Recent Developments in Road Asset Management Technology

Presented by: Verushka Balaram

Date: 27 August 2021

PAVEMENT MANAGEMENT INTELLIGENCE

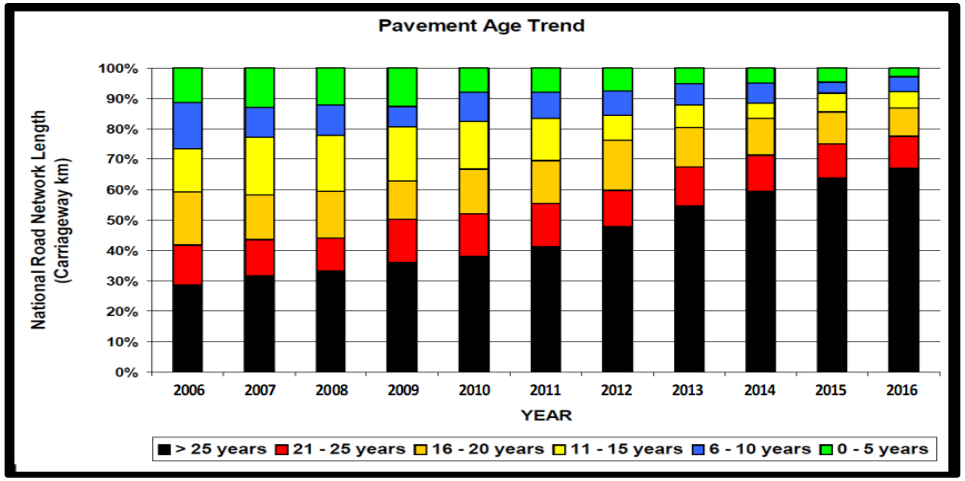
Road Network Management – Why Bother?

- Roads are a fundamental component required to achieve economic growth and development.
- It provides **access** to employment, social, health and educational services. A road network is crucial in fighting against poverty.
- 89% of the countries freight relies on the road infrastructure (PWC Report,2018)
- Poor roads = increased road user costs
- ~12000 to 14 500 people die each year in South Africa due to Road Traffic Crashes. Recent studies show the cost of RTC's is around 3.5% of GDP.

Road Network Management is thus fundamental to ensure efficient and effective investment in road infrastructure to realise a safer road network that is both socially and economically beneficial

SOUTH AFRICAN ROAD NETWORK

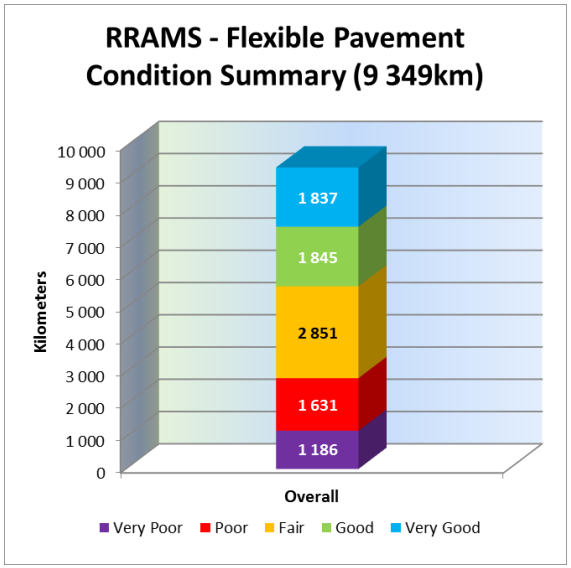
South African Road Network – 2016 (km's)			
Authority	**Paved**	**Gravel**	**Total**
SANRAL	21 946	0	21 946
Provinces - 9	46 805	226 273	273 078
Metros - 8	51 682	14 461	66 143
Municipalities	37 691	219 223	256 914
Sub-total	**158 124**	**459 957**	**618 081**
Un-Proclaimed (Estimate)		131 919	131 919
Estimated Total	**158 124**	**591 876**	**750 000**

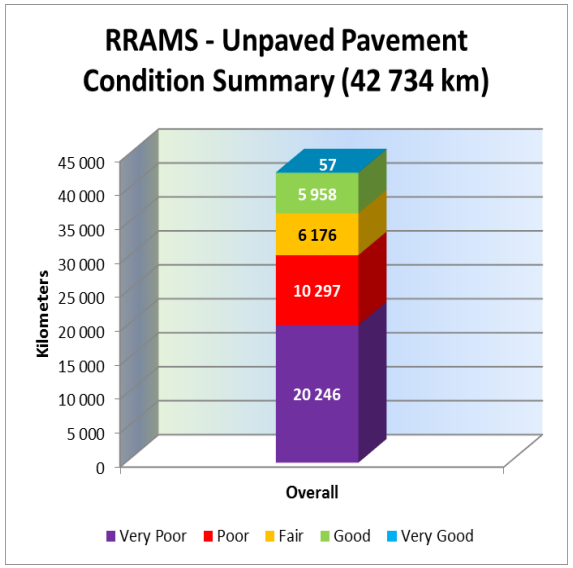


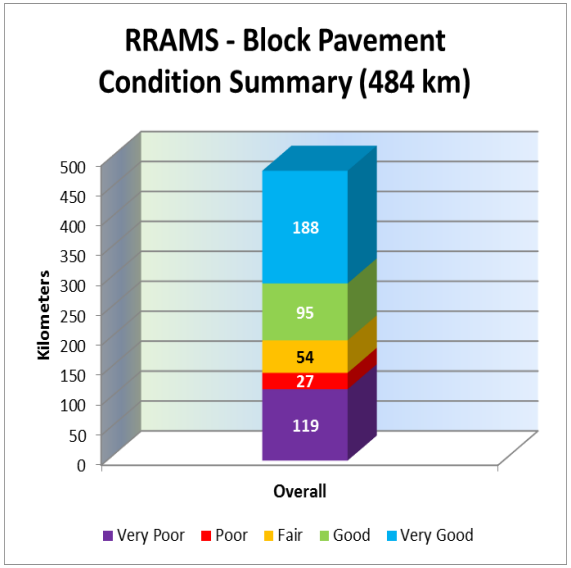
STATUS QUO

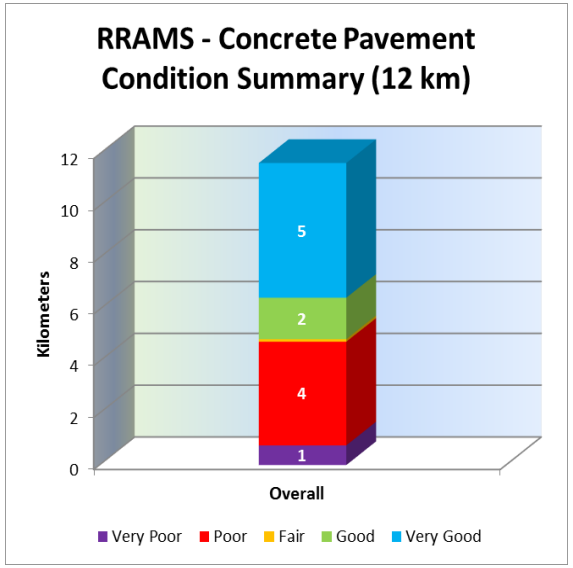
- Longest road network in Africa
- ~80% of provincial network is beyond original design life
- Network Replacement Cost estimated at **R3.5Tn**
- The maintenance backlog is estimated in excess of **R400bn**

Municipal Road Network Condition - 2019







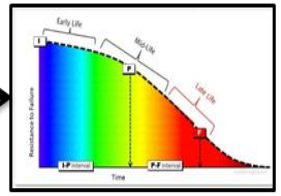


ROAD ASSET MANAGEMENT

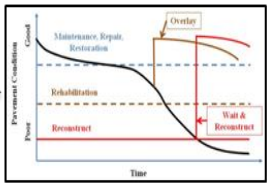
1. WHERE IS IT?
2. HOW DO WE RATE IT?
3. WHAT CONDITION IS IT?
4. WHEN SHOULD WE FIX IT?
5. WHICH ROADS DO WE FIX FIRST?

Network Inventory

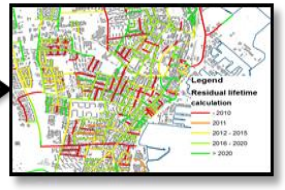
Collection of Condition Data



Pavement Condition Index



Treatment Rules



Prioritization

- RAMS – Systematic Approach
- Decision Support Process starts with the planning and undertaking of road condition assessments
- Greater accuracy = more confidence to generate maintenance strategies

DoRA – RRAMS Grant Funding

Rural Roads Asset Management Systems Grant	
Transferring department	• Transport (Vote 40)
Grant schedule	• Schedule 5, Part B
Strategic goal	• Ensure efficient and effective investment in municipal roads through development of road asset management systems (RAMS), collection and analysis of data
Grant purpose	• To assist district municipalities to set up rural RAMS, and collect road, bridges and traffic data on
Outcome	
Outputs	
Priority of that this g contribute	
Details contained in the business plan	• This grant uses Road Asset Management Business Plans which contain the following details: ○ network hierarchy ○ performance management framework ○ gap analysis
Condition	
Allocation	
Reasons n in equitab	
Past performance	**2019/20 audited financial outcomes** • Of the R108 million was transferred to municipalities and 61.7 per cent was spent

Rural Roads Asset Management Systems Grant	
	2019/20 service delivery performance • 16 017 kilometres of paved road network, 21 644 kilometres of unpaved road network was assessed and 13568 structures identified by the programme in the district municipalities receiving the grant • 164 graduates were recruited into the programme
Projected life	• Grant continues until 2023/24, subject to review
	are complimentary • Submit reports which are consistent with the reporting requirements in the 2021 Division of Revenue Act • Ensure that municipal road authorities conduct regular condition assessments for paved and unpaved roads, structure, traffic data and any other road inventory data

Strategic goal	• Ensure efficient and effective investment in municipal roads through development of road asset management systems (RAMS), collection and analysis of data
Grant purpose	• To assist district municipalities to set up rural RAMS, and collect road, bridges and traffic data on municipal road networks in line with the Road Infrastructure Strategic Framework for South Africa

Responsibilities of municipalities

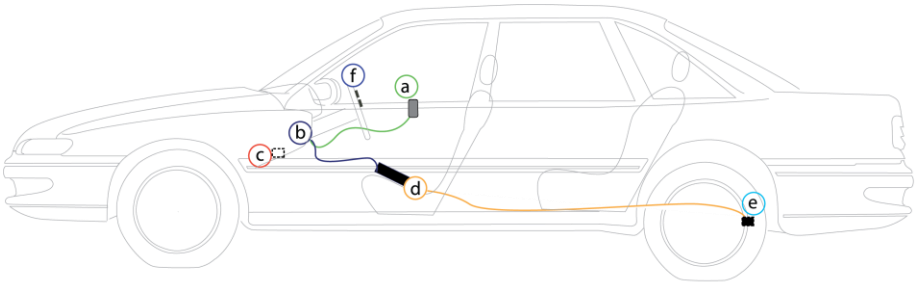
- Municipalities must make provision to maintain RAMS after the lifespan of the grant
- Municipalities must submit monthly reports that comply with the DoT and Treasury financial template as well as performance report by the 15th of every month
- Submit completed quarterly performance report templates 30 days after the end of each quarter
- Data for all rural roads to be updated within two years
- Recruit unemployed youth, S3 experiential training students and young graduates
- Ensure human capacity at municipalities for the operation of RAMS is built
- Municipalities investing in roads infrastructure must utilise data from the rural RAMS where available, to identify and prioritise their investment on roads projects; including maintenance
- Identify municipal officials that will be recipients of skills transfer
- Ensure that municipal officials participate actively in all activities funded through this grant
- Ensure systems and practices developed through this grant are sustained as part of the operations of the municipality
- Submit updated RAMS data in TMH 18 format by 28 May 2021

Roughometer - 4

- Response Type Road Roughness Meter
- Real-time IRI from a tablet or mobile phone
- World Bank Class 3 requirements
- A cost-effective solution for roughness measurement on sealed or unsealed roads
- Accurate and **repeatable** outputs regardless of vehicle type, suspension and passenger loads
- Simple operation and easy to install

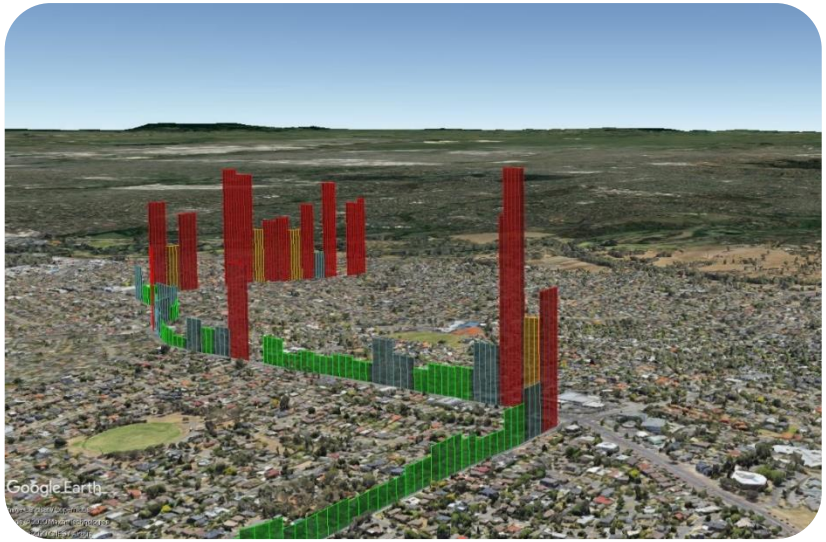
Roughometer - 4

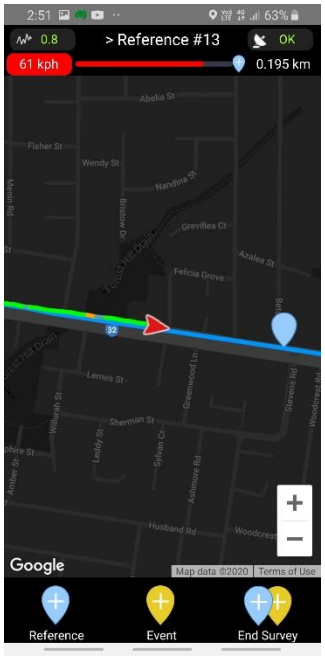
- Wireless distance sensor (communicates via Bluetooth)
- Simple 2-button wireless operation, allowing for 1-person surveying
- System can be operated by most Android phones or tablets
- MP3 voice recording for events

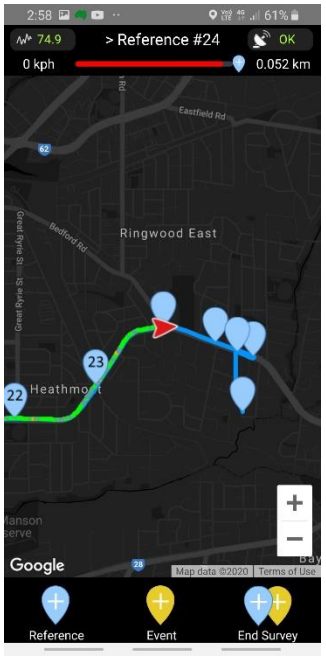


Response Type Road Roughness Meter

- Location data (lat, long, distance and speed)
- Roughness (selectable at time of survey; IRI, NAASRA or BI)
- Multi-format reports available including KML and .CSV files







Network Survey Vehicle – H2000 (Functional Criteria)

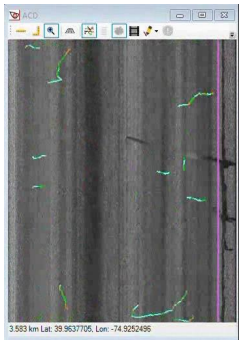
+ Digital imaging system

+ GNNS DGPS geospatial location

+ 3D Surface Defects
Full Lane

+ 3D Rutting
Full Lane

+ 3D Cracking
Full Lane



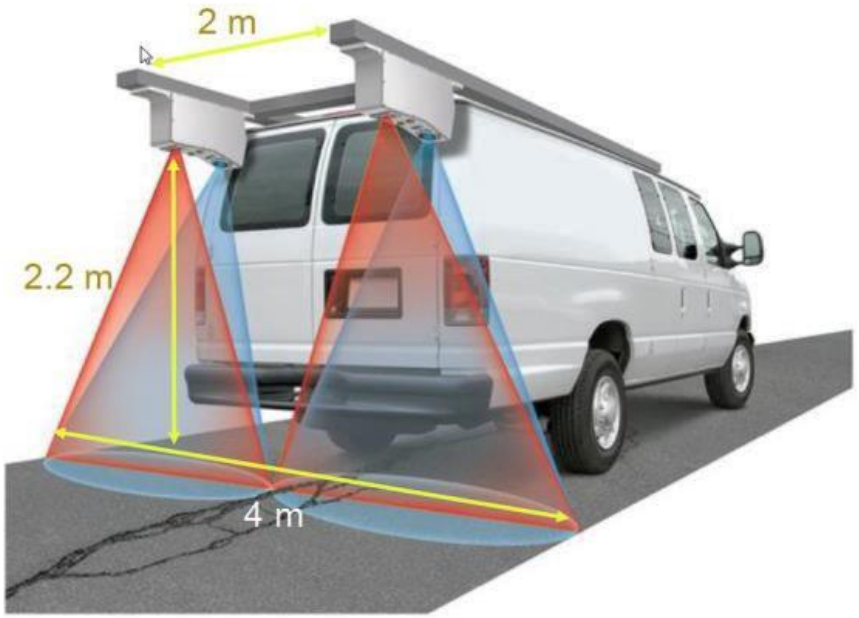
Roughness
Left and Right wheel paths

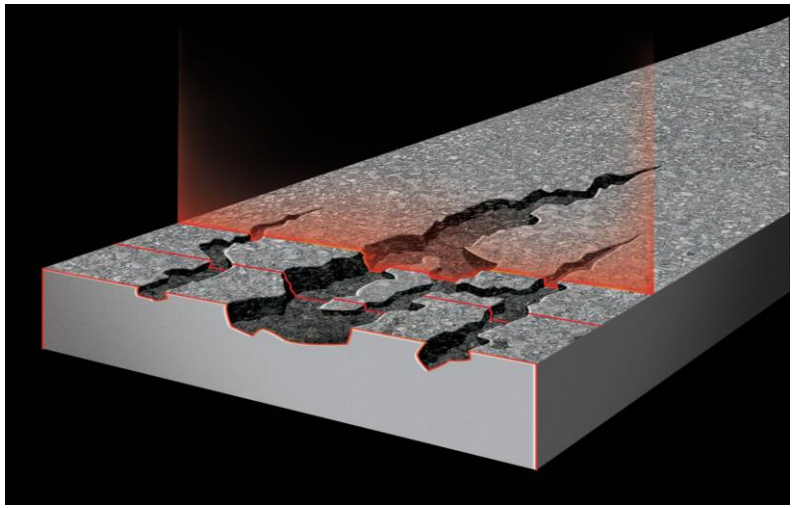
+ Texture
Centre and Both wheel paths

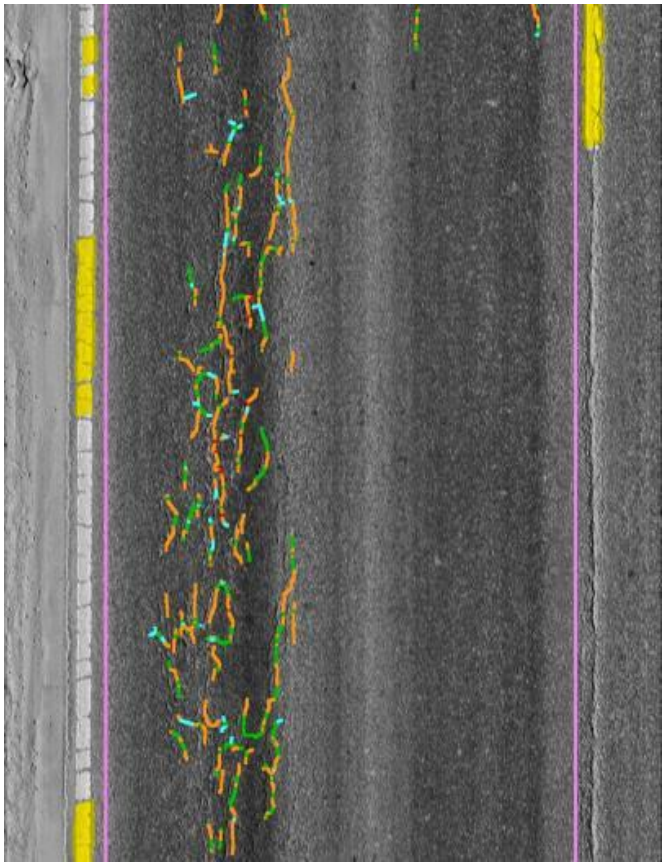
+ DMI linear location

+ IMU Geometry
Cross fall, Grade, Horizontal and Vertical curvature

ACD Operations Schematic

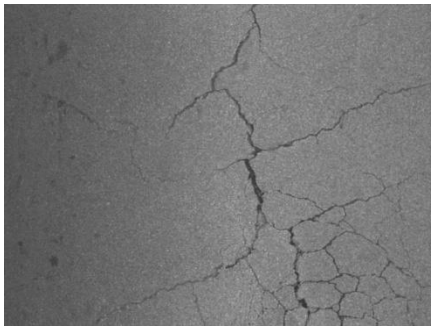


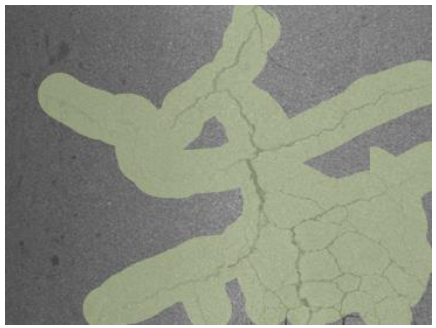




Classification

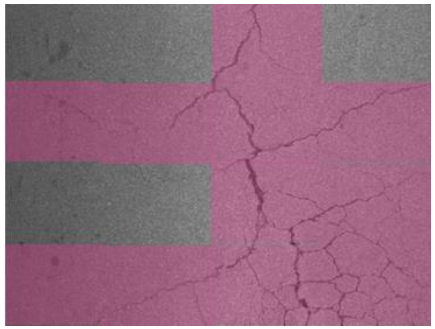
- No international standards for classification
- ASTM and AASHTO in draft stages
- PIARC has produced some recommendations





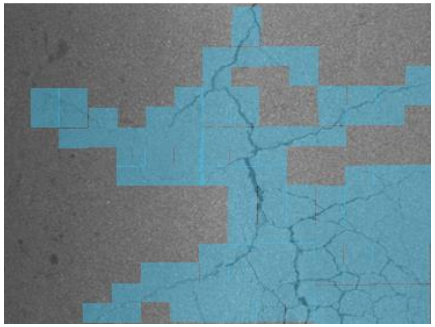
Area selected using 0.3 m regions

Affected area = 55%



Area selected using 0.16 m^2 regions

Affected area = 68%



Area selected using 0.01 m^2 regions

Affected area = 44%

intelligent Pavement Assessment Vehicle

+ 3D Roughness
Full Lane

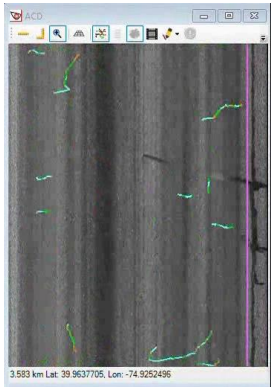
+ 3D Rutting
Full Lane

+ 3D Cracking
Full Lane

+ 3D Surface Defects
Full Lane

+ GNNS DGPS geospatial location

+ Geometry
Cross fall, Grade, Horizontal and Vertical curvature



Continuous Deflection Measurement
Pavement velocity
Full Deflection Bowl
Applied Load
Surface & Air Temperature

Roughness
Left and Right wheel paths

+ Digital imaging system

+ Texture
Centre and Both wheel paths

Comprehensive Pavement Assessment

Comparing other Deflection Devices

intelligent Safety Assessment Vehicle

+ Digital imaging system

+ GNNS DGPS geospatial location

+ Geometry
Cross fall, Grade, Horizontal and Vertical curvature

+ Rutting
Full Lane Width

+ Texture
Centre and Both wheel paths

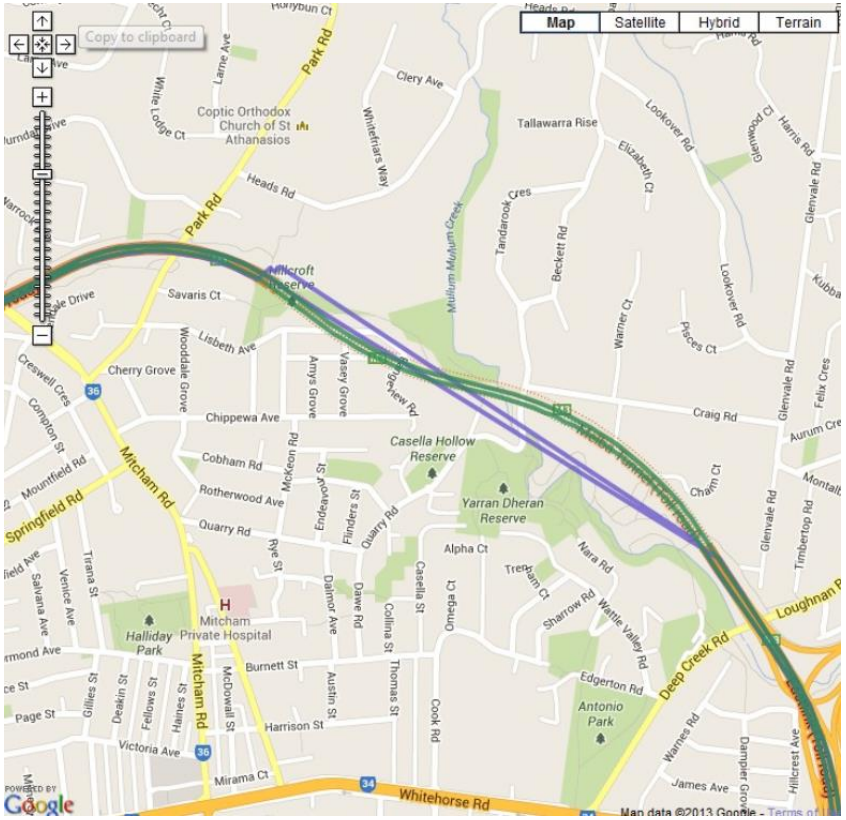
Continuous Friction Response
Sideways Force Coefficient
Vertical Loading Force
Surface, Air, Tyre & Water Temperature

LiDAR Asset Detection

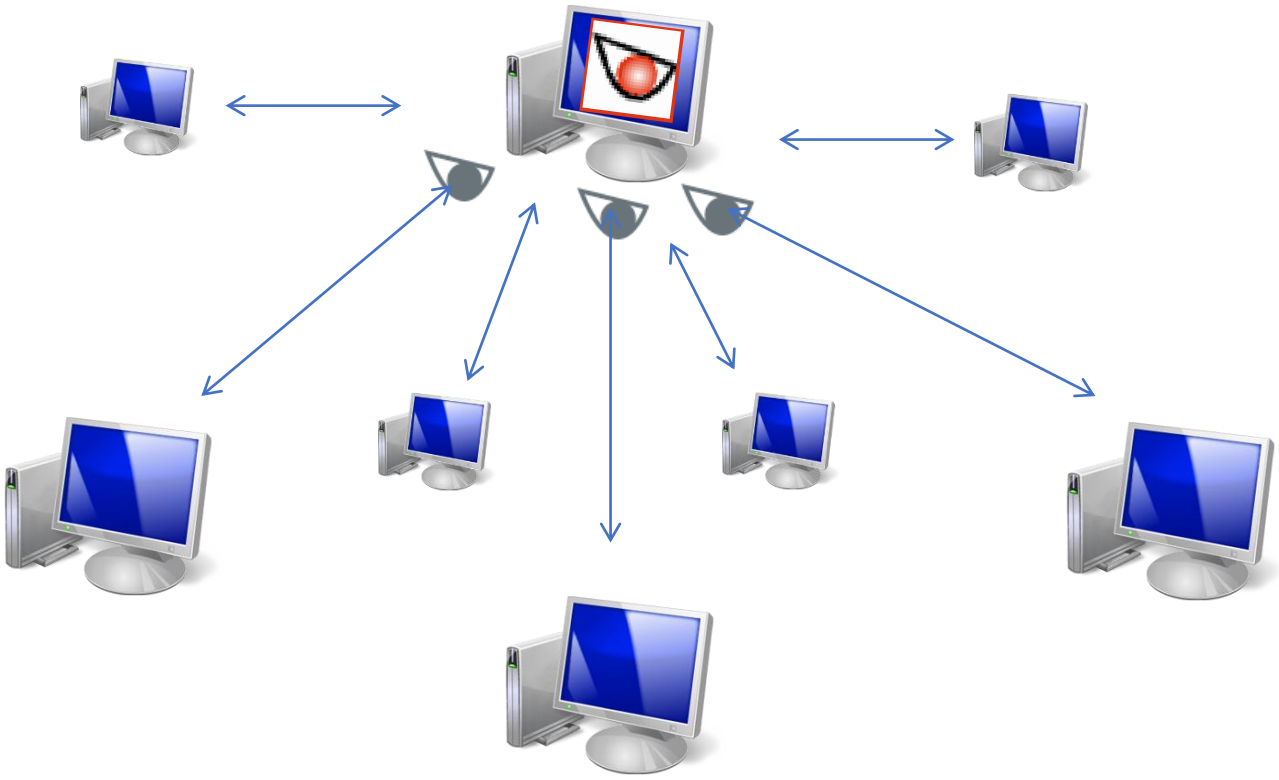
- Light Detection And Ranging optical remote sensing technology
- Up to 270-degree coverage with variable mounting positions
- Various applications
  - 3D mapping and visualization
  - Accurately measure roadside objects
  - Bridge/gantry height measurement
  - Lane width measurement
  - Hazards offsets (safety)

GIPSI TRAC 2

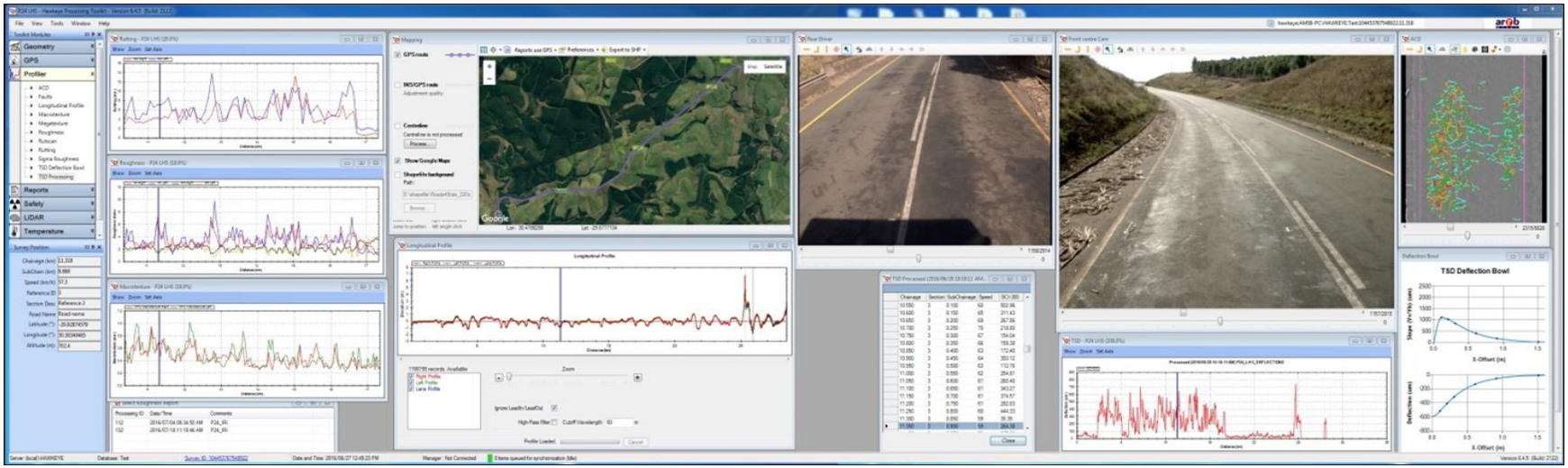
- GYROSCOPE device to track road geometry
- High Accuracy
- Dual GNSS Antenna receiver
- GPS, GLONASS, GALILEO and 8mm positioning accuracy with Kinematica post processing



Distributed Processing



Data Integration –Hawkeye Toolkit



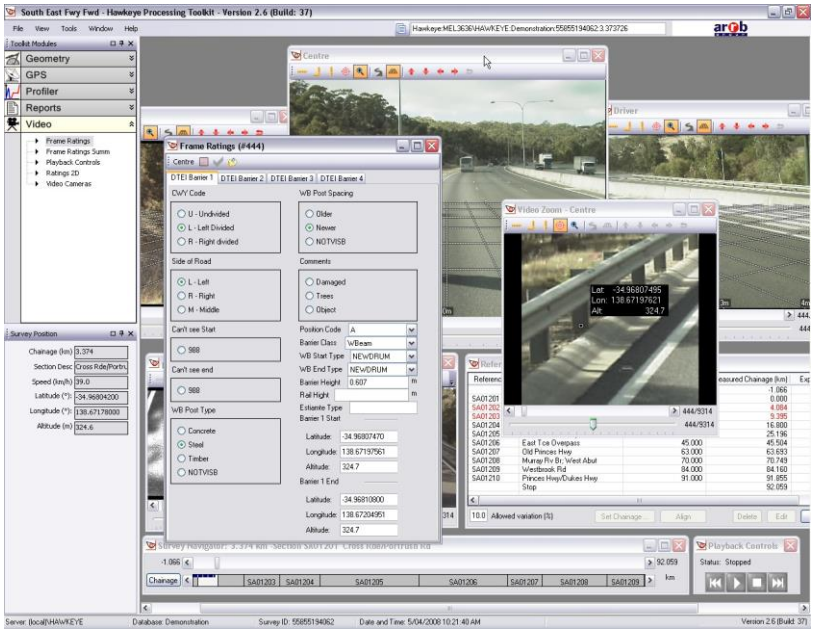
- Integrity of RAMS is dependant on data quality and entry while dealing with copious volumes successfully

- Integrated system - single user interface for post analysis. Eliminates the need to combine various datasets manually

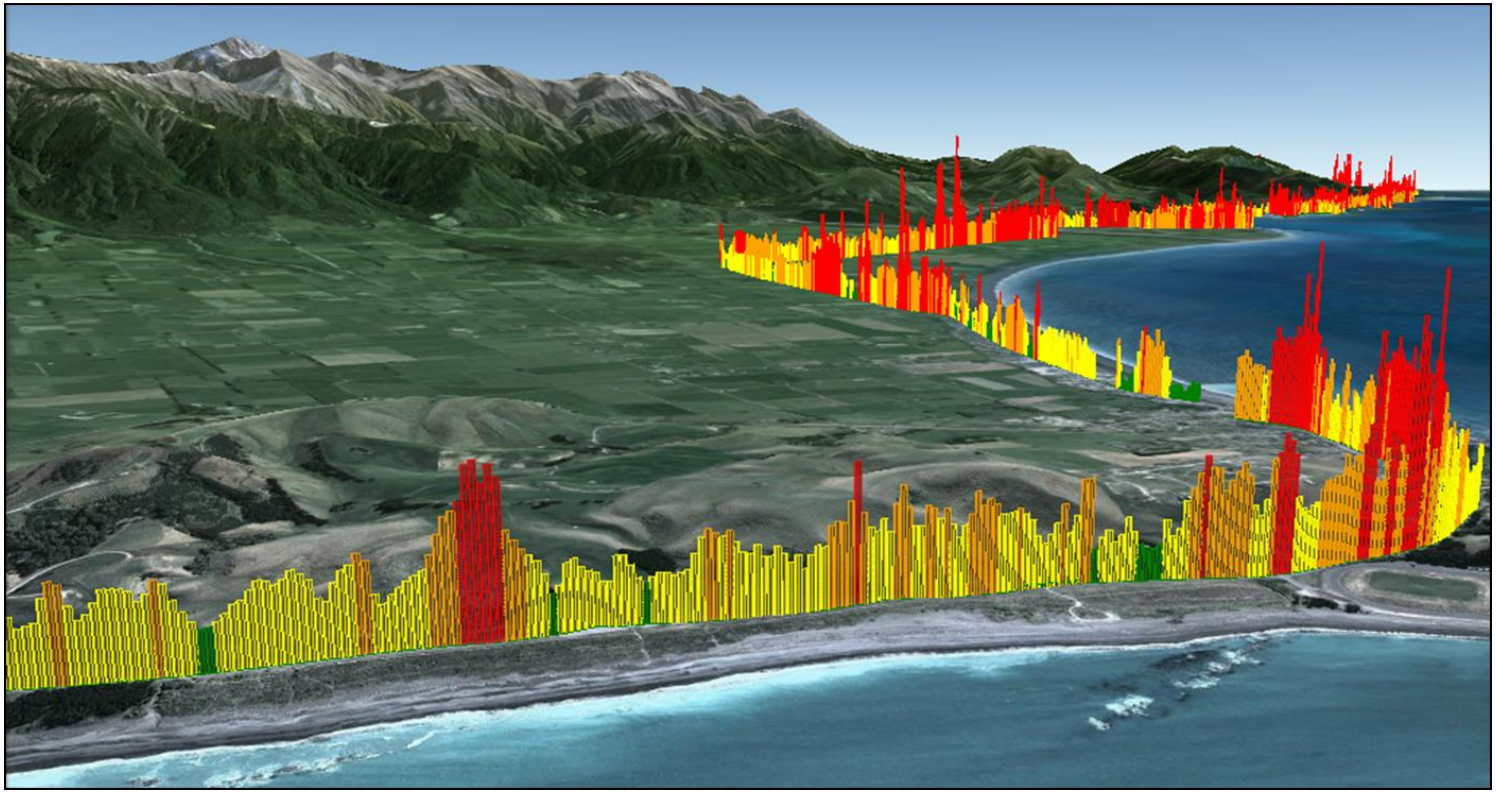
- View multiple images of the road profiles, deflections, geometry and mapping information, etc. in a single application

Analysis software – Processing Toolkit

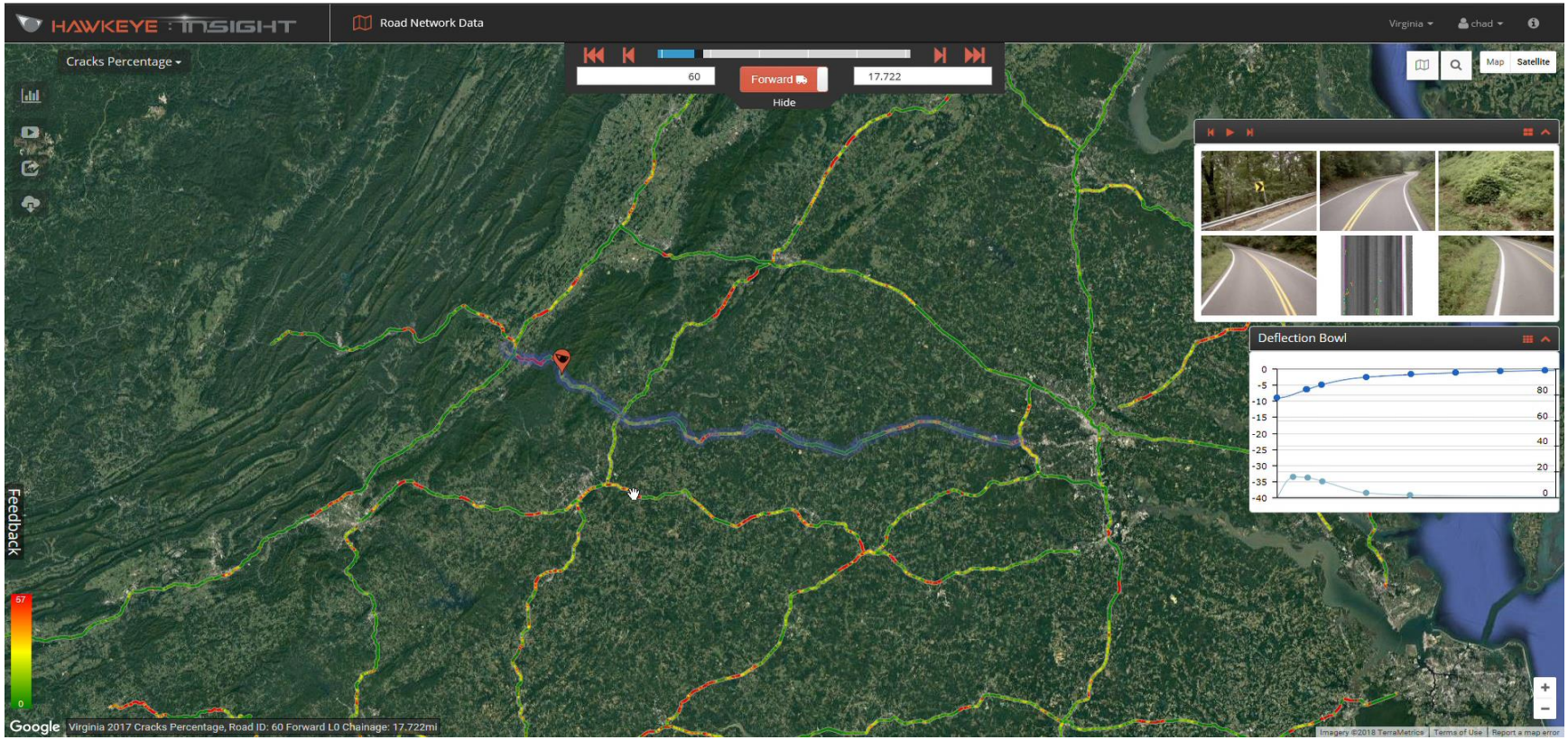
- Image area/ length/ height measurement
- Image stitching, zoom and resizing
- Asset location
- Profilometry analysis
- Graphical inertial / GPS mapping
- Shapefile imports
- User configurable rating forms
- HDM-4 exporting



Accurate Identification of Weak Spots!



Powerful Data integration and interrogation- Hawkeye Insight



Artificial Intelligence

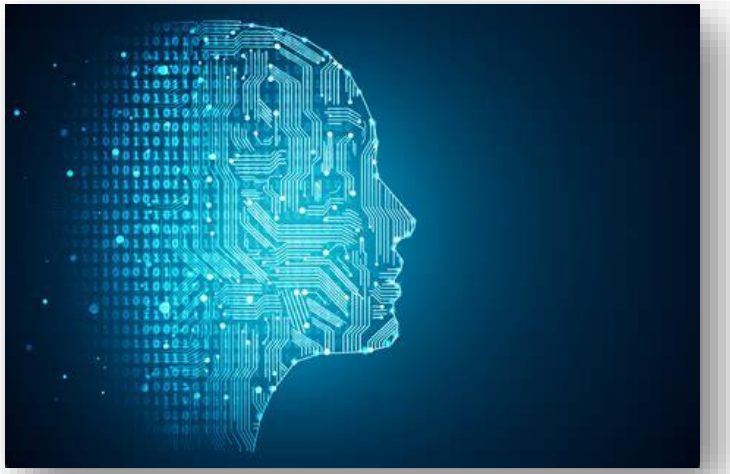
- Machine Learning underway to automate condition assessments
- Already can automate ~70% of distresses using technology.
- Include AI to identify/rate additional distresses and enhance objectivity

- ASTM Draft Standards for cracking indices from digital images.

Not meant to replace the engineer

but **rather arm her** with **better tools**

for the job.



Concluding Remarks

- Continuous significant developments in Road Assessment Technology
- We are well beyond antiquated methods of assessment!
- Specs are being re-written to cater for automation
- Machine Learning - global uptake
- Reduce costs and subjectivity
- This methodology will provide data in the least amount of time to make strategic decisions for the road infrastructure

THANK YOU FOR YOUR TIME

Verushka Balaram Pr Tech Eng

ARRB SYSTEMS AFRICA

verushka.balaram@arrbsa.com