Road Asset Management Systems

Session 2: Data Collection

Serge Cartier van Dissel
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Agenda

Day 1	Day 2
Session 1 **Introduction to RAMS**	Session 5 **RAMS Action Plan**
Coffee break	Coffee break
Session 2 **RAMS Data Collection**	Session 6 **RAMS Action Plan**
Lunch	Lunch
Session 3 **RAMS Data Management**	Session 7 **RAMS Institutionalization**
Coffee break	Coffee break
Session 4 **RAMS Data Analysis and Planning**	Session 8 **Conclusions and next steps**

Data

- A RAMS requires data
  - The data needs to be up-to-date (depends on type of data)
  - The data needs to be complete (entire network)
  - The data needs to cover the data types required for the function of the RAMS
  - The data needs to be reliable
  - The data needs to be sufficiently accurate for the function of the RAMS

Data collection

- Data collection is one of the weakest parts of any RAMS
  - Data collection costs money, time
  - New technologies reduce data collection costs
    - Automated traffic counters
    - Automated pothole and crack identification
    - LiDAR
    - Smartphone applications

- RAMS with missing/outdated data becomes useless
  - Especially condition data quickly becomes outdated

Data collection

- Keep data collection to a minimum
  - Avoid high data collection costs
  - Do not collect data unless you expect to use it
- Some data can be collected at no/little extra cost
  - Example: video data together with IRI survey data
  - Data processing still has a cost
- Balance data needs with collection costs

Network vs Project data

- RAMS is a network planning tool (general data for entire network)
  - Identify general needs and related costs
  - Prioritize allocation of available budget to specific roads or links
  - Propose future maintenance, rehabilitation and upgrading projects
  - Requires data for entire (sub-)network
  - Limit data to be collected to avoid high costs
  - Data collection may become more detailed as RAMS evolves and data collection technologies improve and become less costly

- Different from project planning (detailed data for few roads)
  - Project road (link) selected through network planning
  - Project preparation requires data only for the project road (link)
  - Requires more detailed data specific to the project
  - Collecting project data for entire network would be very costly – much of the data would not be used (only for project road links)

Data Accuracy

- More accurate data costs more to collect
  - More accurate data does not necessarily improve the results
  - IRI data can be collected through smartphone or laser profilometer
  - Technology improvements make more accurate data less expensive

- Information Quality Level (IQL)
  - IQL 1 = Research
  - IQL 2 = Detailed programme, project-level engineering (laser profilometer)
  - IQL 3 = Detailed network-level planning (bump integrator)
  - IQL 4 = General network-level planning, pavement performance (smartphone, visual)
  - IQL 5 = Network performance monitoring

- How accurate do we need the data to be?
  - High accuracy level IRI 3.64 = IRI 3.61-3.67
  - Medium accuracy level IRI 3.6 = IRI 3.3-3.9
  - Low accuracy level IRI 3 = IRI 2-4 (Good, Fair, Poor)

Data Reliability

- Data needs to be reliable
  - Keep data errors within the predefined accuracy
  - Poor reliability can reduce the level of accuracy by an unknown factor
- Calibration of survey equipment
  - High accuracy equipment can give wrong data if not properly calibrated
  - Roughness apps have very varying accuracies depending on the vehicle used
  - Use equipment in defined operating ranges
- Avoid human errors
  - Avoid manual copying of data – ensure automatic data imports
  - Avoid fatigue - assess surface distress from video instead of directly on the road
  - Ensure replicability of data collection – properly store all raw data
  - Check resulting data for errors or inconsistencies

Data types

- General data
- Inventory data
- Traffic (and accident) data
- Condition data
- Project/Contract data (past, ongoing, planned)

General data

- General data
  - Road code
  - Road name (start – end)
  - Administrative road class
  - Construction year
  - Last repaving year
  - Responsible management entity
  - Administrative divisions GIS data (province, municipality, oblast, state, district, etc.)
  - Population data (location, number, density, etc.)
  - Rainfall (by class)
  - City/Town/Village GIS locations
  - Background GIS data (maps, satellite photographs)
  - etc.

- Collected from secondary sources

Inventory data

- Road inventory
  - Length (start + end chainage)
  - GPS location (coordinates)
  - Surface type
  - Carriageway width
  - Number of lanes
  - Terrain class
  - Technical class
  - Shoulder width
  - Drainage type
  - etc.
- Collected through surveys
- Does not change rapidly

- Bridge inventory
  - Bridge type
  - Length
  - Width
  - GPS location
  - Chainage
  - Deck material
  - Number of spans
  - Abutment type
  - etc.
- Other structures
  - Culverts
  - Retaining walls
  - etc.

Traffic and accident data

- Traffic data
  - Number of vehicles per day
    - Preferably by vehicle class
  - Road (link) code
  - GPS location
  - Survey date
  - Survey type
  - Survey duration
  - Traffic category
  - etc.

- Collected through manual/ automated traffic counts
- For different roads or road links

- Accident data
  - Accident date
  - GPS location
  - Number of fatalities
  - Number of serious injuries
  - Type of accident
  - etc.

- Collected from traffic police?

Condition data

- Surface condition
  - Roughness (IRI)
  - Surface distress
    - Potholes
    - Cracking
    - Rutting
    - Edge break
    - Patching
    - etc.
  - Deflection
  - Gravel thickness
- Structure condition
  - Bridge condition
    - Deck
    - Abutment
    - Bearings
    - Beam
    - etc.
  - River/coastal protection condition
  - Culvert condition

- Collected through surveys
- Can change rapidly
- Either measured or as condition class

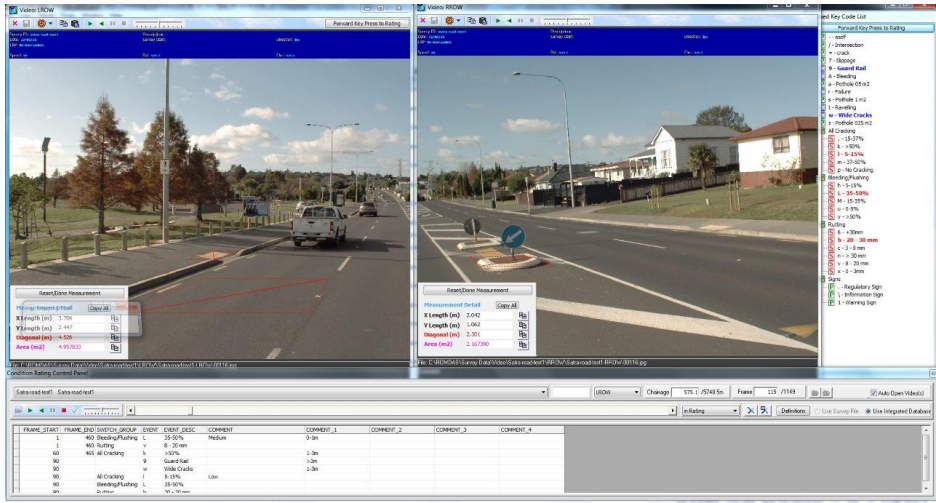
Project and Contract data

- Project/Contract data
  - Project/Contract code
  - Road (link) code
  - Location (start + end chainage)
  - GPS location (coordinates)
  - Treatment type(s)
  - Start/end date
  - Estimated cost/Contract price
  - Funding source
  - Contract documents
  - Contractor registration number
  - Contractor name
  - etc.

- Collected from planning or procurement unit

Video and Photo data

- Video and photo data can easily be collected as part of other surveys
- Important that it is georeferenced
  - Possible to indicate location on GIS map or Google Earth
- Allows for post-processing from the office
  - Inventory data (e.g. surface type, bridge, terrain category, etc.)
  - Condition data (e.g. surface distress, damages to structures)
  - Traffic data (e.g. moving traffic counts)
  - High replicability
- Use can be made of specific software for post-processing



Data needs overview

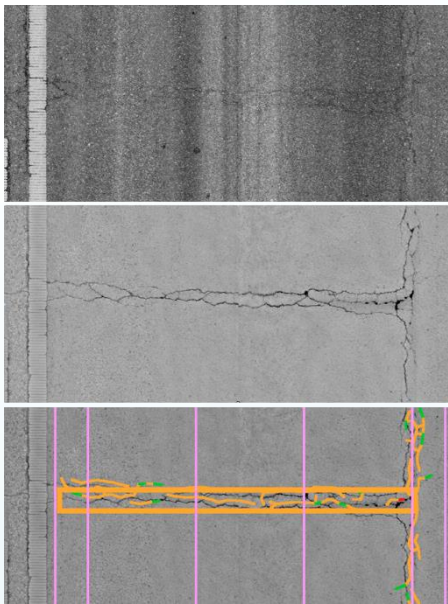
ROADS	TYPE	UNIT	SOURCE	REMARKS	FREQUENCY
Administrative class	Link	Category	DRBFC data, legal documents	A, C, D, E	5 years
Management entity	Link	Category	DRBFC data, legal documents	MPW/DRBFC, Municipality, Private	5 years
Municipality	Segment	Category	GIS administrative boundary data	Municipality list	5 years
Administrative Post	Segment	Category	GIS administrative boundary data	Administrative Post list	5 years
Suco	Segment	Category	GIS administrative boundary data	Suco list	5 years
Road code	Link	X##	DRBFC data, legal documents	Existing codes	5 years
Road name	Link	Text	DRBFC data, legal documents		5 years
Link code	Link	X##-##	DRBFC data, legal documents	Road code-two digit link number	5 years
Link name	Link	Text	DRBFC data, legal documents		5 years
Start name	Link	Text	DRBFC data, legal documents		5 years
Start chainage	Link	#+### m	ROMDAS odometer survey		5 years / After project
Start GPS coordinate	Link	X,Y,Z	ROMDAS GPS survey		5 years / After project
End name	Link	Text	DRBFC data, legal documents		5 years
End chainage	Link	#+### m	ROMDAS odometer survey		5 years / After project
End GPS coordinate	Link	X,Y,Z	ROMDAS GPS survey		5 years / After project
GPS track	Link	X,Y,Z	ROMDAS GPS survey		5 years / After project
Link length	Link	km (m)	ROMDAS odometer survey		5 years / After project
Terrain class	Segment	Category	ROMDAS video data post-processing	Flat, Rolling, Mountainous	5 years
Rainfall class	Segment	Category	Rainfall maps	<1000mm, 1000-2000mm, >2000mm	5 years
Technical class	Segment	Category	DRBFC data	R1,R2,R3,R4,R5,RR1,RR2, underclass	1-2 years / After project
Surface type	Segment	Category	ROMDAS video data post-processing, contract data	AC,PM,ST,CC,SM,GR,ER	1-2 years / After project
Pavement Class	Segment	Category	ROMDAS video data post-processing, contract data	Sealed, Unsealed	1-2 years / After project
Carrageway width	Segment	m	ROMDAS video data post-processing, contract data		1-2 years / After project
Number of lanes	Segment	#	ROMDAS video data post-processing, contract data		1-2 years / After project
Video data	Link	Video/GPS	ROMDAS video survey	.xls/.mp4	1-2 years
Roughness	100m	IRI	ROMDAS profilometer / ROMDAS bump integrator	For network analysis	1-2 years
Roughness survey date	100m	Date	ROMDAS profilometer / ROMDAS bump integrator		1-2 years
Surface distress class	Segment	SDI	ROMDAS video data post-processing	For network analysis	1-2 years
Surface survey date	Segment	Date	ROMDAS video data post-processing		1-2 years
Last treatment	Segment	Year	DRBFC data		1-2 years / After project
Last treatment	Segment	Contract	DRBFC data	Link to contract database	1-2 years / After project
Five Year Plan	Segment	Year	Five Year Plan	Year of planned works	5 years
BRIDGES	TYPE	UNIT	SOURCE	REMARKS	FREQUENCY
Bridge code	Point	X##-B##	Appoint	Based on road code+B+two-digit code	5 years / After project
Bridge name	Point	Text	DRBFC data		5 years / After project
River name	Point	Text	DRBFC data		5 years / After project
GPS location	Point	X,Y,Z	Bridge survey / ROMDAS video post-processing	Start of the bridge	5 years / After project
Chainage	Point	#+### m	Bridge survey / ROMDAS video post-processing	Start of the bridge	5 years / After project
Bridge type	Point	Category	Bridge survey / ROMDAS video post-processing	Beam,Arch,Truss,Suspension,Cable,Other	5 years / After project
Deck material	Point	Category	Bridge survey / ROMDAS video post-processing	Concrete, timber, steel	5 years / After project
Bridge length	Point	m	Bridge survey / ROMDAS video post-processing		5 years / After project
Bridge width	Point	m	Bridge survey / ROMDAS video post-processing		5 years / After project
Bridge spans	Point	#	Bridge survey / ROMDAS video post-processing		5 years / After project
Upstream protection	Point	Category	Bridge survey	None, Concrete, Stone masonry, Gabion	5 years / After project
Downstream protection	Point	Category	Bridge survey	None, Concrete, Stone masonry, Gabion	5 years / After project
Construction year	Point	Year	DRBFC data		5 years / After project

Data collection

- Different ways to collect the same or similar data
  - Depends on the required accuracy
  - Depends on how we will use the data – functions of the RAMS

- Example: potholes and cracking
  - Number and size of potholes or cracking
  - Degree of potholes or cracking (Low, Medium, High, Very High)

  - Manual survey in the field
    - Visual assessments from a vehicle
    - Measurements on the road itself - costly
  - Post-processing of video data
    - Visual assessment of categories based on forward-looking camera
    - Low accuracy measurements based on forward-looking camera
  - Automated data collection
    - High accuracy measurements based on downward-looking camera



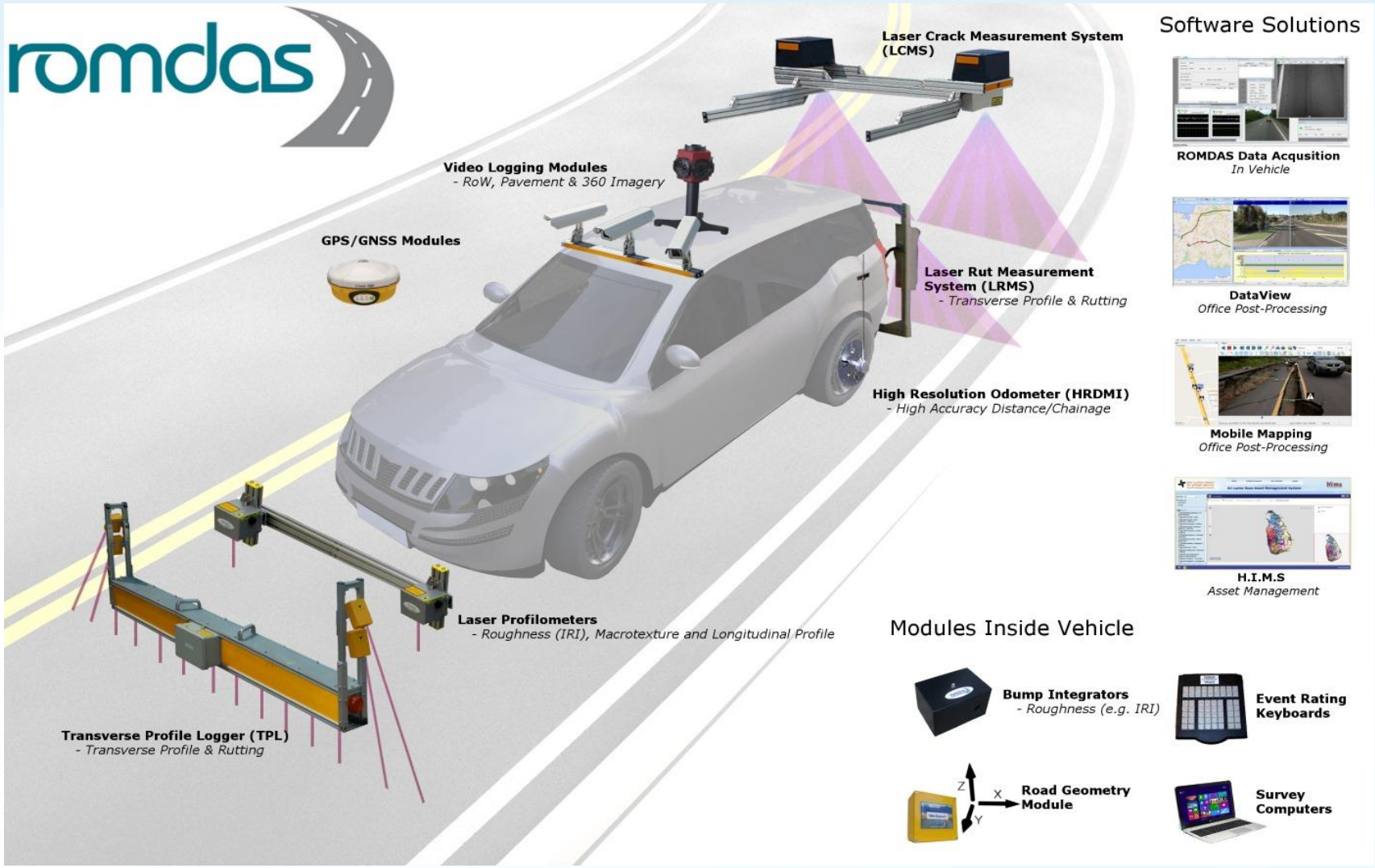
Combining data collection

- Different data types are often collected together
  - Using different equipment
  - During a single survey
  - This reduces data collection costs

- Not possible for all data
  - Some data can be collected in a drive-over survey
    - IRI data
    - Video
    - Road length
  - Some data requires stopping (and measuring)
    - Culvert data
    - Bridge abutment data
    - Falling Weight Deflectometer

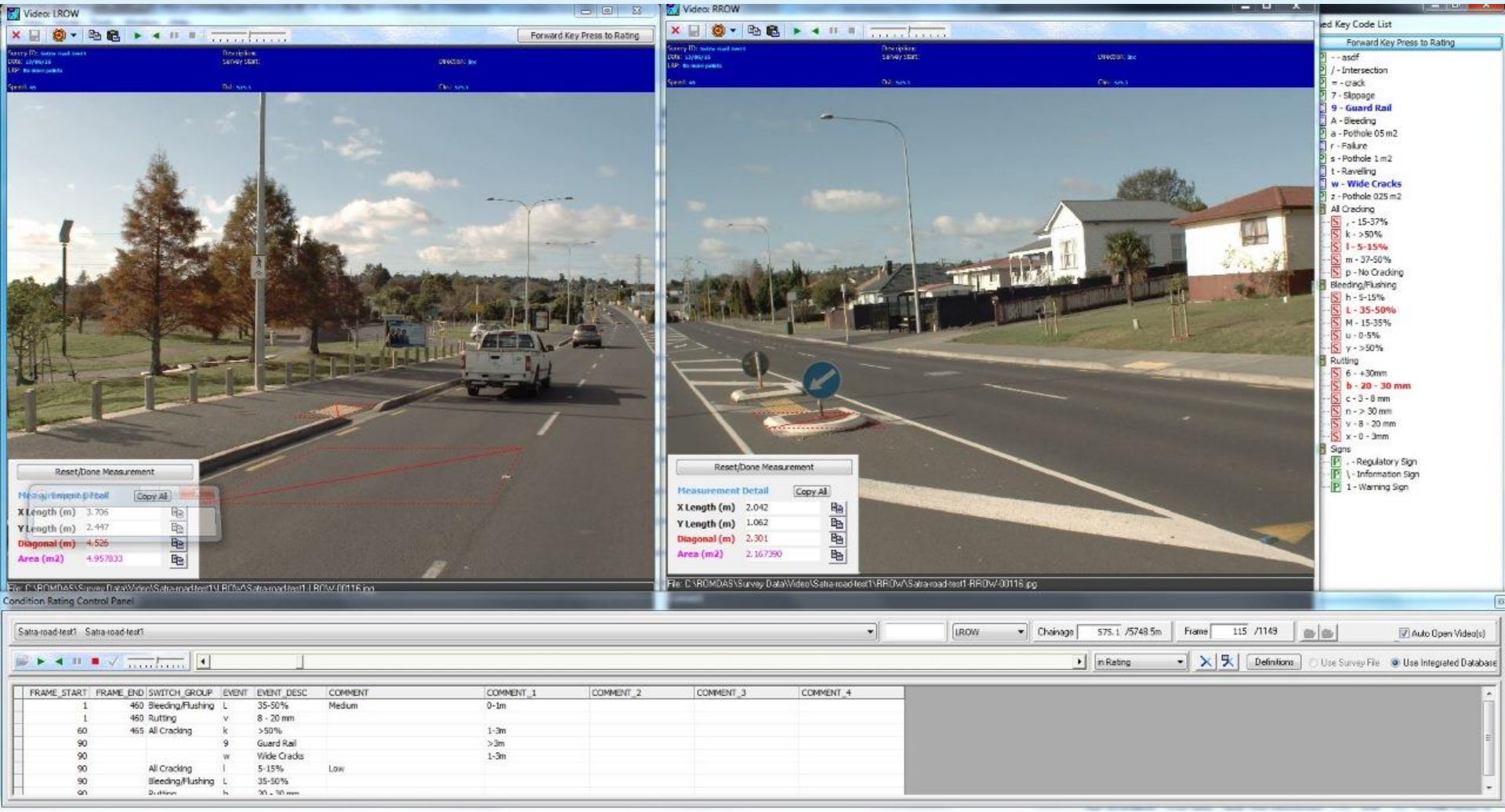
Example of survey equipment

- Example from ROMDAS – this is only one of many possible suppliers



Survey equipment Mongolia

Example of Post-Processing



Data collection timing

- Data generally collected after winter or rainy season
  - Most damage occurs during that season
  - Data remains up-to-date until next winter/rainy season
- Post-processing can be carried out throughout the year
- Data to be used for planning and budgeting
  - Needs to be aligned with budget submission / fiscal year
  - Take account of time required for data processing and analysis
- Generally a peak period for data collection
  - Few months each year
  - Depends on network size and portion to be surveyed each year
  - Depends on frequency of surveys

Example: Pakistan

ID	Task Name	2nd Quarter			3rd Quarter			4th Quarter			1st Quarter			2nd Quarter			3rd Quarte	
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
1	Data Collection				September 15					November 15								
2	Strategy and Programme Analysis							November 16			December 16							
3	Regional Stakeholder Consultations								December 17			January 16						
4	Detailed Project Level Appraisal									January 17			March 3					
5	Scrutiny by RMA Technical Scrutiny Party										March 4		March 10					
6	Review by the Steering Committee										March 11		March 17					
7	Approval by Chairman NHA and NHA Executive Board										March 18		April 2					
8	Convey of Approval to Regions												April 3					
9	Updation of Maintenance Contractors Enlistment											April 4		May 2				
10	Preparation of Detailed Tender Packages by Regional Offices										March 19		April 15					
11	Bids Invitation, Evaluation & Contract Awards											April 16				June 16		
12	Commencement and Completion of RMA Works		July 1													June 30		

Data collection frequency

- Inventory data
  - Only changes if road is damaged or improvements are made
  - Recording damages/improvements in RAMS will keep it up-to-date
  - Still need to update inventory data every 5-10 years
    - Entire network or only portion
    - Can be simple check of existing data – correct/add only where incorrect/missing
- Condition data
  - Changes rapidly – old data not useful
  - New data needs to be collected
  - Generally every 1-2 years for planning
    - May be longer period for low level roads (monitoring)
    - Less frequently for structures
- Traffic data
  - Can be adjusted based on general traffic growth
  - Still need to update traffic data every 5 years

Data collection frequency

- Lower frequency = Lower accuracy/reliability (data is outdated)
- Higher frequency = Higher cost

- Again the question is what accuracy is required
  - Programme analysis - Higher accuracy required to determine treatment for each road link
  - Strategy analysis - Lower accuracy required to determine mix of treatments for entire network

- Part of the network each year
  - Frequency of 5 years – 20% of the network each year to avoid big peaks in data collection
  - Alternatively combine all data collection to include it in a single contract

In-house or contracted out

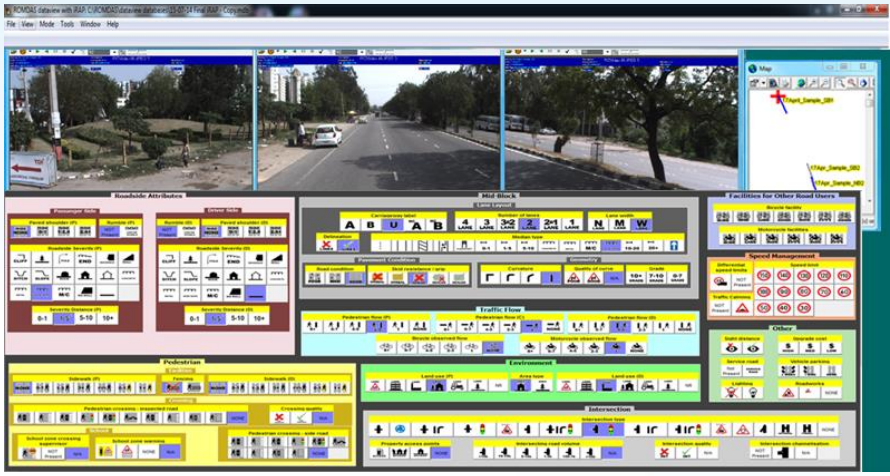
- Condition data collection has peak each year
- Inventory/traffic data collection has peak every few years

- Data collection by in-house staff has benefits
  - Develop specific skills particular to your system
  - Avoid procurement delays and other issues
- It also has drawbacks
  - What will in-house staff do between peaks? Can they be involved in other aspects of the RAMS and planning?
  - How to ensure budget for operation (fuel, per diems) and equipment repairs?

- Can certain data collection tasks be outsourced?
  - Does the capacity/equipment exist in-country?
  - How can quality be ensured?

Example: Georgia

- Data collection is done in-house
  - ROMDAS survey vehicle
    - GPS, odometer, 3 video cameras, laser profilometer
  - 2 mobile traffic counting stations
  - Operated by RAMS unit – 3 staff



- Data needs expected to increase
  - Road inventory (passportization)
  - Bridge Management System
  - iRAP assessments using video data

- Some data collection likely to be outsourced
  - Maintenance contractors already required to collect traffic data
  - Just data collection or also post-processing

Example: Timor-Leste

- No data collection carried out yet
  - ROMDAS survey vehicle used for contract performance monitoring
    - GPS, odometer, laser profilometer, bump integrator, (1 video camera, DataView software)
- Currently a RAMS is being developed
  - Requires data to operate
- WB to support data collection for national and municipal roads
  - Using the existing ROMDAS vehicle
    - Basic inventory and condition data
    - Post-processing of video data using DataView software (e.g. bridges, surface distress)
  - Providing fixed/mobile traffic counters to roads department for traffic counts
  - On-the-job training to government staff
  - Government staff to replicate in future years (RAMS unit, Maintenance Department)

Example: Pakistan

- Data collection initially done in-house by NHA staff
  - Using ROMDAS survey vehicle and Dynatest FWD trailer
  - Later additional equipment procured
- Subsequently data collection was outsourced
  - To private sector consultants
  - Survey equipment was provided by NHA
  - Operation and maintenance to be funded by consultant
- Now contracted out for 3-year periods
  - Updating of inventory, condition and traffic data
  - Entry into road database
  - Preparation of draft annual maintenance plans – finalization and approval still in-house by NHA

Example: Kyrgyz Republic

- Only recently started RAMS development
- Data collection carried out by Production Innovation Centre (PIC)
  - Self-supporting state institute under MOTC
  - Sign a contract with Road Maintenance Department under MOTC to survey roads
  - Entry of data into database
  - Initial analysis of data
- Final planning done by Road Maintenance Department
- Issues with regular funding of PIC
  - Lose staff and unable to invest in equipment

Data collection costs

- Equipment and software
  - Smartphone app: $500 (RoadLab) to $5,000 (RoadRoid)
  - ROMDAS equipment: $50,000-$75,000 (excluding vehicle)
  - Fully automated survey vehicle: >$200,000 (including vehicle)
  - Automated laser crack measuring system: $500,000 (excluding vehicle)
  - Light detection and ranging (LiDAR) system: $1,000,000 (excluding vehicle)
- Operation
  - Staff (driver + operator) + training
  - Per diems
  - Fuel (only one lane of road, or all lanes)
- Post-processing of data
  - Processing of video and other data
  - Data validation
- Maintenance
  - Vehicle servicing and spare parts
  - Equipment servicing and repairs/replacement (service licence)

Data collection

- What data to collect
- How to use that data
- How to collect it
- How often to collect it
- Who will collect it
- What resources are needed
- How to minimize the data collection needs/costs