Investigation of Road Data Technologies for Local Government

Webinar


LG TRRIP
The Local Government Transport and Roads Research and Innovation Program is a joint initiative between WALGA and Main Roads Western Australia.
LG TRRIP seeks to provide collaborative research that positively contributes to the design, construction and maintenance of safe, sustainable transport infrastructure for local government in Western Australia.
Welcome
About LG TRRIP
warrip.com.au/LG-TRRIP/

Our purpose

The objective of the program is to achieve better implementation of innovative practice by improving the specialist capability of local government through a collaborative program of projects which deliver advanced technology, cost effective and practical solutions.

Practitioners' guides

- **Projects in progress**
  - Crumb rubber in asphalt
- **Completed projects**
  - Rural low-cost LG safety treatments
  - Guide for when to seal an unsealed road
  - Sustainable construction
  - Crushed recycled concrete
  - Crumb rubber in sprayed seals
  - Catalogue of standard pavement profiles
  - Road data collection technologies

Housekeeping

- This session is being recorded.
- Please remain muted when not speaking.
- If you have a question during the presentation, please put them into the chat
- Session length: 45 minutes plus questions

Note: if time permits we can have an open discussion at the end.

Presenters

Doug Bartlett
Principal Professional/ Project Leader
NTRO

Max Bushell
Senior Policy Advisor/ Project Leader
WALGA

Asanka de Silva
Professional / Project Delivery
NTRO

Agenda

LG TRRIP

- Welcome and introduction to the project
- Needs and uses of data
- Data types: assets, defects, conditions
- Types of technologies
- Planning and specifying for data collection
- Q & A

DH0

LG TRRIP

Technical Report

Project deliverable is a technical report

Slide 8

DH0 Update icon with QR to published pdf - contact me for assistance.
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Background

Context:

- ►WA local governments manage ~88,000 km of roads
- ►Road asset data underpins funding (e.g. Direct grants, regional road groups)
- ►Road condition data is essential for financial reporting and planning renewals
- ►Poor data quality impacts asset valuations and grant allocations

Challenge:

- ►Traditional surveys are resource intensive and infrequent
- ►Data gaps exist for some types of assets
- ►Difficulty keeping asset registers and condition data up to date

Scope

The scope includes:

- ►Sealed and unsealed roads
- ►Kerbs, paths and verges
- ►Bridges
- ►Roadside vegetation

What we're exploring:

- ►Commercial off-the-shelf technologies
- ►Mature and established products
- ►Operational practicality for LG

Outputs and Intended Outcome

Output:

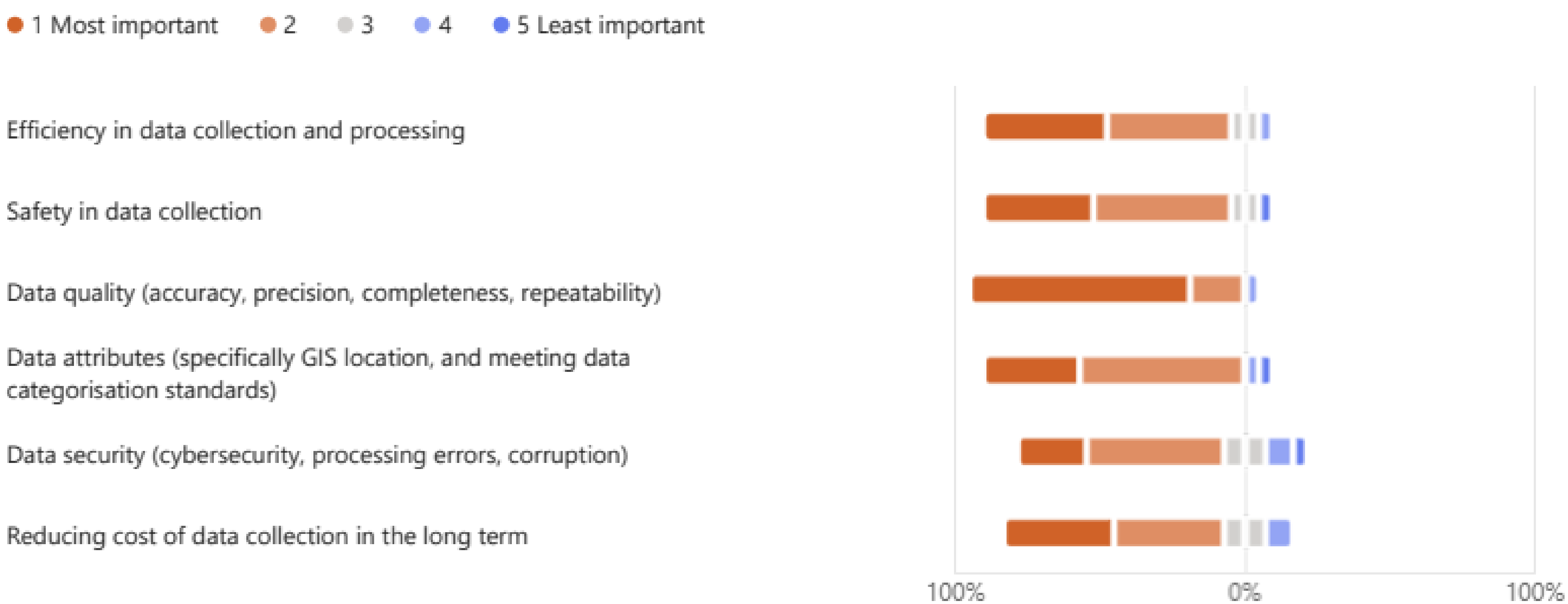
- Technical report and guidance on data collection technologies and data management considerations.

Intended Outcomes for LG:

- Improved ability to specify and select the most effective technology to meet their data collection needs.
- Ability to gain benefits from improved data quantity and quality, reduce data collection effort and improve safety.

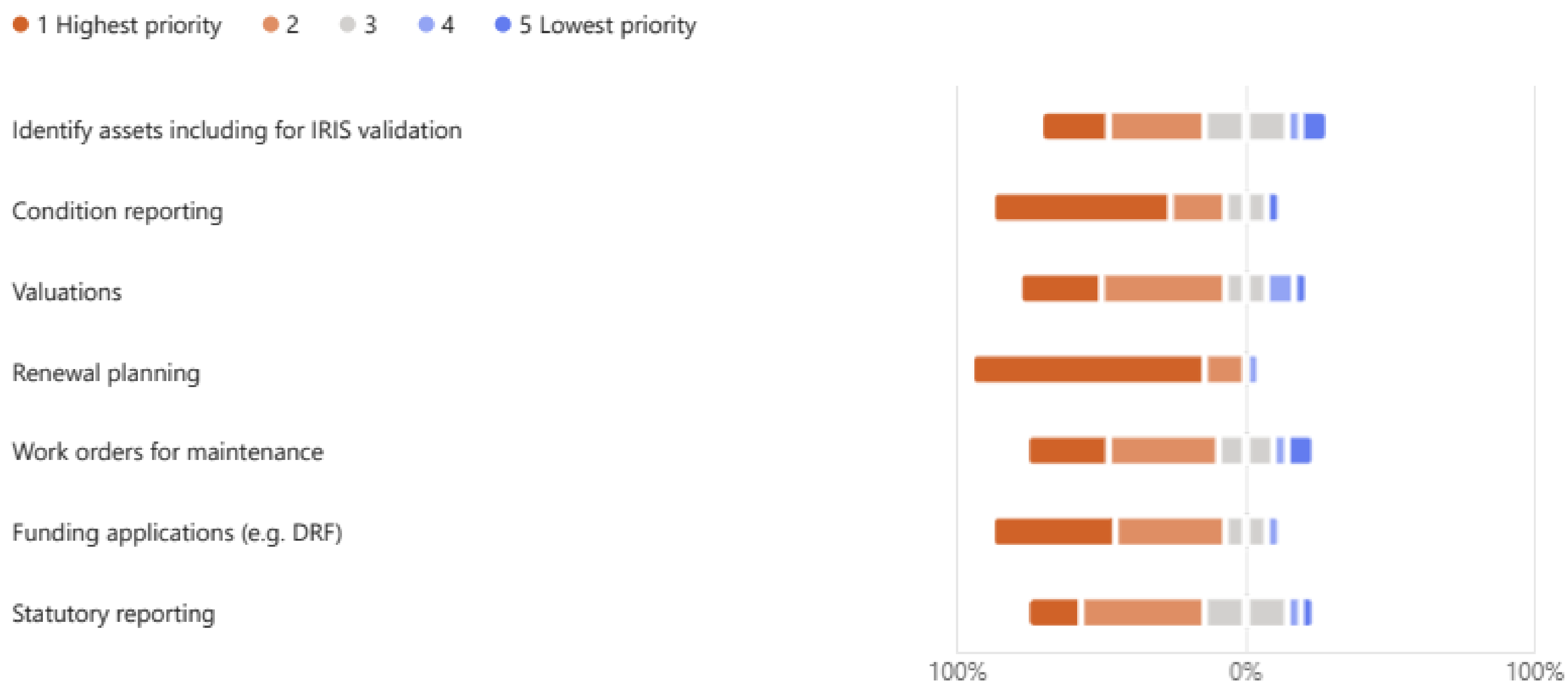
Stakeholder Workshop

1. When considering road and bridge asset data collection, please rate the level of importance for these attributes



Stakeholder Workshop

2. How do you use the data and why do you collect it? Please indicate the priority of collecting data for the following:



Stakeholder Workshop

3. Please comment or add any additional data collection needs

6

Responses

2 respondents (33%) answered data for this question.

4. The guide already considers technologies using LiDAR, laser, radar, sound, videos and photos, including devices attached to vehicles, removable to and from vehicles, portable devices, drones, and aerials.

Of the data collection technologies you are aware of, which technologies would you like more information on? Feel free to name suppliers' product names if you are not familiar with the technology type.

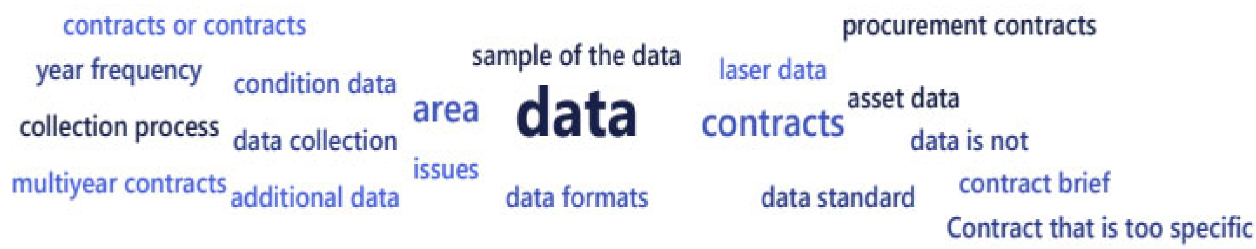
12

Responses

Stakeholder Workshop

5. When planning for data collection, procuring services, and managing the data collection, what problems have you encountered and what solutions did you find?

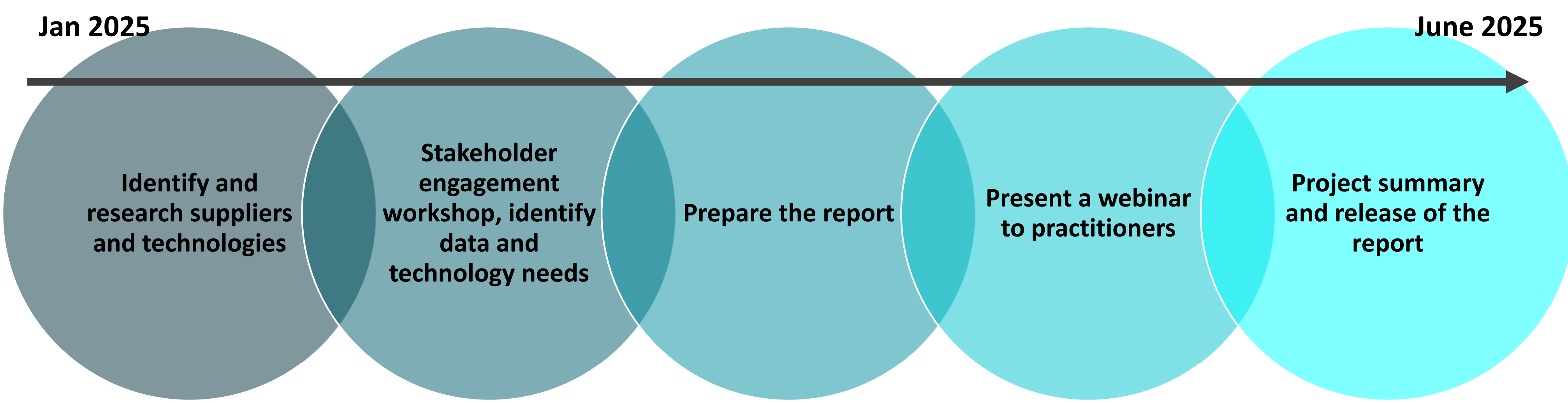
16
Responses



6. Please provide your name, and the name of the local government that you are responding for.

17
Responses

Project timeline



Asset and Defect Types

Asset Types

- **Road Pavements**
  - Sealed roads (asphalt, spray seal)
  - Unsealed roads (gravel, formed earth)
- **Pathways**
  - Shared user paths
  - Footpaths (concrete, asphalt)
- **Structures**
  - Bridges
- **Roadside Elements**
  - Kerbs and channels
  - Signage and guideposts
  - Guardrails and safety barriers
- **Green Assets**
  - Vegetation in road corridors

Defect Types

- **Surface Defects**
  - Cracks (crocodile, longitudinal, etc)
  - Potholes & patch failures
  - Texture loss / bleeding
- **Structural/Functional Defects**
  - Rutting
  - Deflection
  - Edge breaks
  - Drainage blockages
- **Visual & Safety Issues**
  - Faded line markings
  - Obscured signs (e.g. by vegetation)
  - Kerb damage
- **Other Asset Areas**
  - Shared path cracks or uplift
  - Bridge joint issues
  - Vegetation encroachment

Conditions

- ► No technology is directly providing a condition rating for an asset, due to the many failure modes that can exist.
- ► The latest automated technologies can provide defect ratings in high frequency, which can be aggregated to a composite condition index.
- ► Pavement condition index (aka structural condition index), surface condition index and drainage condition index as per WALGA manual

$$CI = MIN\,[5,\ MAX\,[All\ indices] + p \times \frac{\sum All\ indices - MAX\,[All\ indices]}{Number\ of\ Indices - 1}$$

where:

CI = composite index incorporating multiple defect indices

p = influence factor, typically 0.1 - 0.3 used to determine the contribution to the CI from other parameters other than the worst parameter, a default value of 0.1 will be used

Source: COST (2008) as presented in WALGA (2016) and ARRB (2020)

Needs and Uses of Data

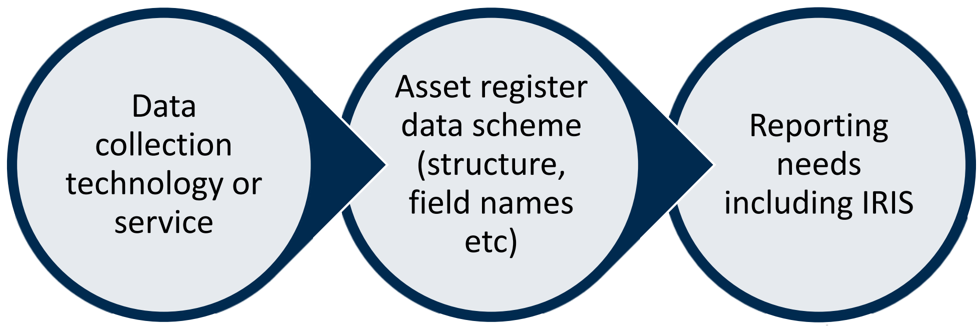
Needs and Uses of Data

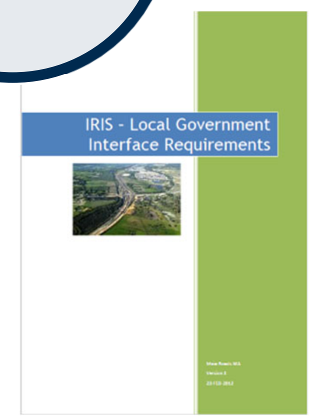
- **Renewal planning**
- **Specified funding**
  - Road improvements
  - Commodity routes
  - Roads and bridges
  - Aboriginal community access
  - Bridges special projects
- **Recovery funding**
  - Essential Public Asset Reconstruction (EPAR) submission

Source: NTRO

Needs and Uses of Data

- **Asset registers**
  - IRIS Validation
- **Gifted assets**
  - A-spec, ADAC





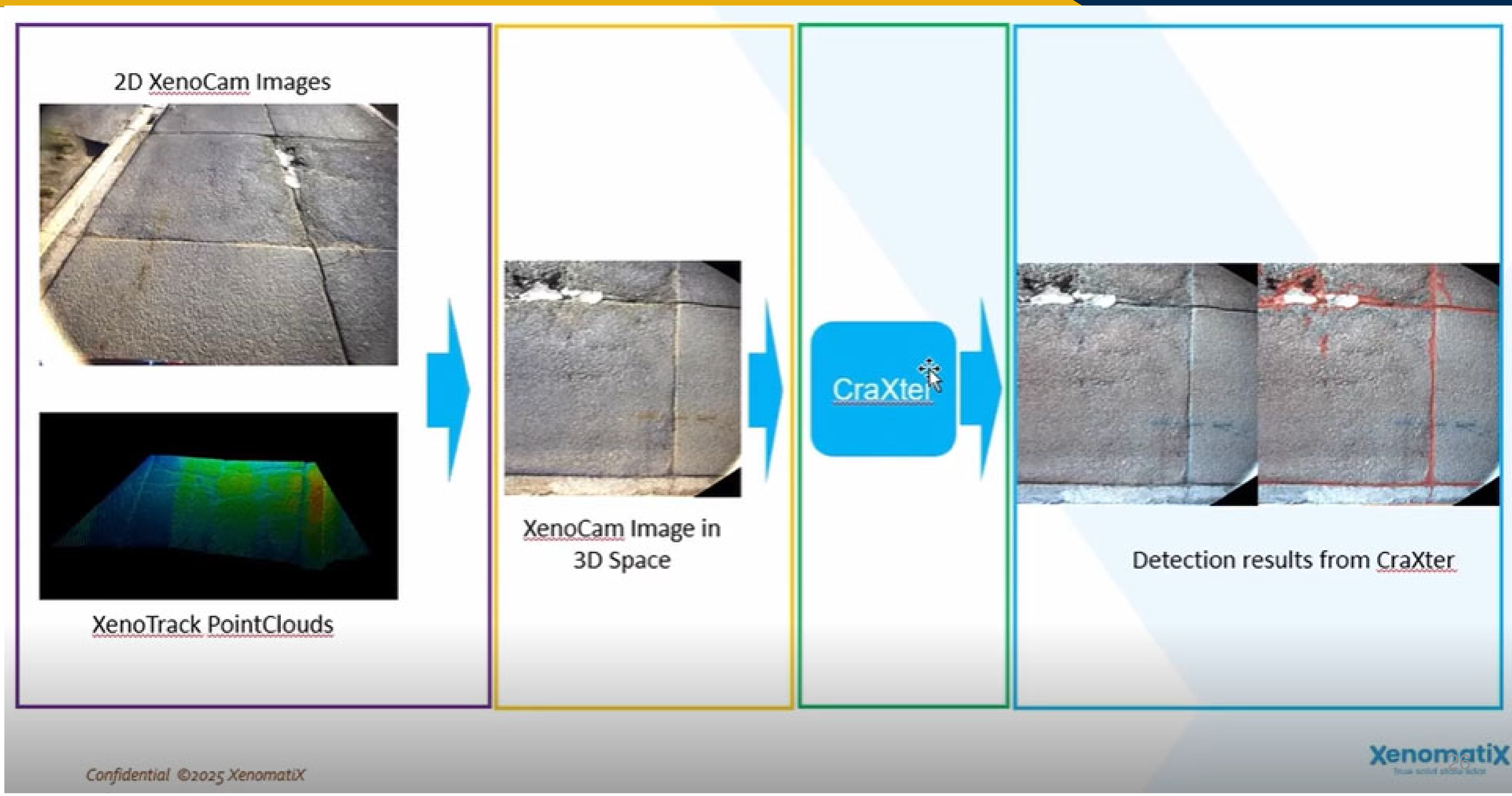
Source: MRWA (2012)

Technologies

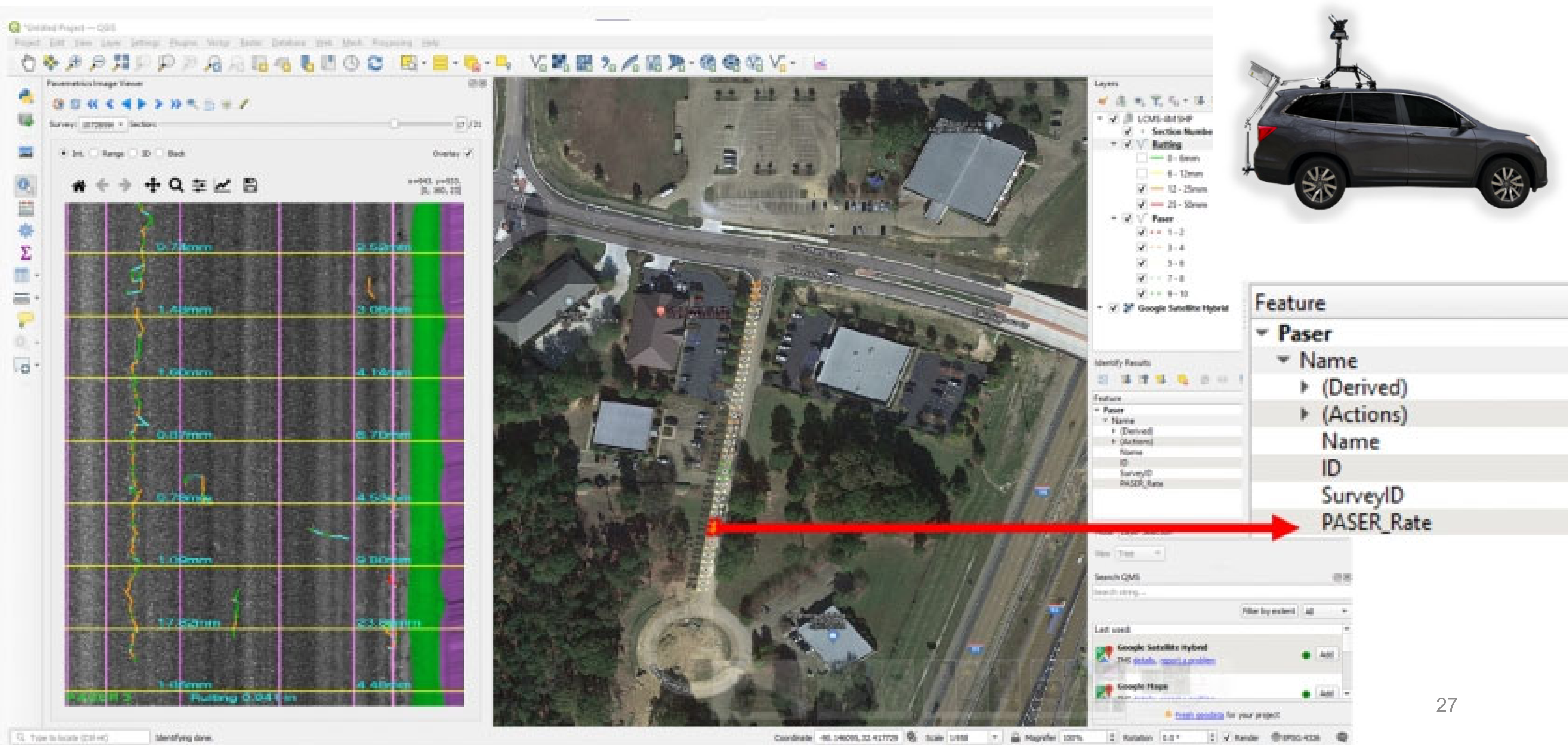
Mature and Emerging Technologies

- **Mature technologies**
  - Laser and LiDAR scanning systems
  - Some image-based feature detection systems
  - Drone-based visual inspections
- **Emerging technologies**
  - Smartphone-based roughness apps
  - Expanding image-based feature detection Systems
  - Smartphone LiDAR / Edge AI Tools
  - Drone-Based Automated Condition Indexing
  - Crowdsourced AI Mapping via Public Apps
  - Multispectral/NDVI Vegetation Monitoring

LiDAR Scanning Systems (Vehicle-Mounted)



LiDAR Scanning Systems (Vehicle-Mounted)



LiDAR Scanning Systems (Vehicle-Mounted)

LiDAR (Light Detection and Ranging)

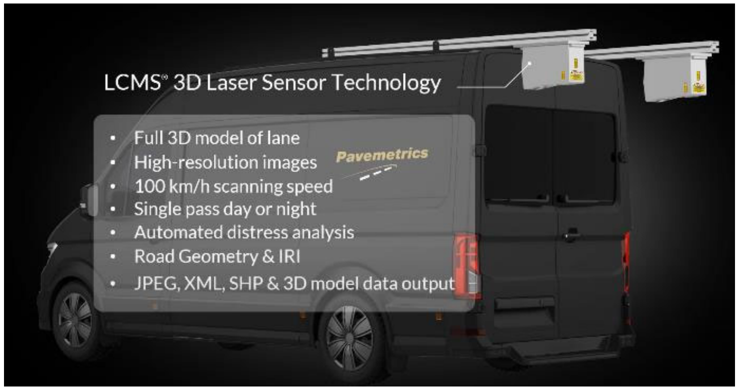
- What it is:
  - Laser profilers scan pavement surface in 3D
  - Detects cracks, rutting, potholes, surface texture
- How it works:
  - Mounted on survey van/ute
  - Operates at traffic speeds
  - Records 3D road shape + images
- What you get:
  - High-resolution 3D profiles
  - Crack maps + road geometry
  - Data in XML/CSV for IRIS or GIS
- Good for:
  - Detailed network-wide surveys
  - Quantitative asset condition records
  - Routine road health benchmarking

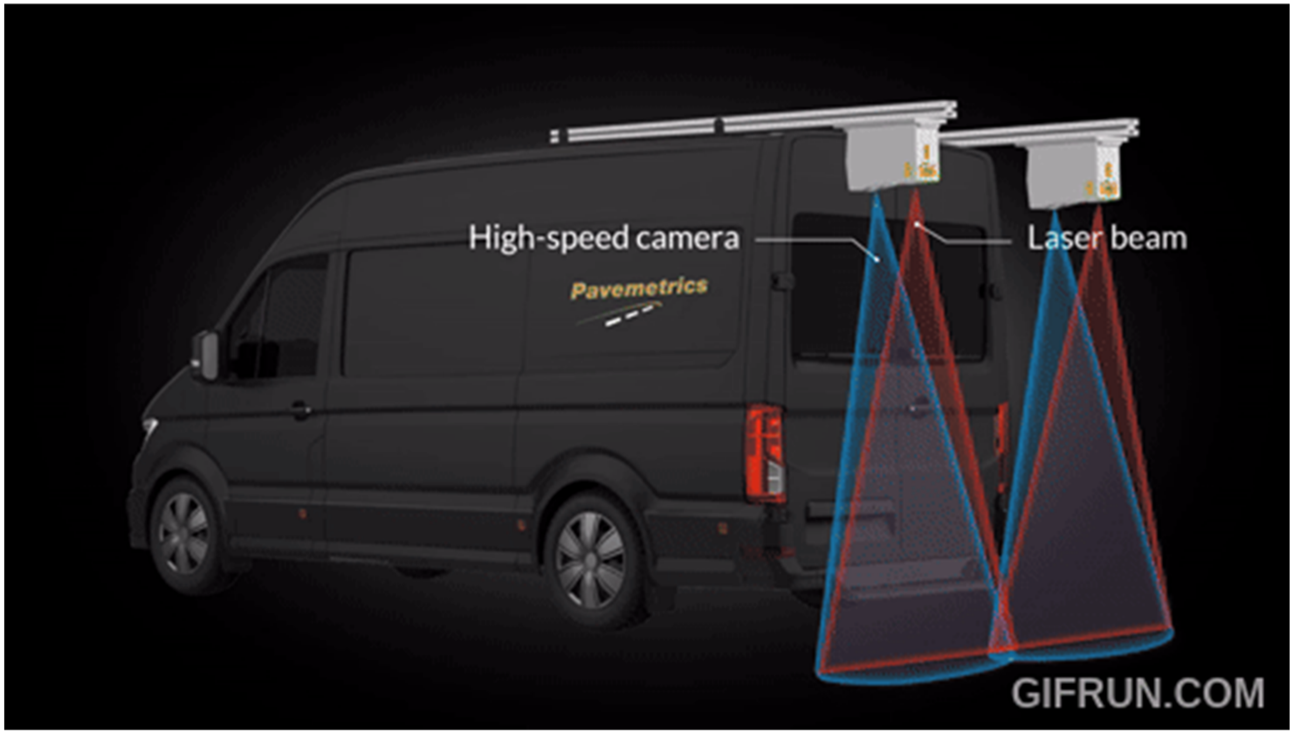
LiDAR Scanning Systems (Vehicle-Mounted)

LiDAR (Light Detection and Ranging)

- Pros:
  - Highly accurate and repeatable
  - Fast - scan at 100 km/h
  - Full lane width + 3D view
- Limitations:
  - High cost & specialized hardware
  - Sensitive to rain/dust/line-of-sight
  - Not suited for shared paths
- Examples:
  - Pavemetrics LCMS-2
  - XenomatiX XenoTrack
  - Trimble DPS
- Where it fits:
  - Network-wide condition surveys
  - Scoping for both short term maintenance and long term maintenance or rehabilitation

LiDAR





Vehicle-mounted LiDAR scanning system (Pavemetrics LCMS)

Data collection needs

- Efficiency in data collection and processing
- Safety in data collection
- Data quality (accuracy, precision, completeness, repeatability)
- Data attributes (specifically GIS location, and meeting data categorisation standards)
- Data security (cybersecurity, processing errors, corruption)
- Cost of data collection (importance of reducing cost in the long term)

Image-Based AI Systems (Camera + AI)

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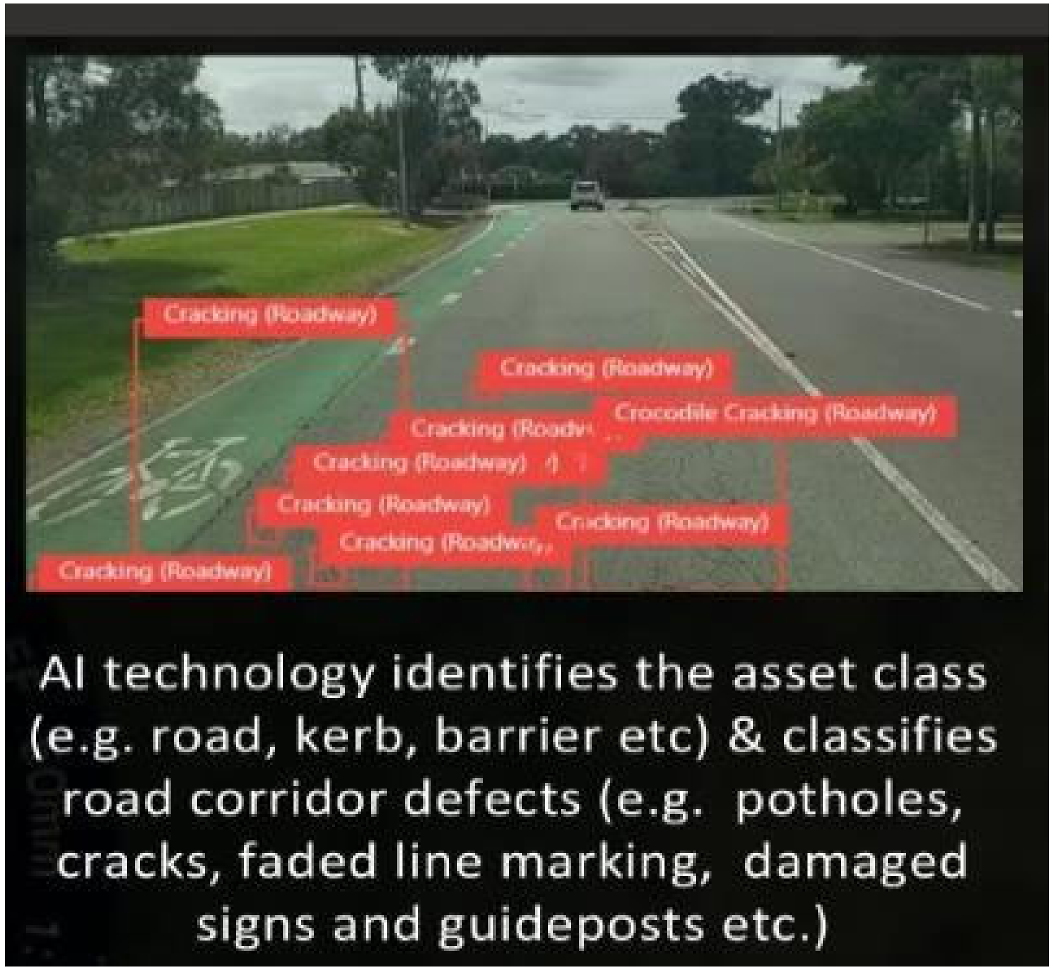
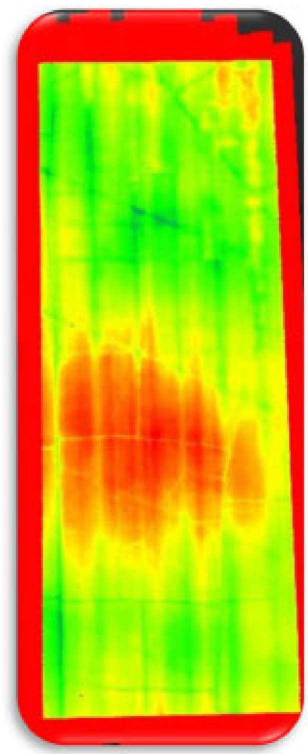


Image-Based AI Systems (Camera + AI)

▲ CS9550 and CS9500 Survey Scanners ▲

▲ Dense Point Cloud ▲



▲ Machine Control Model ▲

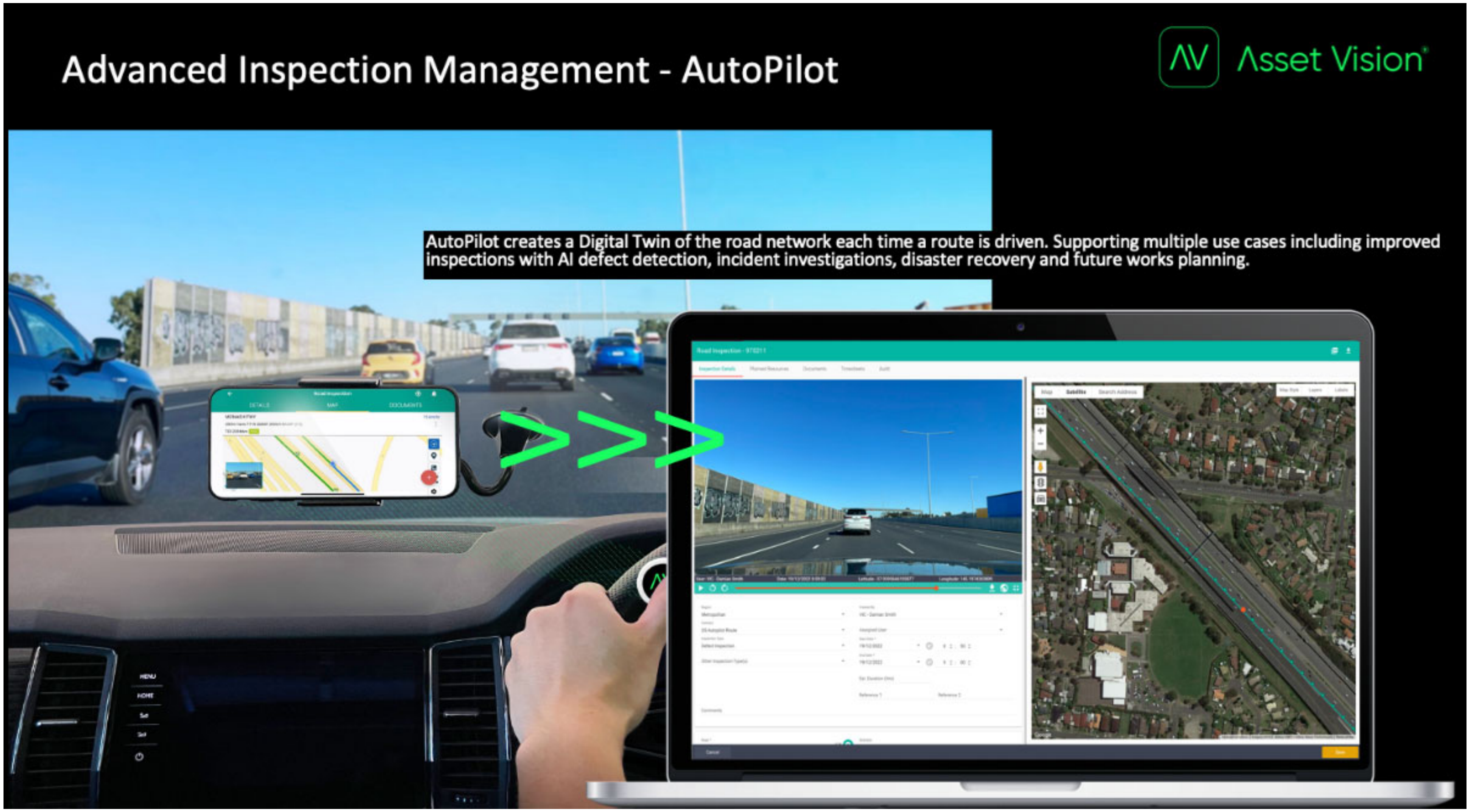
Image-Based AI Systems (Camera + AI)

- What it is:
  - Uses cameras (like dashcams or smartphones)
  - AI analyzes cracks, potholes, edge breaks, faded markings
- How it works:
  - Mount camera on vehicle
  - Drive roads as usual
  - Upload footage to cloud or run AI locally
- What you get:
  - Map of defect locations
  - Images with annotations
  - Excel/CSV of defects for upload to IRIS
- Good for:
  - Fast, cheap inspections
  - Ongoing patrol-based condition tracking
  - Sharing visual evidence with teams

Image-Based AI Systems (Camera + AI)

- Pros:
  - Low-cost, minimal setup
  - Objective, consistent results
  - Great for sealed roads and markings
- Limitations:
  - Can miss small cracks
  - False positives in glare/shadows
  - Doesn’t measure roughness or rutting
- Examples:
  - Vaisala RoadAI (UK, US, trials in AU)
  - Asset Vision AutoPilot (Australia)
  - RoadBotics (now part of Michelin)
- Where it fits:
  - Scoping of surfacing and pavement repairs and renewal
  - Suitable for local governments with wide road verges and low-volume road networks

Smartphone-Based Apps & Crowd-Sourcing



Smartphone-Based Apps & Crowd-Sourcing

- What it is:
  - Uses phone sensors (accelerometer + GPS)
  - Detects vibration spikes (in roughness / potholes)

- How it works:
  - Mount phone in council vehicle
  - App runs while driving
  - Exports road roughness per segment

- What you get:
  - IRI-style roughness map
  - Pothole flags + GPS
  - Data in Excel / CSV / GIS formats

- Good for:
  - Ongoing road patrols
  - Low-volume or gravel road monitoring
  - Budget-friendly roughness tracking

Smartphone-Based Apps & Crowd-Sourcing

- Pros:
  - Low-cost
  - Works with routine vehicle trips
  - Crowd-sourcing possible (public or fleet use)
- Limitations:
  - Accuracy varies by vehicle/sensor
  - Not good for cracks or structural issues
  - Calibration needed for best results
- Examples:
  - Roadroid (global use)
  - Asset Vision CoPilot (Australia)
  - StreetBump (Boston, USA)
- Where it fits:
  - Quick condition sampling
  - Road condition roughness
  - Great for regional councils with unsealed roads

Inertial Profilers & Traffic Speed Deflectometer

SurPRO walking profiler

ARAN 7000

ARAN 7000 ARAN 7000 is a portable profiler with options for one, two or three point measurement. Using a hitch-mount, this is a go-anywhere road profiling solution. The profiler unit comes with the option of right-of way video.

Fugro Roadware

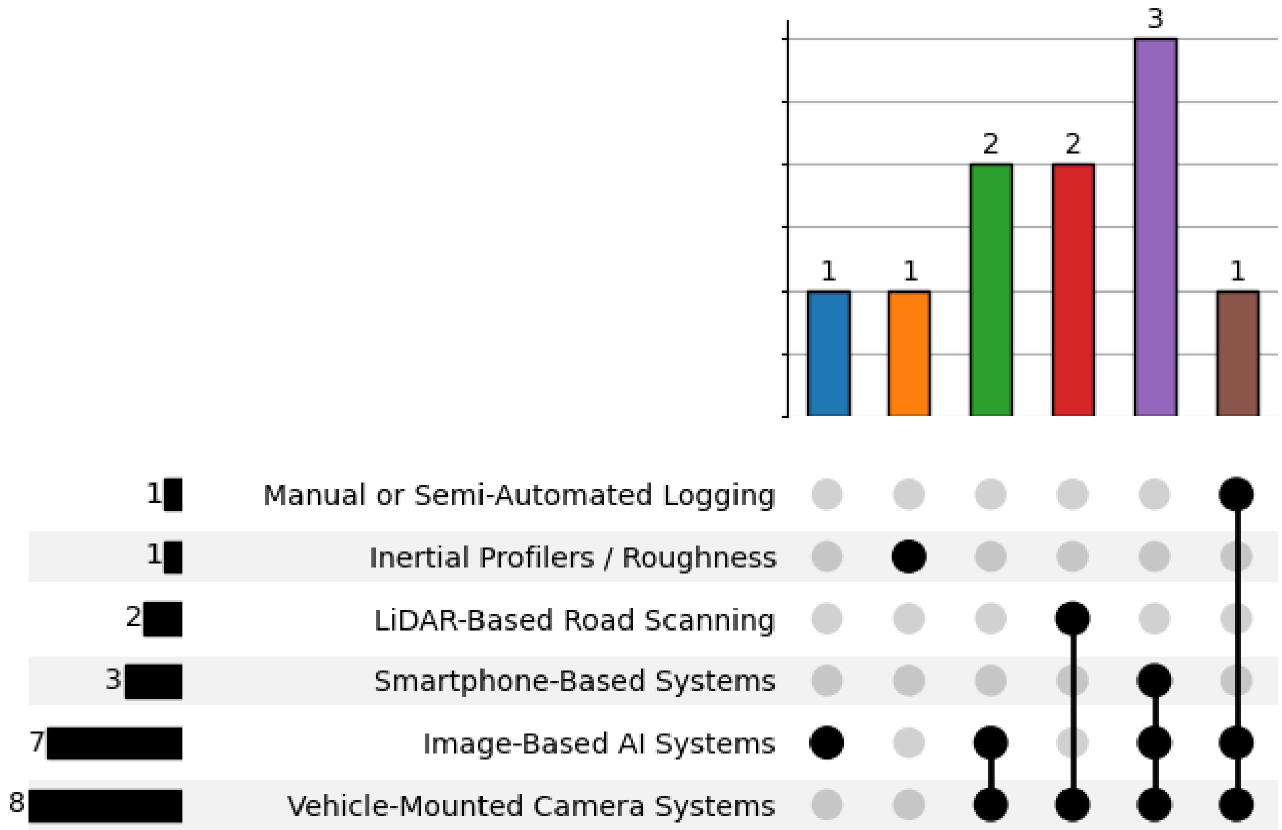
Inertial Profilers & Traffic Speed Deflectometer

- What it is:
  - Uses lasers + accelerometers to measure surface roughness (IRI)
  - TSD measures pavement deflection (structure)
- How it works:
  - Mounted on survey vans (Hawkeye, ARAN)
  - Drive at normal speeds, auto-records IRI, rutting, texture
  - TSD (large truck) scans structural strength at speed
- What you get:
  - IRI per segment (e.g. every 100m)
  - Rut depth, texture, deflection curves
  - Output in CSV, profile files, GIS-ready
- Good for:
  - Network roughness rating
  - Identifying weak roads before failure
  - Structural insight without closures

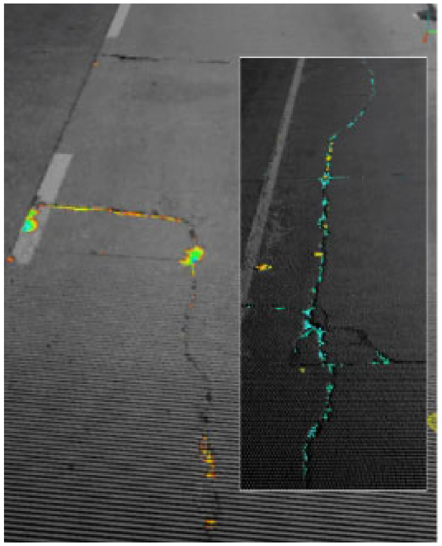
Inertial Profilers & Traffic Speed Deflectometer

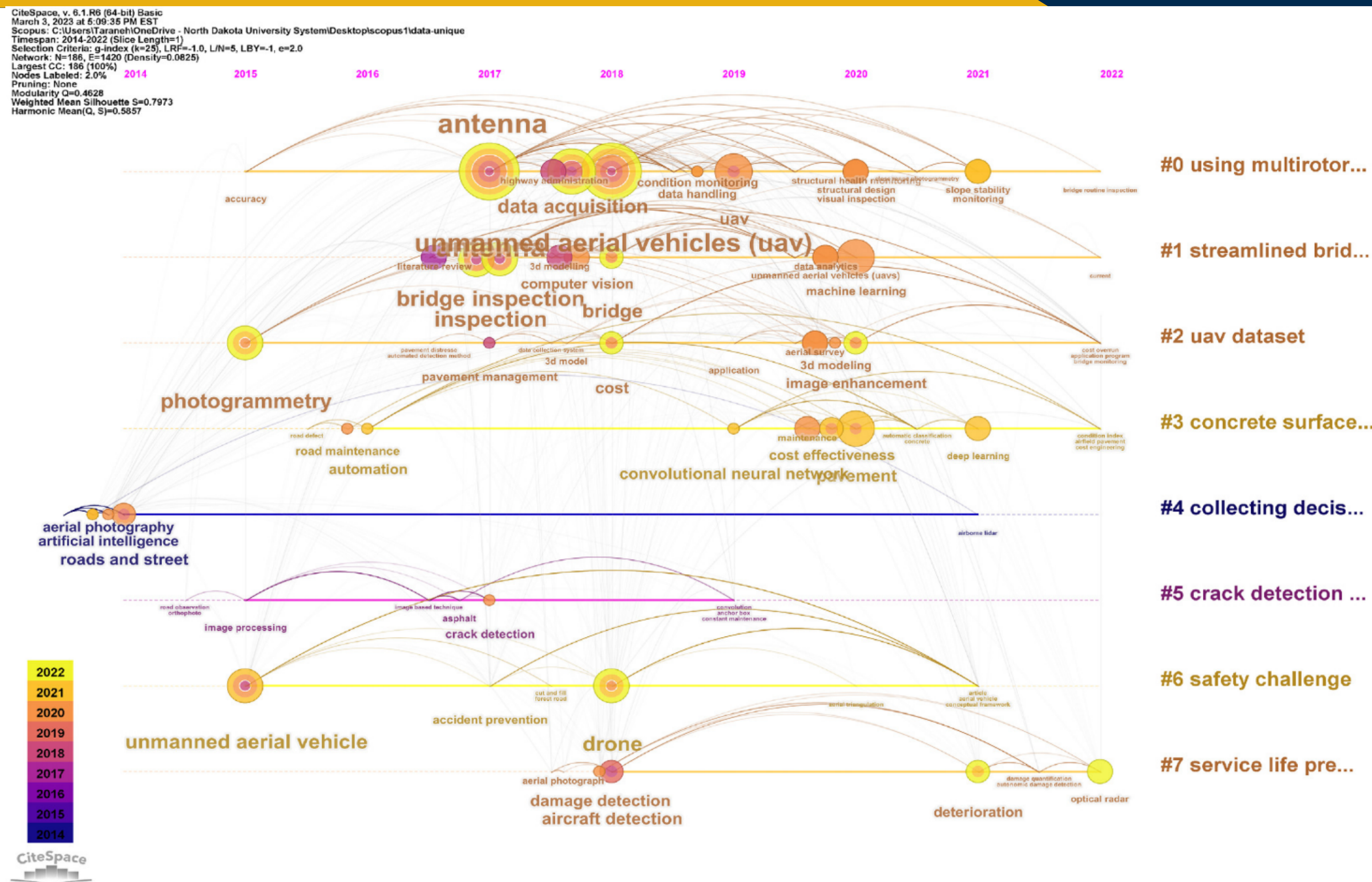
- Pros:
  - Objective ride quality index (IRI)
  - Fast surveys at traffic speed
  - Standard output, fits IRIS and asset models
- Limitations:
  - Doesn't detect cracks or surface types
  - Needs calibration, smooth driving
  - High upfront cost for full system
- Examples:
  - NTRO's iPAVE
  - Fugro ARANTSD (Greenwood Engineering)
- Where it fits:
  - Ideal for sealed roads, asset registers
  - Pavement structural insights for renewal planning

Combined technology



Drone Surveys





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Pruning: None
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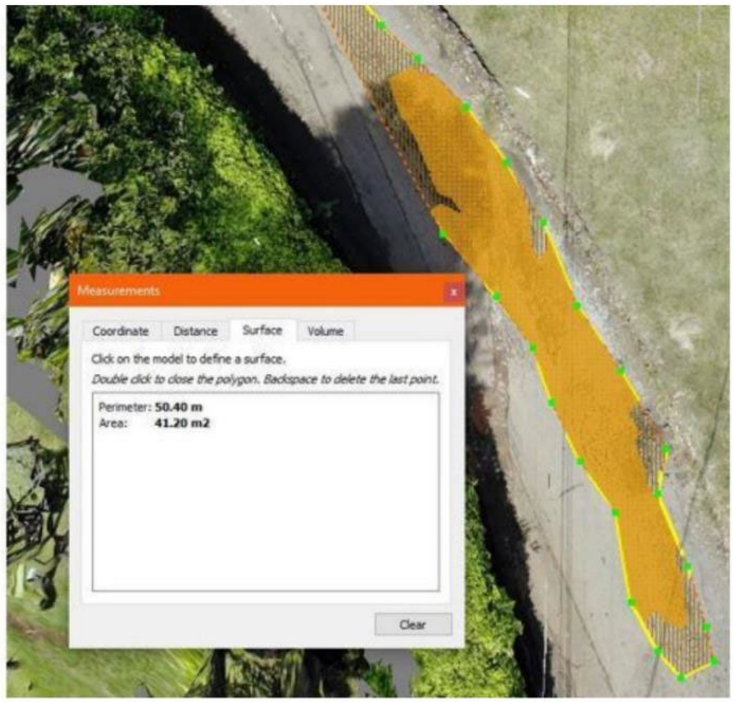
Drone Surveys



Drone Surveys

- What it is:
  - Drones with cameras (and sometimes LiDAR)
  - Capture road surface, bridges, vegetation from above
- How it works:
  - Flies over assets taking high-res photos/videos
  - Used for hard-to-reach areas (e.g. bridges)
  - Photos analyzed by staff or AI tools
- What you get:
  - Orthophotos, 3D models, bridge/road imagery
  - Geo-tagged photos/videos
  - Ideal for documentation & targeted inspections
- Good for:
  - Bridge/culvert inspections
  - Flood/storm damage
  - Vegetation & sign assessments (feature detection from images)

Drone Surveys

- Pros:
  - Safe: no need for traffic closures
  - Great for bridges, roadside condition
  - High-quality visuals, easy to share
- Limitations:
  - Limited range, battery-dependent
  - Images require post-analysis
  - Regulated flight zones
- Examples:
  - DJI Enterprise drones
  - Used by QLD/NSW for bridges + disaster response
- Where it fits:
  - Bridge inspections, corridor mapping
  - Visual inputs for asset register or reports

Summary of Key Technologies

- ‘H’ for high, ‘M’ for moderate, ‘L’ for low, when considering all the key technologies
- This is a very generalised summary and results can vary significantly between suppliers and in different applications.
- As some technology types are designed for a specific small range of defects, the ‘L’ is not representative of a problem in the technology itself.
- Even an ‘H’ does not mean a technology will provide all types or accuracy needed by LG

Technology type	Potential range of road asset inventory that can be collected	Potential range of road defect data that can be collected	Typical level of accuracy of detection
Computer vision	H	H	M
Inertial profilers	-	L	H
LiDAR and laser-based technologies - surface condition	-	L	H
LiDAR and laser-based technologies - road environment	L	M	H
Traffic speed deflectometers	-	L	H
Unmanned aerial vehicles	L	L	M

Planning and Specifying for Data Collection

Planning and Specifying Data Collection

- Process to follow
- WHS and traffic management
- Organisation system need
- Information to be provided by the LG
- Specify the data
- Data accuracy, validation and testing
- Procuring data collection services

Planning and Specifying for Data Collection

1. Confirm the needs and uses of data
2. Identify the type of data to be collected and whether this includes asset inventory data, defect data, and/or condition data
3. Identify the technologies that can provide the data
4. Specify the workplace health and safety requirements for the data collection
5. Confirm the range or extents of the data collection such as lengths of road, extents of verges and numbers of bridges, and identify the information to be provided to the contractor
6. Confirm what type of data is to be collected, identify the systems that will receive the data, and required data formats
7. Consider contractual matters
8. Identify the level of data accuracy and how to validate and check the data
9. arrange the data collection and then manage data storage in the asset register and report for the uses of data.

Information to be Provided (by the LG)

- **The LG is advised to specify the information that will be provided to the contractor. As a minimum this should include:**
  - shapefiles of road centrelines or asset locations
  - template file (such as spreadsheet) that defines the data field arrangements (field names) and data formats (e.g. numerical, integer, date) that are required.

- **Additional information that can be provided to assist in the data collection includes:**
  - quantities of the assets
  - spatial data files such as cadastres or other features to define roads and road reserves
  - reference files such as development plans that show new road assets.

Data accuracy and validation

- **Accuracy in feature detection is defined in terms of:**
  - accuracy – the measured accuracy of dimensions of the feature (e.g., length)
  - precision – the proportion of features that are identified compared to actual occurrences of the feature
  - false negative – that a feature is not recorded when one is present
  - false positive – that a feature is recorded when one is not present.

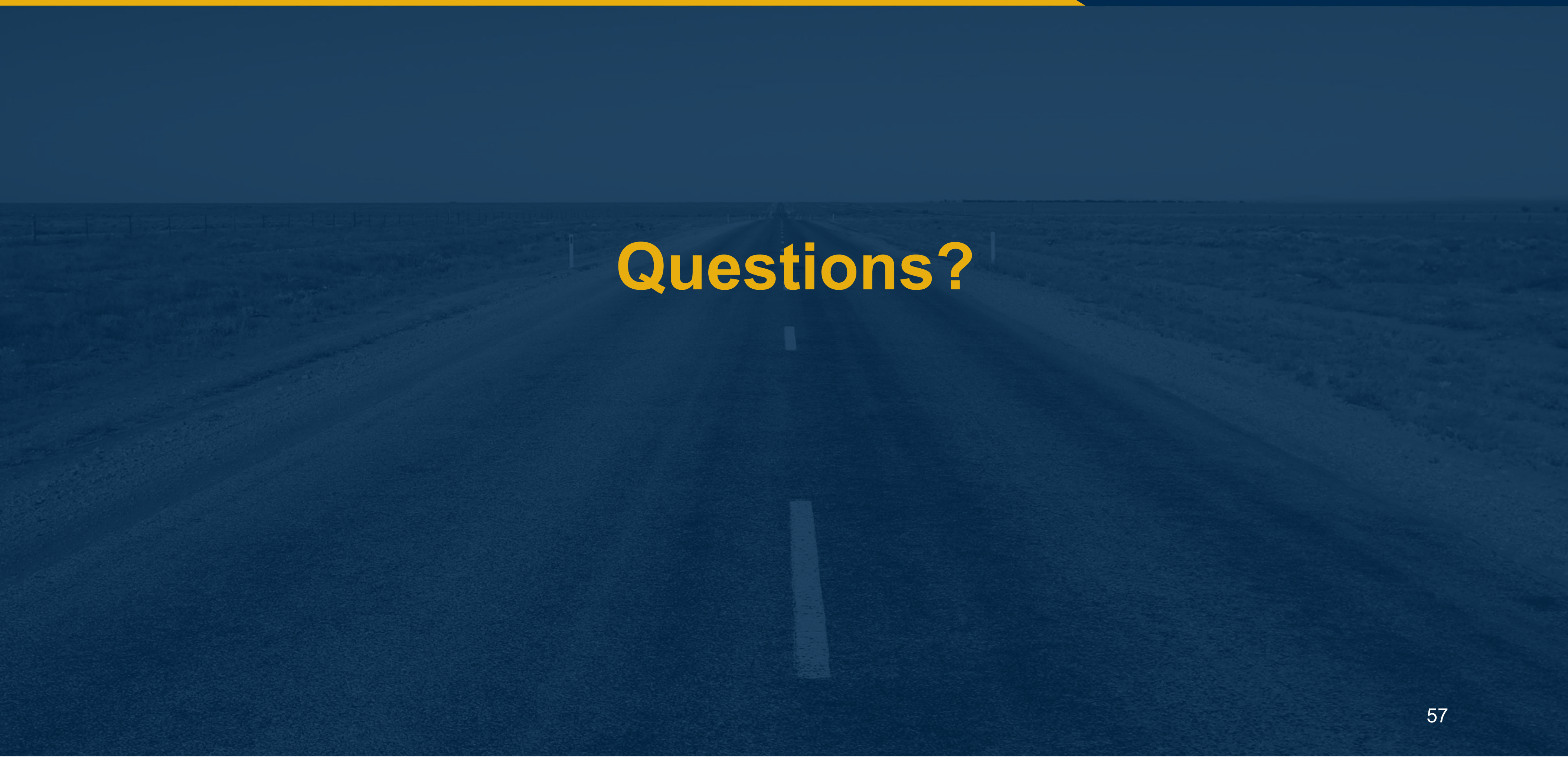
- **Methods that can be used to validate the collected data:**
  - establish a base line data set to compare with the collected data
  - request a set of data early in the data collection to enable the data quality to be checked.

Conclusions

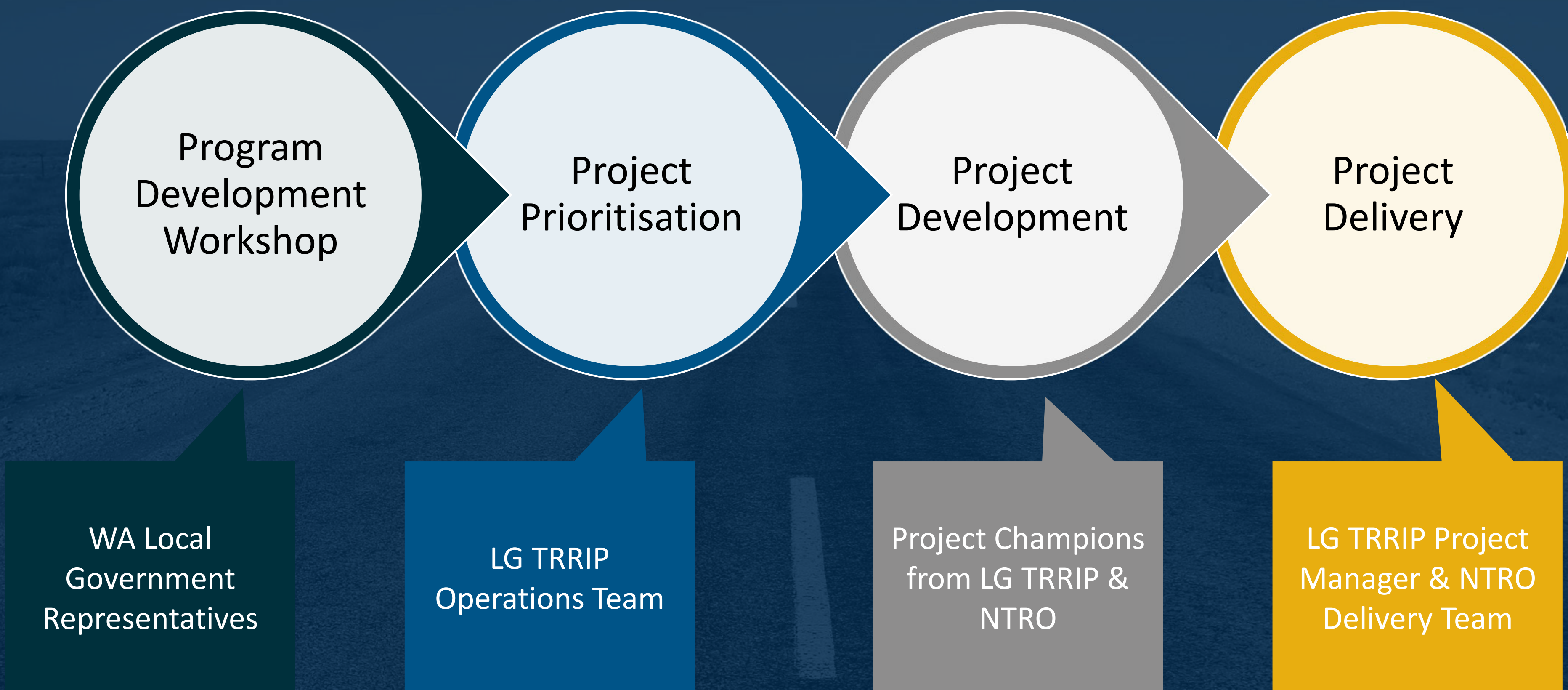
- **Technology has dramatically improved in recent years.**
- **Increasing number of suppliers, each intent on expanding their capabilities.**
- **Increasing range of detection of defects and asset types.**
- **Importance of setting up the in-house systems to enable integration of these semi-automated data sets.**
  - And need to improve data and systems skills and knowledge.
- **There is a reducing need for manual data collection.**

Closure

- Welcome and introduction to the project
- Needs and uses of data
- Data types: assets, defects, conditions
- Types of technologies
- Planning and specifying for data collection
- Q & A


Questions?

Program Development



How to get involved

LG TRRIP

Find out more on our websites

- ► warrip.com.au/lg-trrip/
- ► walga.asn.au/policy-and-advocacy/our-policy-areas/infrastructure/resources/lg-trrip

Nominate projects and get involved:

- ► warrip.com.au/lg-trrip/

Thank you!

Contact:

Mark Bondietti
WALGA
Mbondietti@walga.asn.au