Road Asset Management Systems (RAMS)
+
Performance-Based Contracting (PBC)

Session 2.2: RAMS Integration

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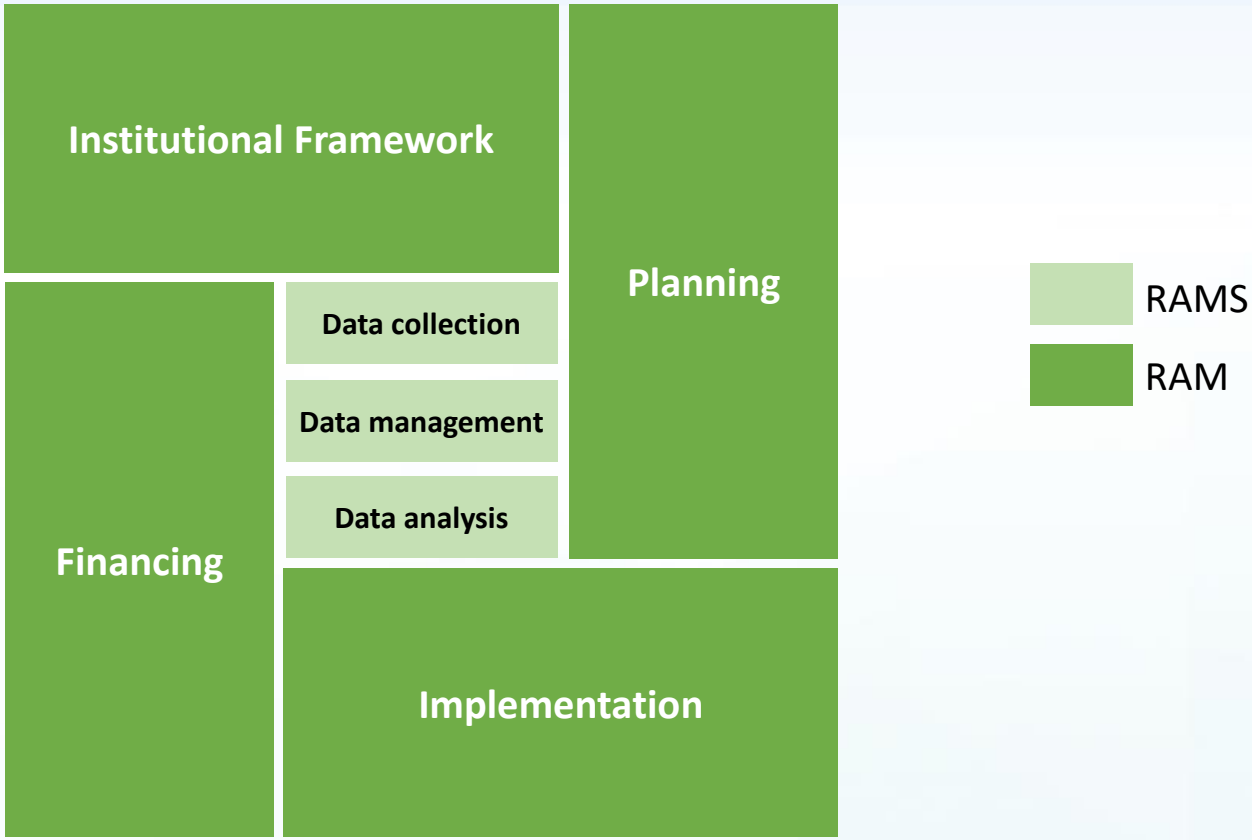
Agenda

Day 1 Road Asset Management System (RAMS)	Day 2 Road Asset Management System (RAMS)	Day 3 Performance Based Contracting (PBC)
Session 1.1 RAMS Introduction	**Session 2.1 RAMS Data Management & Data Analysis**	**Session 3.1 PBC Introduction & Performance Standards**
Break	Break	Break
Session 1.2 RAMS Data Collection	**Session 2.2 RAMS Integration**	**Session 3.2 PBC Inspections & Payments**

Road Asset Management (System)

- **Road Asset Management System**: Any system that is used to collect, manage and analyze road data for road planning and programming purposes
- **Road Asset Management**: Integration of the RAMS into the institutional framework, planning procedures, financing systems and implementation modalities



Institutional Framework

- RAMS Unit
  - Small dedicated group of fixed full-time staff working on the RAMS
  - Not part-time, not large working group
  - Generally under Planning Department or Section
  - As a separate unit or team

- Minimum 3 people
  - Data collection and validation expert
  - Database and pavement management system expert
  - GIS expert
  - Roles to be shared depending on workload and needs over the year

- Size depends on functions
  - Size of network and types of data to be collected
  - Whether some functions are outsourced or not

Data collection

- Outsourcing of data collection
  - Some data collection outsourced (contractors, consultants)
  - May include post-processing (e.g. of video data)
  - Depends on quantity of data and collection methods
  - More common with data collected every few years (inventory, traffic data)

- In-house data collection
  - Some data collected in-house (by RAMS Unit or regional/local offices)
  - Data that is collected every year (condition data)
  - Data that is available in-house or from other units (e.g. from toll stations)

- RAMS Unit to coordinate data collection
  - Prepare contracts for data collection
  - Check that all required data is collected
  - Check that collected data is in order

Data management

- Data validation and processing
  - May be outsourced together with data collection
  - Will need to be verified by in-house RAMS unit

- Data management (database)
  - Database maintenance and support may be outsourced (especially IT side)
    - Cloud-based, remotely accessible, part-time support service
  - RAMS operation generally in-house (data side)

Data analysis

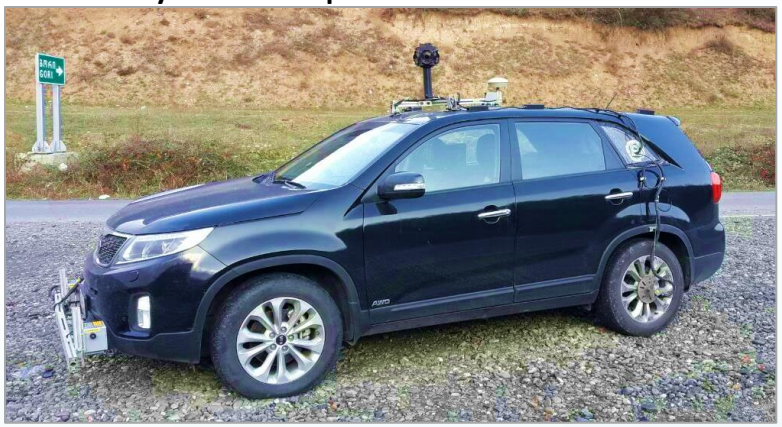
- Generally done in-house (RAMS unit)
  - Allows for back-and-forth, adjusting runs to incorporate other criteria
  - Should have strong linkage with planning unit

- May be supported by consultants
  - e.g. HDM4 strategy analysis every 5 years as basis for decision matrix

Example: Georgia

- RAMS Unit
  - 3 fixed staff (supported by consultant for RAMS development)
  - Part of Planning & Operations Unit (formerly separate RAMS Unit)

- Data Collection
  - Pavement condition every year by RAMS Unit – ROMDAS vehicle surveys
  - ROMDAS vehicle also used for construction quality control
  - Traffic counts outsourced to routine maintenance contractors (24 zones)
  - Inventory data and bridge data to be outsourced – beyond scope of RAMS staff



- Data management
  - RAMS staff (ArcGIS)

- Data analysis
  - RAMS staff (ArcGIS + HDM4)
  - In coordination with Planning and Operations Unit and management staff

Example: China (Yunnan Province)

- Yunnan Province Highway Research Institute
  - Own a highly-automated survey vehicle
  - Second vehicle rented and later purchased

- Data collection
  - Outsourced to Highway Research Institute
  - 46,000 km in 2009 (multiple lanes)
  - Many organizations now have such vehicles, allowing for competitive bidding
- Data management
  - Outsourced to Highway Research Institute
  - Using China Pavement Management System (CPMS)
- Data analysis
  - CPMS analysis module not purchased
  - HDM4 used with ADB support – through Highway Research Institute

Example: Pakistan

- Road Asset Management Directorate
  - Under National Highway Authority
- Data collection
  - In-house by RAMD
  - ROMDAS survey vehicle (bump integrator, laser profiler, GPS, odometer)
  - Dynatest trailer (Falling Weight Deflectometer)
- Data management
  - In-house by RAMD
- Data analysis
  - In-house by RAMD
  - HDM4 used

Planning Procedures

- RAMS analysis has to fit into existing planning procedures

- Timing of data collection, processing and analysis important
  - Results need to be ready in time for budgeting
  - Not always appropriate timing with regard to seasons

- Results of the data analysis need to form basis of planning
  - Data analysis is not the same as planning
  - It is the basis for the subsequent planning process
  - Planning takes into account other criteria and priorities
  - Resulting plan should not deviate too much from the data analysis
  - e.g. Georgia plans include approximately 80% of HDM4 prioritized roads

Planning Procedures

- Data analysis goes further than just planning and budgeting

- Show total needs
  - RAMS can be used to determine the complete needs for the network
  - Not just the current year budget usage
  - Decision support system for longer-term budget allocation priorities

- Predicting road network conditions
  - RAMS can help predict the road conditions to be achieved with the expected budgets
  - Can go up to 20 years, but generally 5-10 years

- Assessing different budget scenarios
  - RAMS can show the impact of higher/lower budgets on road conditions
  - Important tool in budget negotiations with Ministry of Finance

Financing Systems

- Implementing the proposed plan depends on financing
- RAMS analysis can be used to justify (higher) budget allocations
  - Show linkage between budget and achievable road network conditions
- RAMS data can also be used to evaluate other funding mechanisms
  - Concessions
  - Road User Charges (RUC)
- For maintenance road user charges are often used

Road User Charges

- RUCs earmarked for road repair and maintenance
  - Fuel tax or levy (China)
  - Vehicle importation fees or taxes (Timor-Leste)
  - Annual vehicle registration fees / Road tax (Zambia, Netherlands)
  - Transit fees (Zambia)
  - Tolls (Kazakhstan, Pakistan)
  - Heavy vehicle surcharges / Weighbridge fees and fines (Zambia)

- Access-based or usage-based
  - One-off payment to access the road network
  - Payment according to level of usage of road network

- RUC revenue well-suited to maintenance
  - User-pays principle
  - Predictable funding
  - Revenue increases with road usage and vehicle ownership

Road Fund

- Revenue from RUCs often earmarked to Road Fund
  - Road Fund receives revenue from RUCs and other sources
  - Road Fund allocates funding to road authorities
    - National road authority
    - Local road authorities
    - Often according to fixed criteria (percentage, network length, etc.)

- Some countries apply same concept without Road Fund
  - Simple bank account managed by road authority
  - Receives RUC revenue based on parliamentary approval of the budget

- RUC revenue as part of general budget
  - (Partly) allocated to road maintenance and improvement as part of general budget

Road Funds in the CAREC region

Country	Road maintenance financing
Afghanistan	Road Fund Unit (planned)
Azerbaijan	Road Fund (restored in 2007)
China	Fuel tax through General Budget
Georgia	General Budget
Kazakhstan	General Budget (tolls)
Kyrgyz	Road Fund (created in 1998 but not used)
Mongolia	Road Fund (but very low revenue)
Pakistan	Road Maintenance Account
Tajikistan	General Budget (Road Fund abolished in 2000)
Turkmenistan	General Budget
Uzbekistan	Regional Budget (Republican Road Fund abolished)

Example: Zambia

- National Road Fund Agency
  - Receives RUC revenue ($200 million in 2018)
    - Fuel levy, toll revenue, transit fees, weigh bridge fees and fines, road taxes and licences
  - Receives general budget allocations and domestic loans ($160 million in 2018)
  - Receives funding from donors ($320 million in 2018)

- Funds managed by National Road Fund Agency
  - Road Development Agency 60%
  - Local road authorities (rural roads) 25%
  - City councils (urban roads) 15%

- Funds mainly used for upgrading and rehabilitation, insufficient funding for maintenance
  - Currently push to use RUC revenue only for maintenance

Example: Pakistan

- Road Maintenance Account (RMA)
  - Simple bank account created by Ministerial Notification
  - Budget allocations from general budget - mainly financed from RUCs
  - Budget allocations largely follow needs as defined by RAMS
- Only used to fund national highways
  - States are pushing to have some roads reclassified as national highways
- National Highway Agency
  - RMA managed directly by NHA
- Used specifically for maintenance (mainly periodic maintenance)

Example: China

- Fuel tax introduced in 2009
  - Replaced existing RUCs
    - Class II highway tolls
    - Vehicle maintenance fee
    - Farm vehicle and motorcycle maintenance fee
  - Collection costs greatly reduced

- Revenue increased significantly with fuel consumption
  - Flows into state budget, allocations as part of annual budget

- Revenue used for maintenance, rehabilitation and development
  - 20% for highway maintenance (by provinces)
  - Fixed allocations to local authorities for local roads (based on 2007 revenue)
    - Cofinancing from local authority revenues
  - Large portion used for development

Implementation modalities

- RAMS economic analysis introduces shift in type of works
  - Prioritizes maintenance of good/fair roads over rehabilitation of poor roads
  - Limits upgrading to roads where this is economically justified

- Much more emphasis on maintenance works
  - Increased attention to routine maintenance
  - Significant increase in length of periodic maintenance
    - In Pakistan 59% of the maintenance budget was spent on periodic maintenance in 2015
  - Complementary need for emergency maintenance

- This requires
  - Contracting (or in-house) capacity to implement the maintenance works
  - Contracting modalities suitable for maintenance contracting

Contracting capacity

- Many countries lack maintenance experience
  - Especially periodic maintenance
- This capacity needs to be developed
  - Training of contractors/in-house units
  - Gradual increase in size and complexity of contracts

Example: Pakistan

- Capacity gradually developed
  - Introduction of HDM4 resulted in significant increase in periodic maintenance
  - Contractors lacked experience and suitable equipment for maintenance
  - Difficulties implementing the planned works

- Over time, contractors have gained experience
  - Currently many contractors with experience and equipment
  - Competitive bidding of maintenance works

Example: Kazakhstan

- Routine maintenance carried out by Kazakhavtodor
  - Including patching
  - Sole-sourced
  - Routine repair (repaving short sections) and periodic maintenance (repaving long sections) through competitive bidding

- Focus is on routine maintenance
  - 1 million square metres of patching in 2017
  - Many roads that require periodic maintenance are being patched
  - Inefficient use of funding

- Periodic maintenance very limited
  - 5% of road network length in 2014 – once every 20 years
  - Expected to increase significantly with introduction of RAMS

Contracting modalities

- Three main contracting modalities

- Input-based
  - Payment according to inputs (time, materials, etc.)
  - In-house force account units

- Output-based (volume-based)
  - Payment according to volume of work completed
  - Traditional Bill of Quantities contracts

- Outcome-based (performance-based)
  - Payment according to resulting condition/standard
  - Lumpsum payments with deductions in case of poor performance

Contracting modalities

- Volume-based contracts not suitable for routine maintenance
  - Incentive to let damages increase in size – greater work volume and payment
  - High management burden to approve and measure completed works
  - Risk of insufficient volume and additional costs beyond contract price

- Performance-based contracts more suitable
  - Incentive to repair damages when they are still small
  - Management burden reduced to performance inspections (sampling)
  - Fixed payments that can only go down

Contracting modalities

- Periodic maintenance / rehabilitation
  - Large, pre-defined work volumes, implemented in short period
  - Generally paid on volume-basis
  - Increasingly paid as outcome-based lumpsum with predefined standards
  - At start of contract or when trigger is reached – agreed length of road

- Routine/winter maintenance
  - Small, roughly estimated work volumes, implemented over extended period
  - Generally paid on performance basis
  - Payment based on resulting condition (deductions in case of poor performance)
  - Activities that are difficult to predict are paid on volume basis or additional payments (e.g. snow removal)

- Emergency maintenance
  - Small-large, unpredictable work volumes, implemented in short period
  - Generally paid on volume basis
  - Often included as provisional sum
  - Avoids need for lengthy procurement – simple issuing of work order
  - Only damages of limited size

Road Asset Management Plan

- What we want to achieve with RAMS in next 5 years (by year)
  - Data collection
  - Data management
  - Data analysis
  - Integration into the Institutional Framework
  - Integration into the Planning Procedures
  - Integration into the Financing System
  - Integration into the Implementation Modalities

- What this will cost (funding, staff, equipment)
- How this will be funded
- Who will lead/coordinate this

Example: Timor-Leste

	2020	2021	2022	2023	2024
RAMS Unit	• RAMS Unit created and staffed (DRBFC) • RAMS unit trained in data collection and processing (WB/R4D)	• Funding allocated to RAMS Unit ($20,000 OGE or RMF) • On-the-job training RAMS unit in data collection and processing (ADB) • RAMS unit trained in data analysis (ADB) • PD+MD trained in planning using RAMS (ADB)	• Funding allocated to RAMS Unit ($25,000 OGE or RMF) • On-the-job training of RAMS unit and PD+MD in RAMS operation (ADB)	• Funding allocated to RAMS Unit ($55,000 OGE or RMF) • On-the-job training of RAMS unit and PD+MD in RAMS operation (ADB) • Training of RAMS unit and PD+MD in FYP preparation (ADB)	• Funding allocated to RAMS Unit ($30,000 OGE or RMF)
Data collection	• Road data (inventory, condition and traffic) collected for all national and municipal roads (2,250km/$400,000/WB) • Road data (inventory, condition and traffic) collected for all core rural roads (1,975km/R4D)	• Bridge data collected (inventory and condition) for all national and municipal roads ($50,000/ADB) • Road condition data collected for national roads (500km/$10,000/DRBFC)	• Road condition data collected for national and municipal roads (1,000km/$15,000/DRBFC)	• Road + bridge inventory data collected for improved road segments (500km/$20,000/DRBFC) • Traffic data collected for important road links (500km/$5,000/DRBFC) • Road condition data collected for national, municipal and rural roads (1,500km/$20,000/DRBFC)	• Road condition data collected for national, municipal and rural roads (1,500km/$20,000/DRBFC)
Data management	• Data processed and entered into RAMS (DRBFC with WB/R4D support)	• Data processed and entered into RAMS (DRBFC with ADB support)	• Data processed and entered into RAMS (DRBFC with ADB support)	• Data processed and entered into RAMS (DRBFC with ADB support)	• Data processed and entered into RAMS (DRBFC)
Data analysis and planning	• Initial data analysis for national and municipal roads (WB using HDM-4) • Data analysis for updating Rural Road Master Plan (R4D)	• RAMS used as basis for 2022 budget request (DRBFC with ADB support) • Publish Annual Report 2020 (DRBFC)	• RAMS used as basis for 2023 budget request (DRBFC with ADB support) • Publish Annual Report 2021 (DRBFC)	• RAMS used in preparation of FYP 2024-2028 (DRBFC with ADB support) • RAMS used as basis for 2024 budget request (DRBFC with ADB support) • Publish Annual Report 2022 (DRBFC)	• RAMS used as basis for 2025 budget request (DRBFC) • Publish Annual Report 2023 (DRBFC)

Example: Tajikistan

	2020	2021	2022	2023	2024
RAMS Unit	• Creation of Road Asset Management Unit (MOT) • Procurement of RAMS Consultant for 3-4 years ($1,000,000 – MOT)	• Procurement of equipment for RAMS Unit ($20,000* – Consultant) • Training of RAMS Unit and relevant MOT departments (Consultant)	• Continued training of RAMS Unit and relevant MOT departments (Consultant)	• Continued training of RAMS Unit and relevant MOT departments (Consultant)	• Provision of operational budget to RAMS Unit (MOT)
Data collection	• Procurement of road survey equipment and vehicle ($170,000* – Consultant)	• Data collection for portion of international roads (2,000 km – Consultant)	• Data collection for all international and republican roads (5,500 km – Consultant/RAMS Unit)	• Data collection for all international, republican and local roads (14,000 km – RAMS Unit/Consultant)	• Data collection for 100% of international roads, 50% of republican roads and 35% of local roads (7,500 km, $30,000** – RAMS Unit)
Database management	• Assessment of existing database (Consultant)	• Development and testing of improved road database (Consultant) • Validation, processing and entry of collected data (Consultant)	• Finalization of improved road database (Consultant) • Validation, processing and entry of collected data (Consultant/RAMS Unit)	• Validation, processing and entry of collected data (RAMS Unit/ Consultant)	• Validation, processing and entry of collected data ($10,000** – RAMS Unit)
Data analysis /planning	• Procurement of pavement management software licenses ($10,000* – Consultant)	• Assessment of existing algorithms and pavement management software (Consultant)	• Preparation of rolling 5-year and annual work programme for international and republican roads (Consultant/RAMS Unit)	• Preparation of rolling 5-year and annual work programme for all roads (RAMS Unit/Consultant)	• Preparation of rolling 5-year and annual work programme for all roads ($10,000** – RAMS Unit)
Maintenance financing		• Assessment of existing road user charges in Tajikistan (Consultant)	• Estimation of required funding levels for road maintenance (Consultant) • Allocation of road user charges to road maintenance (MOT/MOF)	• Preparation of priority tolling projects (Consultant/MOT) • Presentation of options for Road Maintenance Fund (Consultant)	• Priority tolling projects approved (MOT/MOF) • Creation of dedicated Road Maintenance Fund (MOT/MOF)

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

Data collection

- 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)

- Operation
  - Staff (driver + operator) + training
  - Per diems
  - Fuel (only one lane of road, or all lanes)

- Maintenance
  - Vehicle servicing and spare parts
  - Equipment servicing and repairs/replacement (service licence)

Data management

- Who will validate and process data
- What type of database we need (initially)
- Who will manage and operate the database
- Who can access data and how
- What in-house skills we need

Data management

- Equipment and software
  - Excel/Access: $10,000+ (including costs for developing structure)
  - Off-the-shelf: ROMDAS HIMS
    - Desktop $80,000-$250,000
    - Enterprise: $200,000-$750,000
    - Web version: $500,000-$1,250,000
    - Cloud version: $2,500-$7,500 per month
  - Custom-made: >$250,000
  - Server, computers, network equipment, printers, plotters
- Operation
  - Staff + training
  - Operational expenses (paper, ink, internet, etc.)
- Maintenance
  - Servicing and adjustments to software (service license)
  - IT staff

Data analysis

- What prioritization criteria to use
- How to combine the different prioritization criteria
- Use a detailed or basic analysis
- Have an integrated/separate analysis function

Data analysis

- Equipment and software
  - Off-the-shelf HDM4 $4,000-$5,000 per license
  - Custom made Depends on complexity
- Operation
  - Staff + training
  - Operational expenses (paper, ink, internet, etc.)
- Maintenance
  - Service license for off-the-shelf software/equipment
  - Service contract for custom-made software/equipment

Group Work

- What are the next steps in further developing the RAMS?
- What is the timeframe for doing so?
- What institutional set-up will we use for the RAMS?
- How will the RAMS fit into existing planning procedures?
- What funding will be applied to prioritized maintenance works?
- How can we develop the capacity to implement the prioritized works?
- What kind of support is required (from development partners)?

Road Asset Management Plan

	2021	2022	2023	2024	2025
RAMS Unit					
Data collection					
Data management					
Data analysis and planning					