Road Asset Management Systems
+
Performance-Based Contracting

Session 3.3: Inspections and Payments

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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 **Introduction to RAMS**	**Session 2.1** **Data processing and management**	**Session 3.1** **Introduction to PBCs**
Coffee break	Coffee break	Coffee break
Session 1.2 **Functions of a RAMS**	**Session 2.2** **Data analysis and planning**	**Session 3.2** **Performance standards**
Lunch	Lunch	Lunch
Session 1.3 **Data to be collected**	**Session 2.3** **Road asset management**	**Session 3.3** **Inspections and Payments**
Coffee break	Coffee break	Coffee break
Session 1.4 **Method of data collection**	**Session 2.4** **Conclusions and way forward**	**Session 3.4** **Conclusions and way forward**

Inspections and Payments

- Inspections
  - To check compliance with the performance standards
- Payments
  - Based on inspection results
  - Payment deductions in case of non-compliance

Inspections

- Formal Inspections
  - Monthly inspections (frequency can be reduced at later stage)
  - Together with contractor representative
  - Basis for payments and deductions

- Informal Inspections
  - At any time
  - Contractor may be informed of any identified defects
  - Generally do not influence payments

- Exception for certain important performance standards
  - Urgent defects (e.g. accidents, landslides)
  - Penalties can be applied during informal inspections
  - Usually linked to response times (time to open up the road)

Formal Inspections

- Full inspection of contracted road length
  - All non-compliance recorded for entire road
  - Basis for calculating payment
  - Often applied when PBCs are introduced (pilot)

- Inspection of sample of contracted road length
  - All non-compliance recorded for sample road sections
  - Used to calculate payment for entire contracted road length
  - Sampled sections change each month – random selection

- Contractor required to submit performance report
  - Spot checks to verify accuracy of report
  - Results from spot check and report used to calculate payment
  - Errors in performance report may result in additional payment deductions

Carrying out inspections

- In-house
  - Inspections are carried out by road department staff
  - Often staff from regional/provincial offices
  - Requires sufficient numbers and capacities of staff
- Contracted
  - Supervision consultant responsible for inspections
  - Inspection reports are reviewed by road department staff
  - Some inspections are audited to confirm quality
- Performance compliance easily checked
  - Performance standards remain the same – compliance can be checked at any time
  - Either as formal inspection, informal inspection or audit inspection
- Inspections cost money – reduce the number and duration of inspections
  - High relative cost compared to routine maintenance costs

Response Times

- Some PBC contracts include response times
  - Period within which a contractor must repair a defect after identification
- Contractors no longer proactively identify and repair defects
  - Contractors wait until defects are identified by inspectors before repairing them
  - This way they only repair what is needed to receive the full payment
  - Defects that are not identified during inspection are not repaired
  - Requires full inspections of the entire road length to ensure compliance
- Response times undermine the PBC concept
  - This takes away the responsibility for road management from the contractor, and places it back with the employer
  - Additional inspection visits are required to check that identified defects have been repaired within the defined response time

Example: Tajikistan

Performance standards	Threshold	Response time
1.1 Road shall be open to traffic at all times with maximum interruption of:	24 Hours	2 days
2.1 Average Safe Operating Speed from beginning to end of the Road Section	60 km per hour (1 minute per km)	28 days
2.2 Potholes on road surface >10 cm in any dimension	No potholes > 0.5 m2 or < 5 smaller potholes in any 1 km section	7 days
2.2a Maximum size of any pothole on the paved road surface	0.5 m2	7 days
2.3 Potholes on shoulder > 15 cm in any dimension	< 15 potholes in any 1 km section	14 days
2.4 Vegetation on road formation including shoulders, medians and traffic islands	No vegetation >0.5 m tall in any 1 km section	14 days
2.5 Vehicles, soil, rock or other debris that compromises safety	Roadway clear and no material < 0.5 m outside of pavement edge in any 1 km section	8 hours
2.6 Vehicles, soil, rock or other debris not compromising the safety of road users	No unsightly material on/in pavement, shoulder or drainage facilities in any 1 km section	28 days
2.7 Road Signs are present, clean, visible and undamaged	No tolerance allowed	14 days
2.8 Pavement Markings	All markings visible at 100 m	28 days
2.9 Existing Guardrail	No section missing and/or damaged in any 1 km section	28 days
2.10 Guide Posts and guide barriers	Present, clean, visible and undamaged in any 1 km section	28 days

Example: Georgia

Defect Type		Performance Indicator		Threshold	Penalty
Performance Indicators, non-compliance results in 100% penalty		1	Potholes, diameter	>20 cm	
		1.1	Potholes and/or Edge breaks amount	>5 units	100%
		2	Drop-off; Height difference	>75 mm	100%
		3	Missing Traffic Sign related to Safety Element	1 unit	100%
		4	Missing Guardrails and parapets providing emergency safety measures	1 unit	100%
Pavement	Potholes, Edge Break	1	Potholes, diameter	≤20 cm	10%
		1.1	Potholes, Edge breaks amount	≤5 units	
		1.2	Edge Break, maximum width allowed	>75mm	
		1.3	**Response time, potholes and edge break**	**10 days**	
	Cracking	2	Cracks, maximum width allowed	5 mm	6%
		2.1	**Response time-Crack sealing >5 mm**	**2 days**	
	Rutting	3	Rutting, maximum depth allowed	30 mm	6%
		3.1	**Rutting >30mm Response Time**	**30 days**	
	Raveling	4	Ravelling on the sections rehabilitated under this project	0 m^2	5%
		4.1	Ravelling on the maintenance sections	>5% m^2	
		4.2	**Ravelling - Response Time**	**30 days**	
Shoulders	Cleanliness	5	**Cleanliness of road carriageway and shoulders when safety hazard. Response time**	**12 hours**	8%
		6	**Cleanliness of road carriageway and shoulders when no safety hazard. Response time**	**10 days**	
	Drop-off	7	Drop-off; Height difference pavement vs shoulders > 25mm and < 75mm acceptable length/km	100 m	8%
		7.1	**Drop-off; Response time: Excess length with drop-off > 25mm and < 75mm**	**15 days**	
Drainage	Ditches	8	**Road side ditches and lined drains. Response time when damaged/blocked**	**3 days**	6%
		9	**Other ditches. Response time when standing water**	**7 days**	
	Culverts	10	**Response time to culverts requiring cleaning or repair**	**30 days**	6%

Example: Georgia (continued)

Defect Type		Performance Indicator		Threshold	Penalty
Road side	Vegetation Control	11	Up to 3m from road edge Maximum Height Vegetation	20 cm	5%
		11.1	**Response time - Vegetation Control**	**5 days**	
Safety	Signs	12	Road signs	0 defects	10%
		12.1	**Response time - damaged signs; No safety element**	**30 days**	
		12.2	**Response time - damaged signs; Safety element - May be Temporary replacement**	**1 days**	
	Guardrails and parapets	13	Guard Rail and parapets- true to line and level, undamaged, rust free, paint in good order	0 defects	10%
		13.1	**Response time – Guardrails and parapets - provide emergency safety measures**	**2 days**	
		13.2	**Guard rails and parapets. Response time - Permanent repairs**	**14 days**	
	Road Markings	14	Traffic markings, visibility	70 %	8%
		14.1	**Traffic markings - Response time, restore to 100%**	**60 days**	
Structures	Retaining Walls	15	**Retaining walls; Structural damage of instability**	**60 days**	3%
		16	**Retaining walls; Damage or blockage to drainage**	**15 days**	
	Bridges	17	Bridge Bearings and Expansion Joints; Free of dirt and debris; Properly sealed; Free draining; River Beds	-	3%
		17.1	**Response time - Expansion Joints and River Beds**	**30 days**	
	Steel Structures	18	Steel structures - Sound, safe and Corrosion free; paint in good condition	-	3%
		18.1	**Response time - Steel Structures minor repairs to structure or paint**	**14 days**	
		18.2	**Response time - Steel Structures major repairs to structures or paint**	**90 days**	
	Concrete Structures	19	Concrete structures - Free of damage, no spalling, no exposed reinforcement, no signs of rebar corrosion	-	3%
		19.1	**Response time - Concrete Structures Minor Repairs**	**14 days**	
		19.2	**Response time - Concrete Structures Major Repairs**	**60 days**	

Response Times - Alternatives

- Instead of response times, apply immediate deductions
  - Forces contractor to repair defects before the inspection (when they occur)
  - Apply to defects that grow gradually before exceeding threshold (e.g. potholes)
    - Maximum 5 potholes/km < 30 cm, no potholes > 30 cm
  - Does not work for damages that occur suddenly (e.g. landslides)

- Require contractor to report any defects in monthly report
  - Apply higher deductions for identified defects not included in report

- Limit the use of response times
  - Immediate deductions where possible
  - One-month response times where reasonable (in line with inspections)
  - Shorter response times only for high urgency defects
    - Landslides
    - Snowfall

Payment Deductions

- Payment deductions in case of non-compliance
  - Compliance threshold may be set lower than 100%
    - 100% payment if compliance at least 90%
  - As percentage of monthly payment (per kilometre)
  - Repeated (and increased) if not rectified by next inspection

- Must reflect the importance of the defect
  - Cost of repairing the defect
  - Impact of defect on the road and road users

- Must be high enough to provide incentive for compliance
  - Too low – less compliance
  - Too high – risk premium in the contract price

Deductions

- Deductions often applied per 1-kilometre section
  - Independent of total length of road under contract
- Deductions often as percentage of payment
  - Different percentages for different performance standards
    - Costlier to repair – higher percentage
    - Bigger impact on road or road users – higher percentage
- Total of percentages for different standards should exceed 100%
  - Even no maintenance will result in compliance with some standards
  - Must be a financial incentive to perform well – deduction to exceed repair costs
  - Deduction percentages should be in order of 10%-50% of payment amount
  - Maximum deduction per kilometre often 100% - can be more
- Deductions often introduced gradually
  - Not during first 3 months – non-compliance indicated but no deduction

Example: Tajikistan

- Low deduction percentages – potholes only 5%
  - $1,600/km/year - $640/km/year for routine equal to $53/km/month
  - 5% deduction only $2.70

Date: 21 October 2017 — Contract Name: Syron-Karamik Road PBM 03 — Contract Month 36 — commencing ?? December 2017

Batter protection structures — Section A 560 m — Length 47.74 km — Number of Bridges 3 — Number of Signs ??? — Number of Culverts ???

	Service Level (Required Compliance Criteria)	Service Level Unit of Measure	1) Performance Measure (to Remove Defect)	Compliance With Service Level 2) Unit	3) Compliant	4) Non-Compliant	5) Payment Reduction Factor	6) Km Penalty Applied This Month
1. Road Usability	1.1 Road open to traffic at all times	30 days	2 days	Days	30.00	0.00	0.01	0.000
2. Road User Safety, Service and Comport	**Roadway Surface, Shoulders and Roadside**							
	2.1 Travel time to achieve target speed of at least 60 kph (50 minutes)	Number of minutes	28 days	Min	50.000	0.00	0.01	0.000
	2.2 No pothole more than 0.5 m and less than 5 smaller potholes on the road surface	Any 1 km Section	7 days	Km	48.00	2.00	0.05	0.001
	2.3 Less than 15 potholes on shoulder >15 cm in any direction	Any 1 km Section	14 days	Km	50.00	0.00	0.02	0.000
	2.4 Vegetation on shoulders, medians and traffic islands <1 m tall	Any 1 km Section	14 days	Km	45.00	5.00	0.02	0.001
	2.5 Roadway is clear of vehicles, soil, rock or other comprising safety	Any 1 km Section	8 hours	Km	49.00	1.00	0.05	0.050
	2.6 Vehicles, soil, rock or other debris not comprising safety is removed	Any 1 km Section	28 days	Km	45.00	5.00	0.01	0.050
	2.7 Poorly maintained rest areas and ablution facilities that compromise their use users	Each Unit	8 hrs	Ablution	3.00	0.00	0.05	0.00
	Signalization and safety Devices							
	2.8 Road signs are present, clean, visible and undamaged	Any 1 km section	28 days	Sign	40.00	10.00	0.01	0.000
	2.9 Centreline marking is visible from 100 m	Any 1 km section	28 days	Km	50.00	1.00	0.02	0.000
	2.10 Guardrail is undamaged and no section missing	Any 1 km section	28 days	Km	49.00	0.00	0.02	0.020
	2.11 Guideposts and guide barriers are present, clean and undamaged	Any 1 km section	28 days	Km	50.00	50.00	0.01	0.000
	Winter Maintenance							
	2.12 After snow fall, flow is restricted, and icepack is <15 cm	Any 1 km section	8 hours	Km	50.00	0.00	0.10	0.000
	2.13 After traffic is restricted, salt/grit mixture id placed on ice pack	Any 1 km section	4 hours	Km	50.00	0.00	0.10	0.000
	2.14 Snow and ice is removed from shoulder and drains after roadway is cleared	Any 1 km section	14 days	Km	50.00	0.00	0.01	0.000
						Sub-Total	**0.50**	**0.420**
3. Durability	3.1 Cracks wider that 3 mm are less than 20 m in length	Any 1 km section	28 days	Km	47.00	3.00	0.10	0.300
	3.2 Less than 10m2 ravelling or aggregate stripping on roadway surface	Any 1 km section	28 days	Km	49.90	0.10	0.10	0.010
	3.3 Height of shoulders vs height of movement is not >10 cm for more than 2 m length	Any 1 km section	28 days	Km	49.20	0.80	0.05	0.040
	3.4 Culverts and inlets and outlet ditches for 5 m are less than 20% obstructed	Each Unit	28 days	Culvert	480.00	20.00	0.01	0.200
	3.5 Drains and scuppers allow unobstructed drainage from bridge deck	Each Unit	28 days	Bridge	16.0	4.00	0.10	0.400
	3.6 Debris obstructing flow at bridge abutments and piers is removed	Each Unit	28 days	Bridge	18.00	2.00	0.10	0.200
	3.7 The Project Manager is advised in writing of any damage affecting bridge integrity	Each Unit	7 days	Bridge	20.00	0.00	0.05	0.000
	3.8 Less than 20 m2 water more than 5 cm deep on roadway 3 hrs. after rainfall	Any 1 Km Section	14 days	Km	49.00	1.00	0.05	0.020
	3.9 Less than 40m2 water 10 cm deep on shoulder 24hrs. after rainfall	Any 1 Km Section	28 days	Km	49.00	1.00	0.02	0.020
	3.10 Lined and unlined drains are less than 50% blocked or impeding free flow	Any 1 Km Section	56 days	Km	49.00	5.00	0.01	0.050
	3.11 All damaged drains or erode sections of the road formation are replaced	Any 1 Km Section	28 days	Km	46.00	2.00	0.04	0.080
						Sub-Total	**0.60**	**1.320**
	Payment Registered for Defects Repaired Within Response Time (Km)	3.25						1.740
	Less Penalty for Defects this Month (Km)	1.740						
	Length for Payment this Month	51.510						

Example: China (Yunnan)

Defect type	Performance Standard	Deduction
Drains and ditches	• No more than 10% of the cross section of a drain or ditch is obstructed at any location • Lined ditches do not have structural damage and are firmly contained by surrounding soil or material	30%
Vegetation control	• Height is <10cm within 5m of the edge of the pavement or side drain • No vegetation obstructs the view of road signs • No vegetation is located in structures or sealed surfaces • Vertical clearance of vegetation over the pavement is >6m	20%
Retaining walls	• Retaining walls are stable, without damage and weep holes are clear	10%
Slopes and fences	• Slopes are intact with no loose rocks and free of erosion • Fences are in good repair with no missing sections	10%
Greening	• Trees, flower beds are properly tended and fertilised and trees are whitewashed as needed	10%
Block/alligator cracks	• No cracks >3mm wide • Total area of cracks is ≤20m^2 per 1km section	50%
Longitudinal/ transverse cracks	• No unsealed cracks >3mm wide • Total length of unsealed cracks ≤100m per 1km section	50%
Potholes	• No potholes >15cm diameter or >3cm depth • Total number of potholes is ≤5 per 1km section	50%
Ravelling	• Total area of ravelling is ≤20m^2 per 1km section	50%
Rutting	• No ruts >3cm deep • Total length of rutting is ≤25m per 1km section	50%
Depressions	• No depressions >3cm depth • Total area of depressions is ≤20m^2 per 1km section	50%
Shoving	• No shoving >3cm height difference • Total area of shoving ≤20m^2 per 1km section	50%
Bleeding	• Total area of bleeding is ≤20m^2 per 1km section	50%
Edge break	• No loose or breaking pavement edges • Pavement width is at least 95% of design width as mentioned in contract	50%
Cleanliness	• No soil, debris, trash, other objects or oil/chemical spills on pavement or shoulder	10%
Shoulder	• Length of shoulder continuously higher or >3cm lower than pavement does not exceed 25m in any 1 km section	30%

Example: China (Yunnan-continued)

Defect type	Performance Standard	Deduction
Bridges	• Guardrails are present and not deformed • All metal parts of the overall structure are painted or otherwise protected and free of corrosion • The bridge deck is clean and the deck material is fully intact and bolted down • The drainage system is in good condition and fully functional • Expansion joints are clean and in good condition • There are no obstacles to the free flow of water under the bridge and up to 100m upstream • The clearance under the bridge is according to design • There is no erosion around bridge abutments and piers	50%
Culverts	• No more than 10% of the cross section is obstructed at any location in the culvert • There is no structural damage and culverts are firmly contained by surrounding soil or material	20%
Tunnels	• Lighting, ventilation and emergency equipment are fully operational • The drainage system is in good condition and fully functional • Footpaths are clear of debris and in good repair • External structures are in good repair and clear of vegetation	50%
Signs	• Information signs are present, complete, clean, legible, and structurally sound • Warning and traffic signs are present, complete, clean, legible, structurally sound and clearly visible at night	20%
Horizontal demarcation	• Horizontal demarcation is present, legible and firmly attached to pavement	20%
Guardrails	• Guardrails are present, clean, without structural damage • No guardrail sections are missing	20%
Lighting	• Lighting is functioning with no more than 5% of total lights unserviceable	20%
Traffic Signals	• Traffic signals are functioning with no lights unserviceable	50%
Kilometre posts	• Kilometre and guidance posts are present, complete, clean, legible and structurally sound	10%

Example: Georgia

Performance Standard	Non-compliances P	Weighting W	Delay Z	Score P x W x Z
MPM- 4 Safety & Traffic Management	5	2	5	50
MPM- 5 Inventory Data Base Management	1	2	1	2
RUS&CPM - 4 Bridges and Other Structures	3	2	1	6
RUS&CPM-6 Vegetation Control	15	2	1	30
RUS&CPM- 7 Road Sign Maintenance	20	2	1	40
RUS&CPM 8 Pavement Marking	11	2	1	22
Road Safety Hazard Repair	10	6	2	120
RDPM non-conformance	0	5	0	0
RUS&CPM Generated by the Employer	5	6	1	30
Total non-compliance score				300

P= Number of non-compliances, W= Weight of performance standard, Z= Response time beyond allowable limit

Contract Period	Threshold Score for 100% Payment	Threshold Score for 0% Payment
Months 1-3	Score<350	Score>450
Months 4-6	Score<250	Score>350
Months 7+	Score<150	Score>250

- Payment deduction $Y= -0.0091X^2 - 0.097X + 100$, whereby X=non-compliance score above 100% payment threshold
- In month 5, score 300 is 50 above threshold of 250, so $Y= -0.0091*50^2 - 0.097*50 + 100 = 72.4$ %
- Applied to 80% of monthly payment, so payment is 72.4% * 80% + 20% = 77.9%

Bidding documents

- Generally using standard bidding documents
  - Under “Specifications” or “Employers Requirements”
  - World Bank has OPRC standard bidding document template (response times)
- Initial works
  - Standard BOQ
- Maintenance services
  - Performance Standards
  - Inspection procedure
  - Payment deductions
- Emergency repairs
  - Standard BOQ
  - Thresholds for invoking emergency repairs
  - Need for work order

Bidding documents

- Separate performance guarantees
  - For initial works – ending after completion/defect liability period
  - For maintenance services – ending after contract completion
  - Avoids high costs in longer contracts

- Need to cover contractor default risks
  - After completion of initial repairs – Lack of interest in maintenance services (smaller profit)
    - Ensure that proper guarantees and penalties are in place
    - Avoid front-loading of contract
  - Towards end of contract – Maintenance costs increase while payment remains same
    - Ensure that proper guarantees and penalties are in place (retention payments)
    - Start with lower monthly payments and end with higher monthly payments

- Need to balance securities with costs/risks for contractor

Emergencies

- Minor emergency maintenance included under performance standards
  - Removal of small landslides (e.g. <100 m^3)
  - Washout of embankment (e.g. <50 m^3)

- Larger damages treated as force majeure
  - Separate payment under provisional sum
  - To avoid procurement delays in addressing emergency maintenance
  - To avoid disputes between different contractors regarding responsibility
  - Requires work order
  - Payment on volume basis

- Size of provisional sum limits amount of work that can be done
  - May still require separate contract or contract variation

Group Work

- How will inspections be carried out?
  - Timing
  - Formal/informal
  - Who will do inspections
- How will they affect payments?
  - Compliance score
  - Deduction calculation
- How to deal with response times?
- How to deal with emergencies?