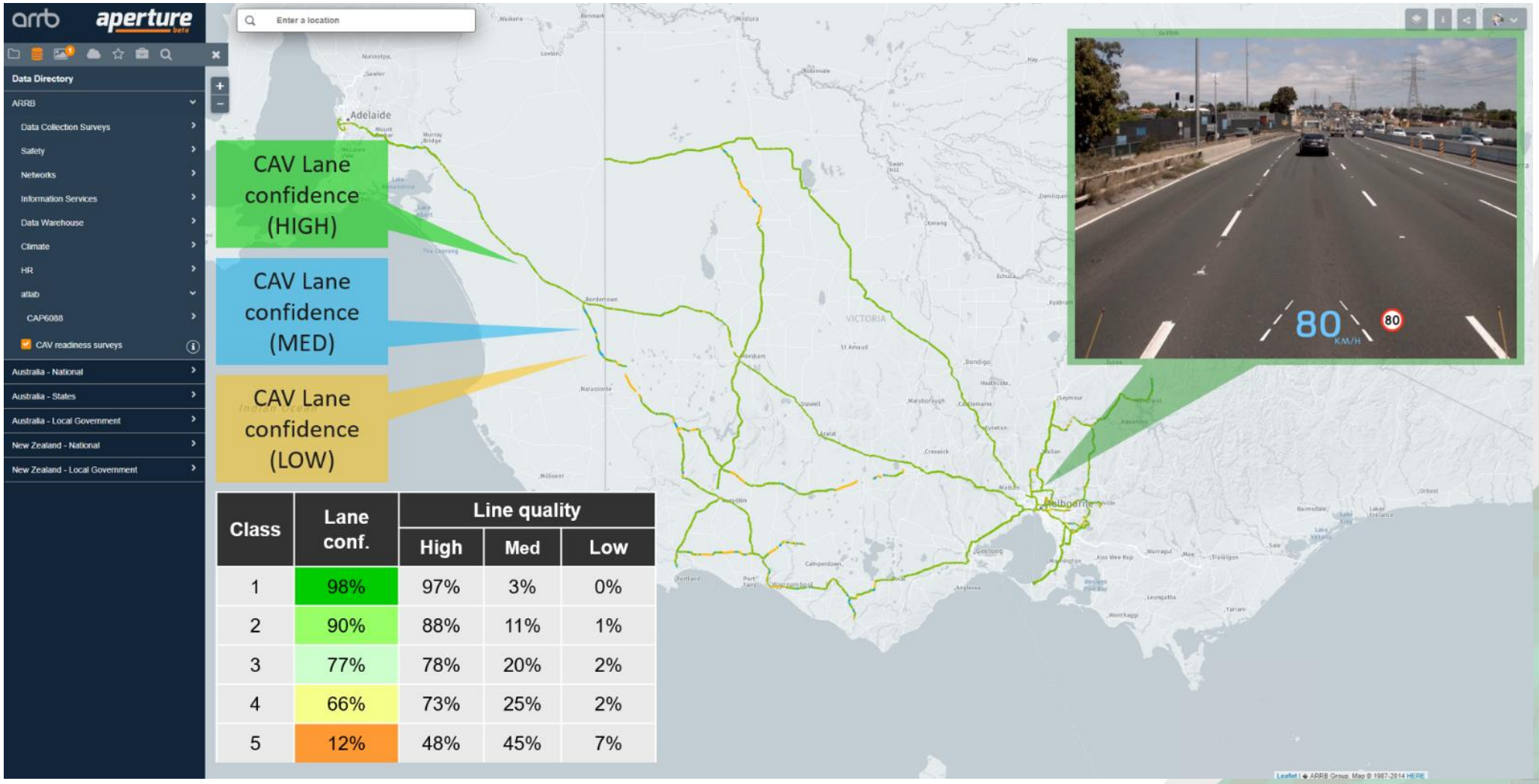


- A total of 17 findings categorized:
  - Lines
  - Road signs
  - Digital infrastructure
  - Real-time operation

General findings

- Used EuroRAP Roads that Cars can read standards
- Freeways and highways typically (but not always) have edge lines and lines of good quality more than 90% of the time.
- Cellular availability on these roads is also typically high, at least on roads with higher traffic volumes.
- Mobileye proved to be most effective method

CAV Road Classification- Australia



Class	Lane conf.	Line quality		
		High	Med	Low
1	98%	97%	3%	0%
2	90%	88%	11%	1%
3	77%	78%	20%	2%
4	66%	73%	25%	2%
5	12%	48%	45%	7%

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