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

Session 2.1: RAMS Data Management & Analysis

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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**

Data processing and management

- Data is only useful if we can access it and analyse it
  - Data needs to be reliable
  - Data needs to be accessible
  - Combining of different data needs to be possible

- Data therefore needs to be:
  - Validated (checked for errors or issues)
  - Processed (right format, combining different data sources)
  - Managed (in a database)

Data validation

- Checking data for errors/inconsistencies
  - IRI value of 98.5 – this is not possible and should be marked as an error
  - RoadLab roughness app records IRI=1 if speed is too low – this should be recorded as no data rather than a very low roughness of IRI=1
- Validation to be carried out before data is uploaded into database
  - Based on raw data (or processed data)
  - May include auditing of sample of data
  - Complemented by automatic checks in database – e.g. values within thresholds
- This is an important activity that is often given insufficient attention
  - Errors or problems in data can make the RAMS useless

Data processing

- Transforming data into the required format
  - Transforming data into a format that can be imported into the database
  - Transforming the units of the data
    - Transforming from m^2 to a percentage of the pavement surface
    - Sometimes automated in the database

- Importing data into a database
  - Making data ready for import
    - Preparing as a single CSV sheet with fixed columns
  - Some equipment can export data into a specific format
    - ROMDAS uses MS Access database
    - RoadLab uses CSV and KML files

- All raw data should be kept and properly stored
  - If issues are found with processed data, raw data can be checked
  - Proper folder structure + backup system are needed

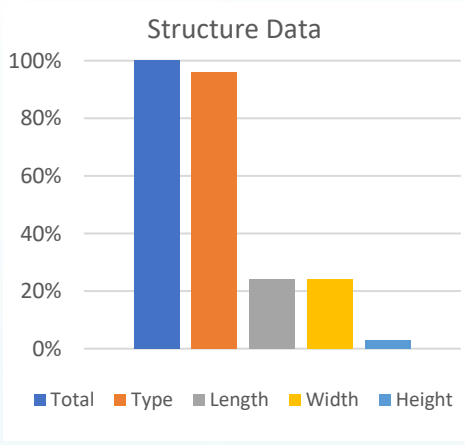
Example: Cambodia

- Rural Roads Information Management System (RRIMS)
  - Data collection by provincial departments – 45,000 km
  - Data entry by different staff (working group of 25 people)
    - Limited time and responsibility

- Insufficient data validation and processing
  - Provinces used Excel sheets to send data – data errors and format inconsistencies
  - Data was not always validated and instead imported directly into the RRIMS

- Database contained many errors and corrupted data
  - Data entered in wrong location (road width instead of pavement type)
  - Data entered in wrong format (e.g. centimetres instead of metres)
  - Data not according to defined categories (e.g. wrong spelling)
  - Data was often incomplete
  - Database did not include automatic checks of imported data

- Analysis of the data proved impossible
  - Data cleaning required first – very costly (for out-of-date data)
  - Raw data not always recoverable
  - Data will need to be collected again – 45,000 km



Example: Myanmar

- Road Data Bank (RDB) for trunk roads
  - 27,000 km surveyed using RoadRoid app and visual assessments
- Road data was only validated towards end of data collection
  - For much data the travel speed was too low to allow accurate IRI measurement
  - A lot of data had unrealistic IRI values
  - Only 16,800 km was found to have reliable IRI data
  - Over 10,000 km of IRI data was found to be unusable
- Although data validation was carried out and identified unreliable data, it was done too late in the process

Data management

- Data is entered into a database to facilitate access and combination of data

- Different complexities of database
  - Standard spreadsheet software (e.g. Microsoft Excel)
  - Standard database software (e.g. Microsoft Access)
  - Off-the-shelf road database software (e.g. HIMS, ArcGIS)
  - Custom-made road database software (often web-based)

- Start simple, gradually develop further
  - Using off-the-shelf software, find out what you want first
  - Later upgrade as needed

Database software

Software type	Advantages	Disadvantages	Examples
Standard spreadsheet (MS Excel or similar)	• Inexpensive • Easy to operate • Software often available • Support widely available • Simple interface possible	• Limited functionality • Need to develop structure	• Nepal (PTMP) • Kyrgyz (СУДА) • Afghanistan
Standard database (MS Access or similar)	• Inexpensive • Support widely available • Simple interface possible	• Limited capacity • Need to develop structure	• Bangladesh (RSDMS) • Solomon Islands (SITAMS) • Tajikistan (HMS) • Uzbekistan (HMS)
Off-the-shelf road database software	• Can be less expensive • Support widely available	• Not always suitable • Limited functionality • Language issues	• Georgia (ArcGIS) • Cambodia trunk (HIMS)
Custom-made database software	• Adjusted to needs • In own language	• Expensive • Limited support	• Myanmar (RDB) • Timor-Leste (ESTRADA) • Azerbaijan (RDBAze) • Pakistan (RMS) • Cambodia rural (RRAMS) • Kyrgyz (RDB) • Afghanistan (RAMP)

Example database costs

- Excel/Access:
  - $250 for software licence
  - $10,000+ for developing structure

- Off-the-shelf:
  - Example: ROMDAS HIMS
    - Desktop version $80,000-$250,000
    - Enterprise version $200,000-$750,000
    - Web version $500,000-$1,250,000
    - Cloud version $2,500-$7,500 per month

- Custom-made:
  - >$250,000

Database use

- Skill requirement
  - Is the software easy to use or only useable by trained staff
  - How feasible is it to train staff and retain them?

- Language
  - Is the database software available in a local/regional language?
  - Is it possible to have a local language interface?

Database access

- Remote access – central server
  - Does the database only work as a standalone desktop software?
    - Requires sharing and merging of database copies
  - Can it be accessed remotely by multiple users?
    - Central server within local area network (LAN)/wide area network (WAN)
    - Online access through internet

- Does the software allow for differentiated user rights?
  - Technical operators – data entry and editing
  - Road entity users – data viewing and exporting
  - Public users – limited data viewing

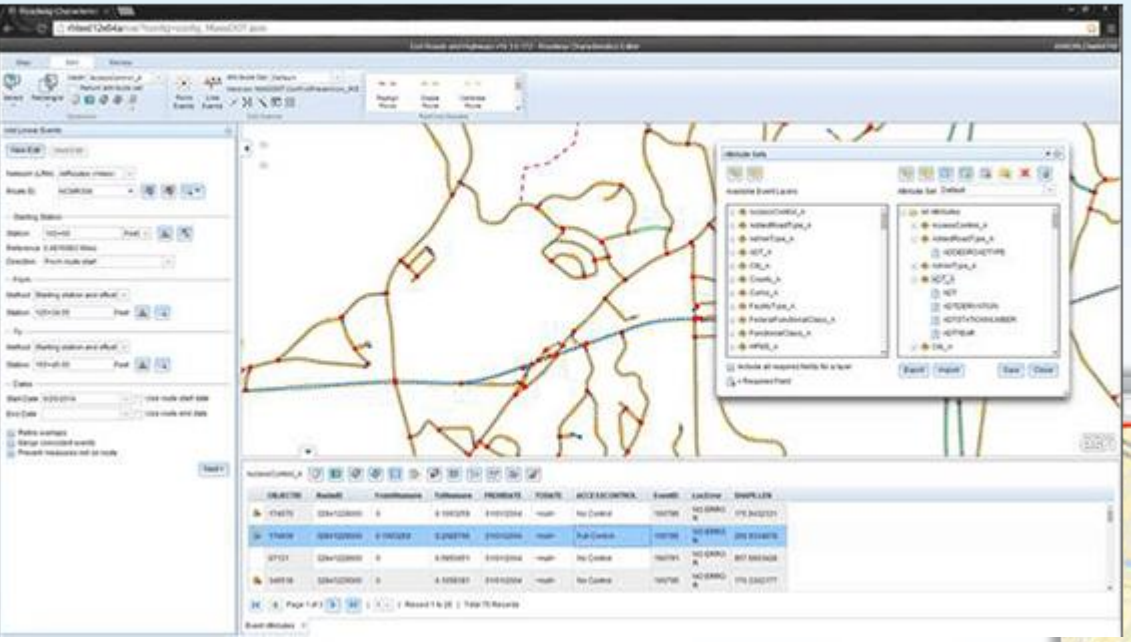
Database functions

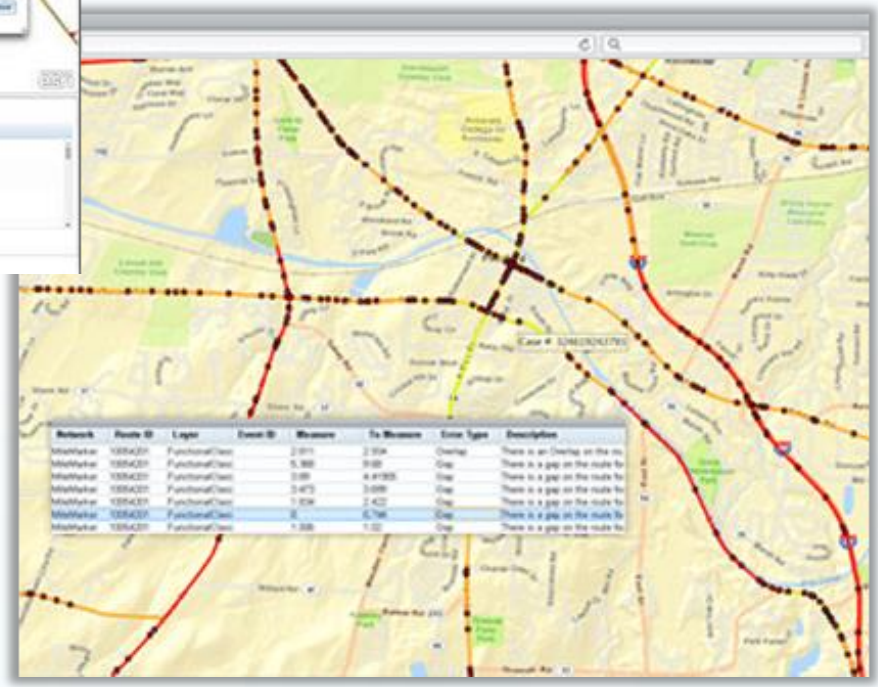
- Related to functionality of the RAMS

- Database functions
  - Search/select data (multiple filters)
  - Show selected data (tables, graphs and maps)
  - Export data (generally as tables to PDF or CSV format, also as maps)
  - Prepare standard reports (sets of agglomerated data for certain road types)
  - Calculate statistics and key performance indicators

Example: Georgia

- Off-the-shelf software (ArcGIS Roads and Highways)

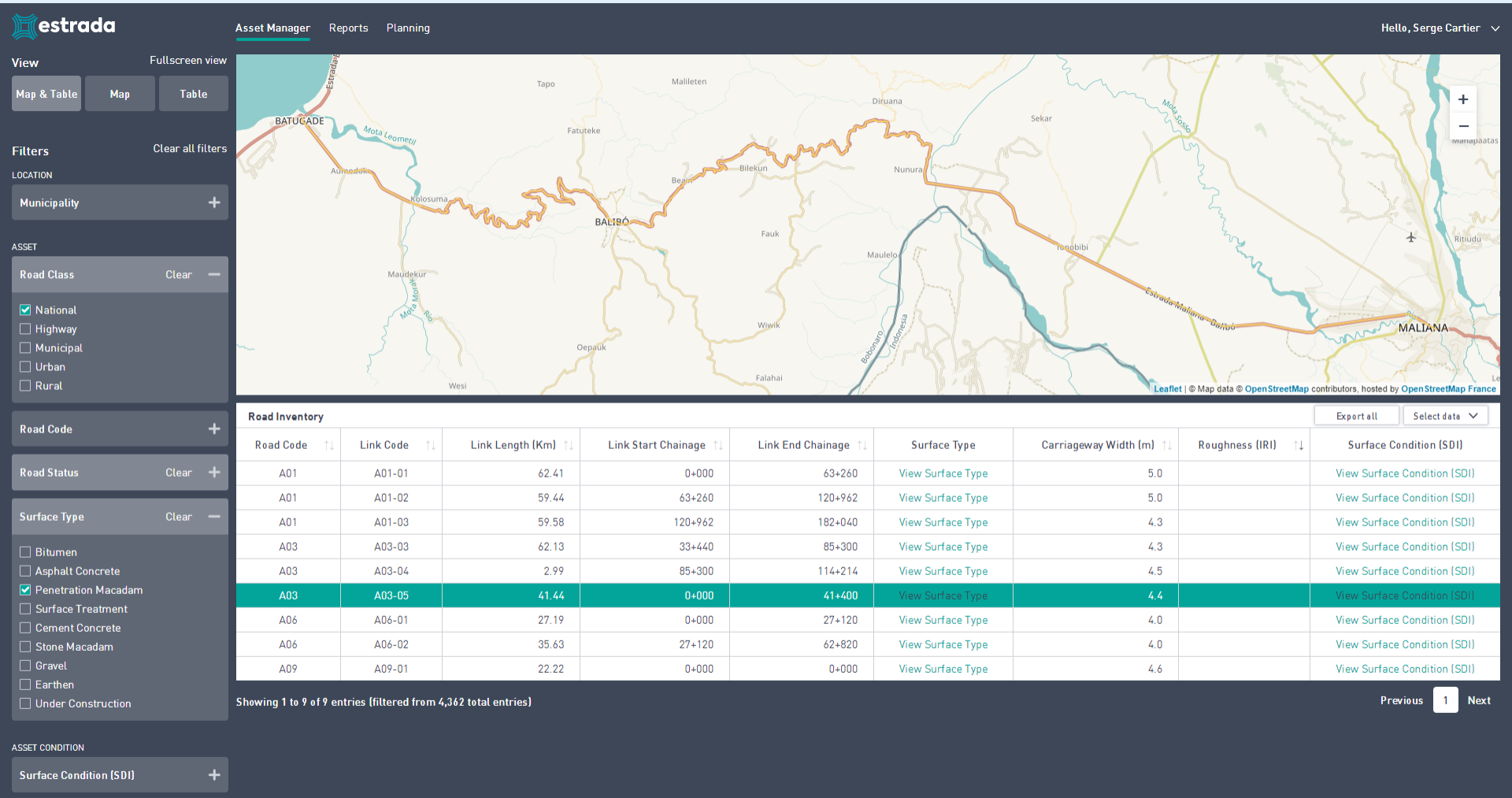




- Desktop version – need to copy and merge data files for use by other units
- Planning to upgrade to web-based version

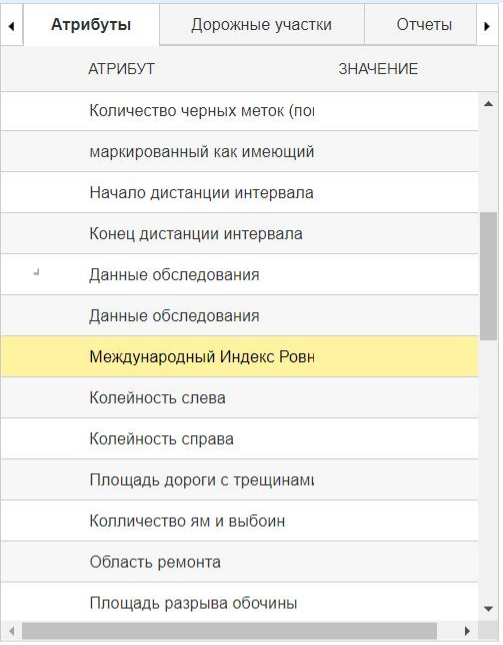
Example: Timor Leste

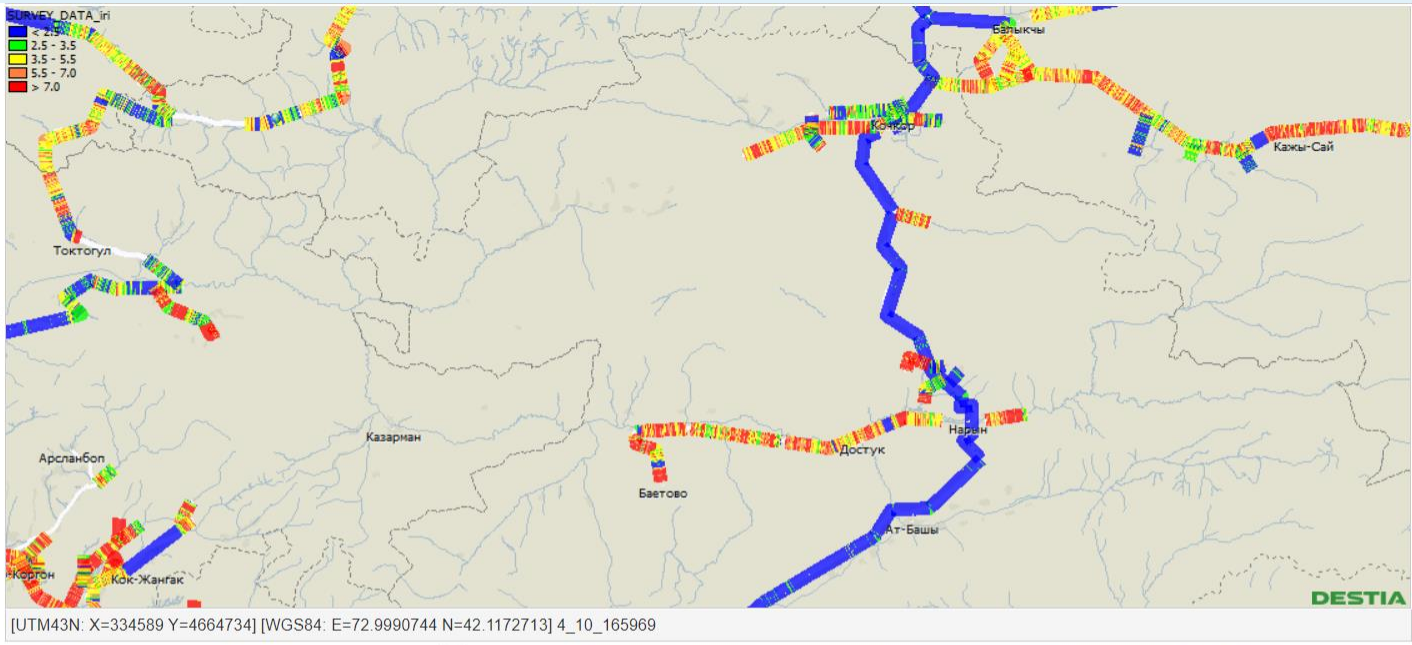
- Custom-made database (under development)

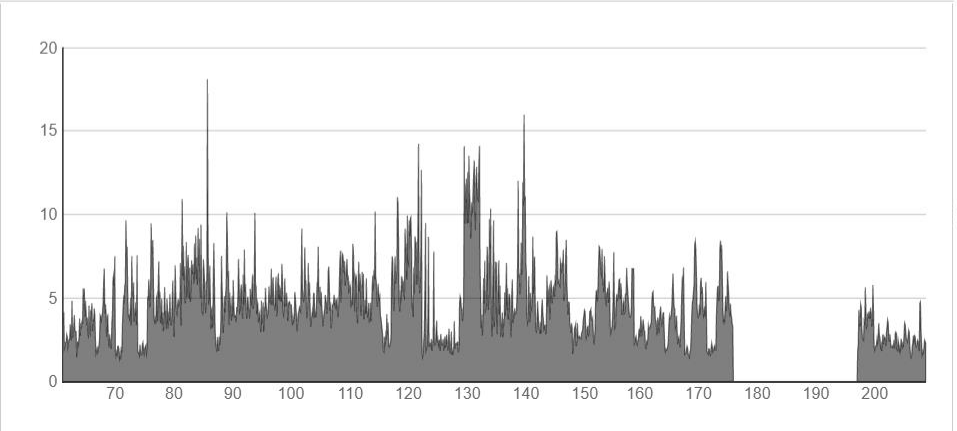


Example: Kyrgyz

- Custom-made database (under development)







Database development

- Database development has to go hand-in-hand with data collection

- Do not develop the database before collecting any data
  - Problems in Timor Leste

- Do not collect all the data before developing the database
  - Problems in Myanmar

- Apply a stepwise approach
  - Collect data for a portion of the road network(s) to be included in the database
  - Check and validate the data collection
  - Develop and test the database
  - Collect the data for the rest of the network(s)
  - Complete database development and testing

Data Analysis and Planning

- The next step is to use the data as the basis for planning

- Determine current treatment needs
  - Based on road conditions

- Predict future road conditions and treatment needs
  - Based on road deterioration modelling

- Determine budget requirements
  - Based on unit costs for different treatments

- Prioritize budget allocations to different roads/treatments
  - Based on prioritization criteria – optimize results
  - Based on available budget

Prioritization Criteria

- Different criteria used

- Economic benefits most commonly used
  - Benefit/cost ratio
  - NPV of the net benefits divided by NPV of the treatment costs
  - Strongly influenced by traffic volumes (road user costs)
  - Afghanistan: cost/vehicle-km

- Sometimes complemented by other criteria
  - Core road concept – priority to core roads
  - Connectivity – connecting administrative centres, airports/ports, border crossings
  - Economic productivity – connecting industrial, agricultural, tourism areas
  - Population – connecting densely populated areas, large populations
  - Social inclusion – connecting poor areas, remote areas
  - Security situation – ability to carry out works (e.g. Afghanistan)

Economic benefits

- 3 main concepts

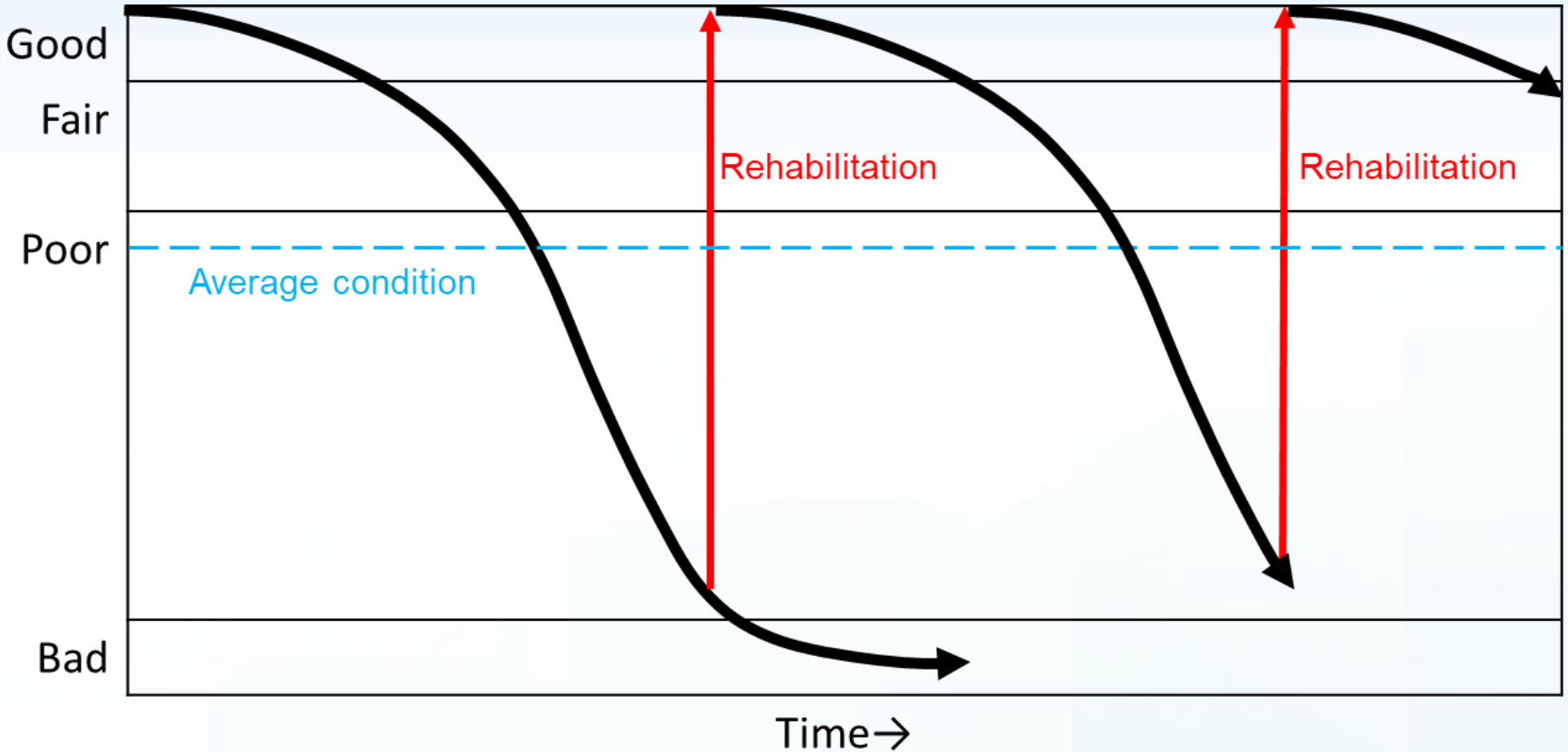
- Deterioration and treatments
  - Roads gradually deteriorate depending on traffic, climate, topography, design, etc.
  - Different treatment types have different effects on road conditions

- Total transport costs
  - Agency costs of carrying out treatments
  - Road user costs as a result of current and future road conditions

- Influence of traffic
  - More traffic causes quicker deterioration
  - More traffic results in higher road user costs

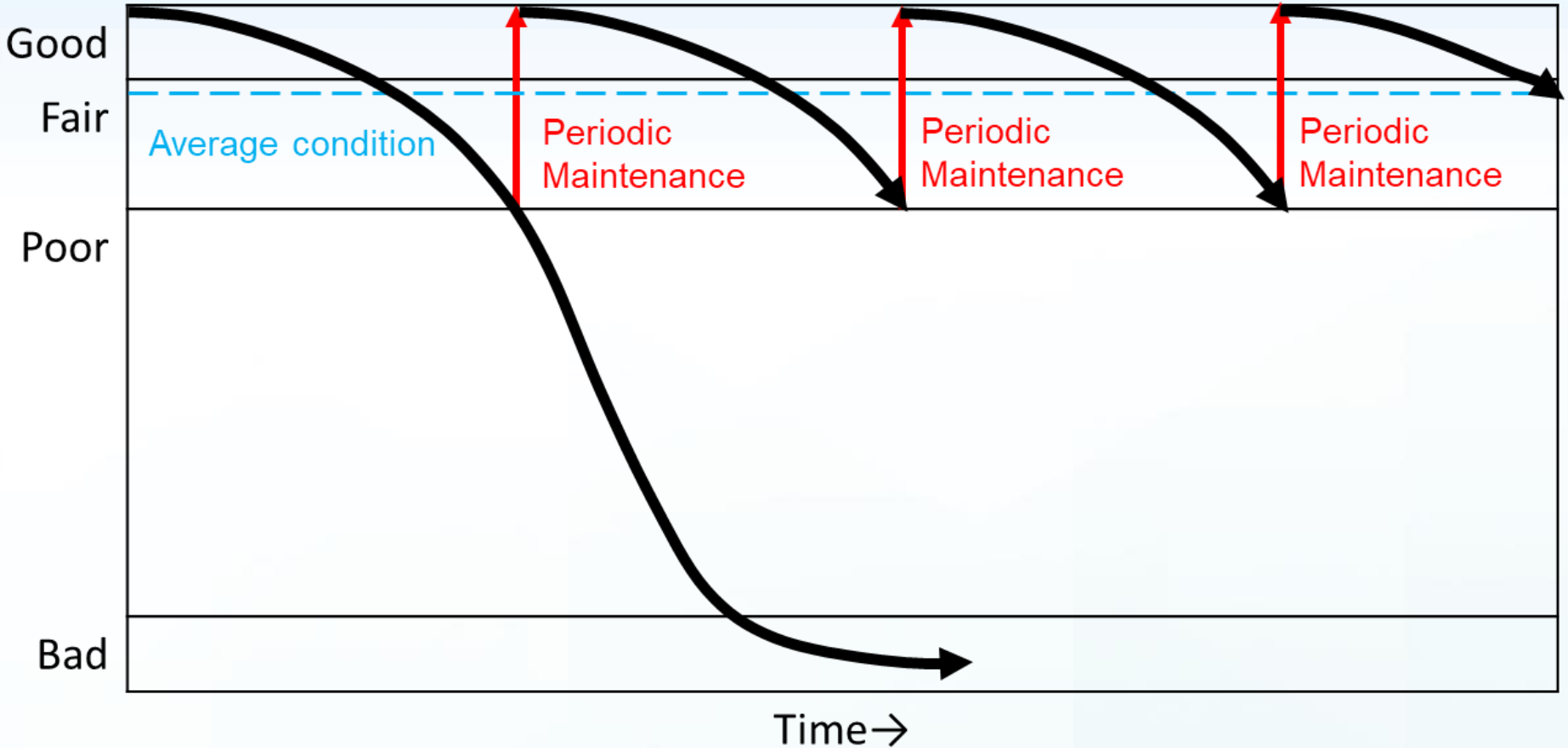
Deterioration and Maintenance

- Deterioration left unaddressed – reduced lifespan
- Costly rehabilitation needed
- Average road condition poor



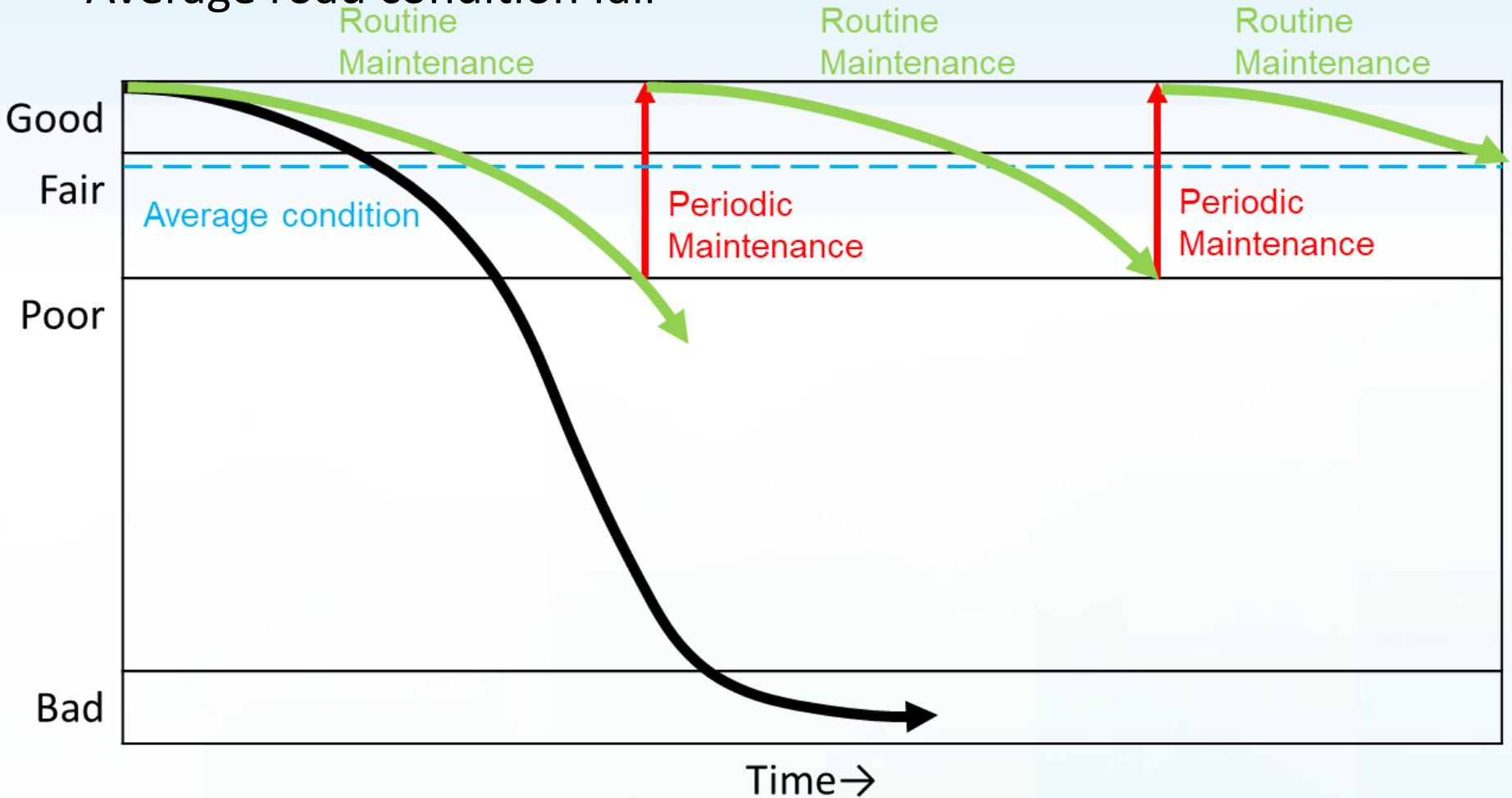
Deterioration and Maintenance

- Condition improved before it becomes poor
- Periodic maintenance less costly (but more frequent)
- Average road condition fair

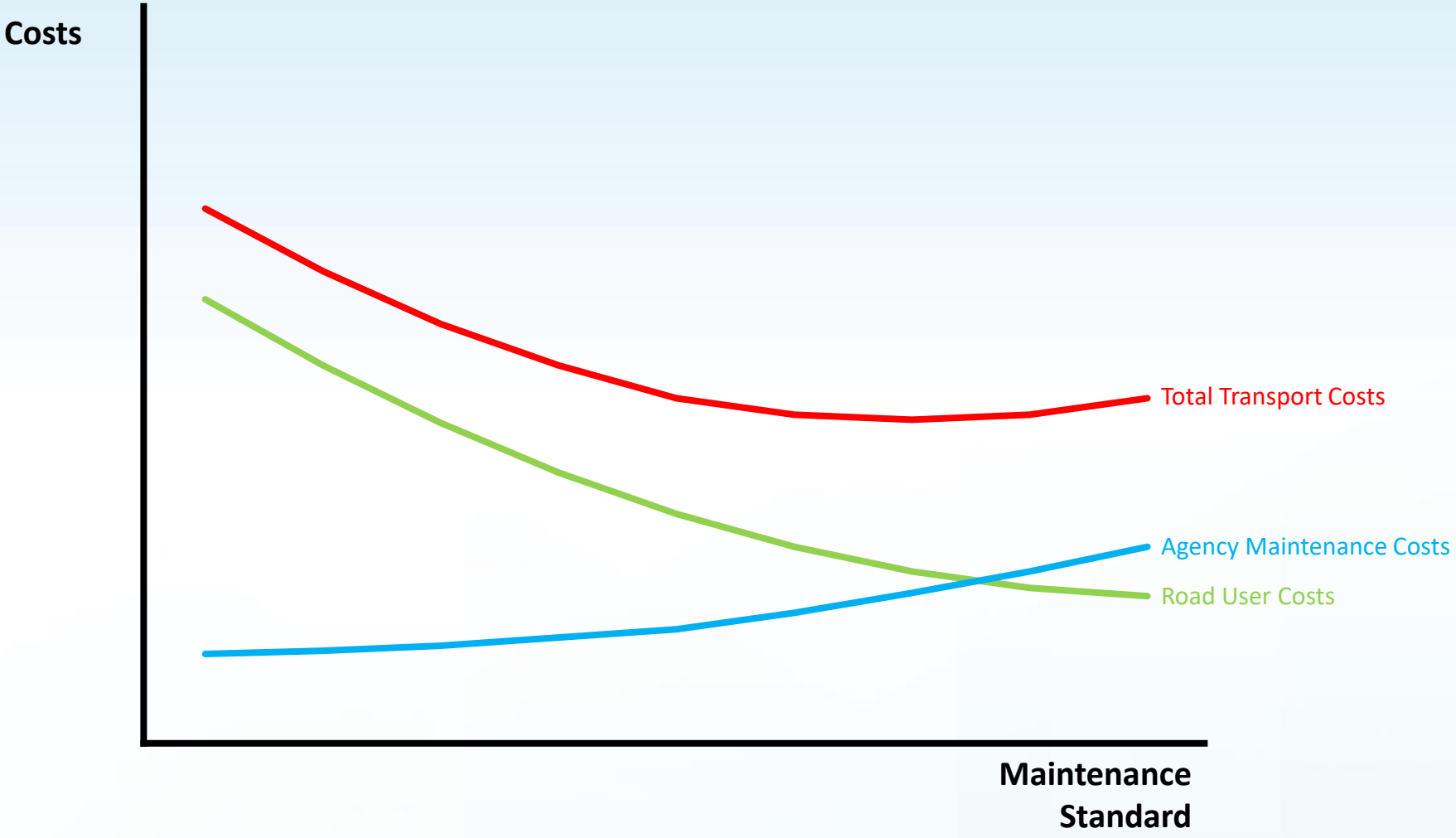


Deterioration and Maintenance

- Deterioration slowed down through annual routine maintenance
- Low additional cost, but high cost savings
- Average road condition fair



Total Transport Costs



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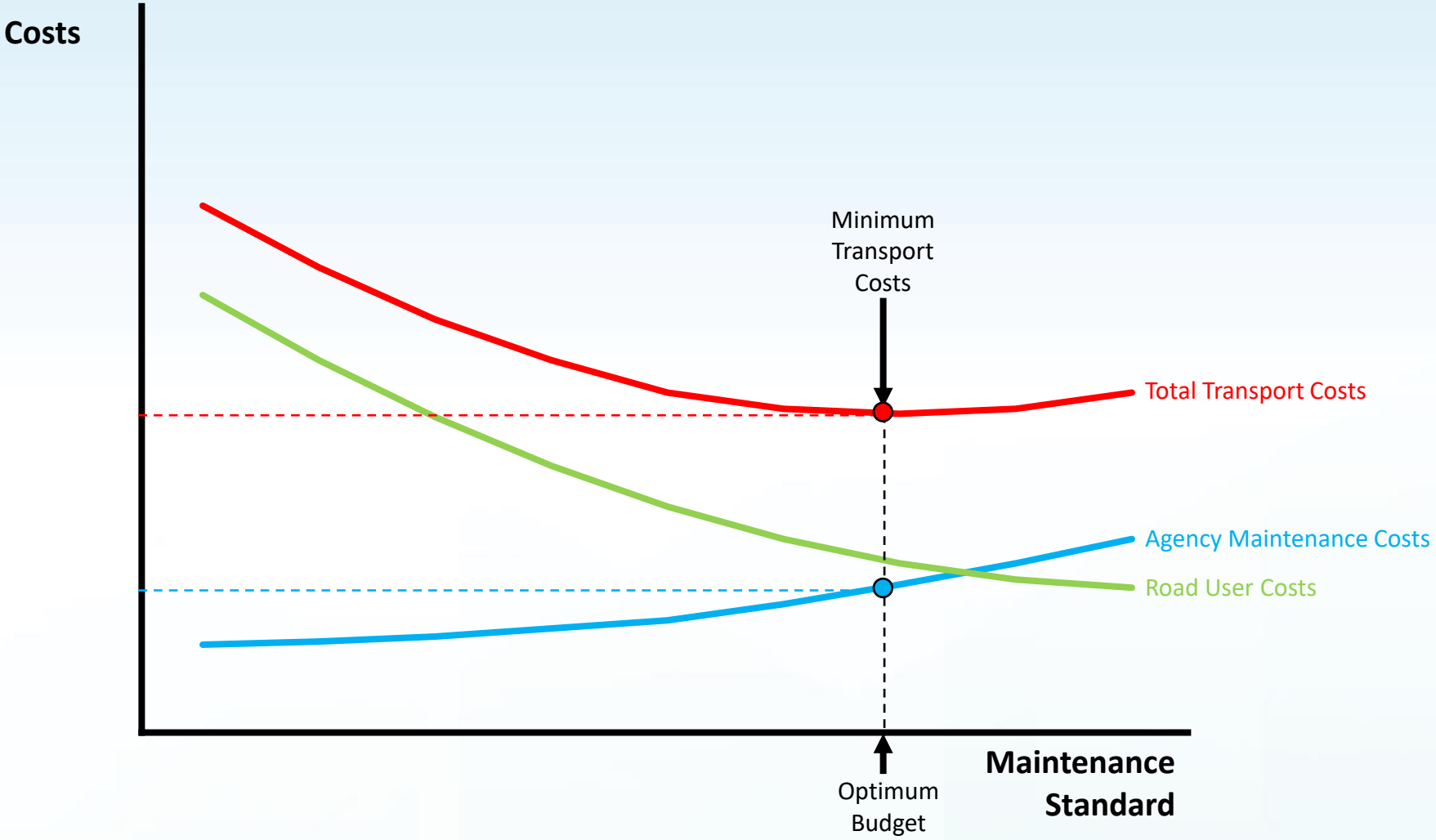

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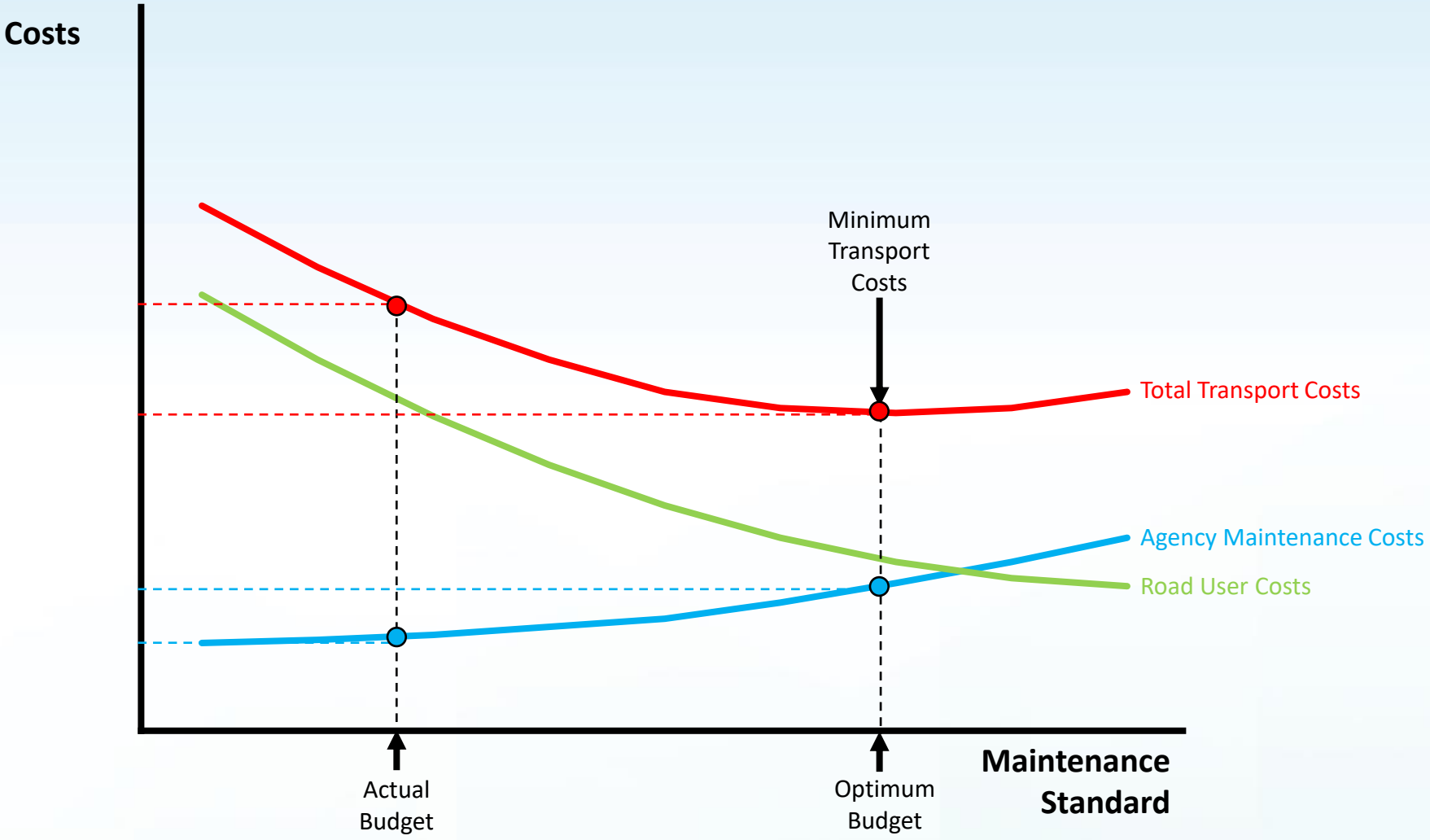
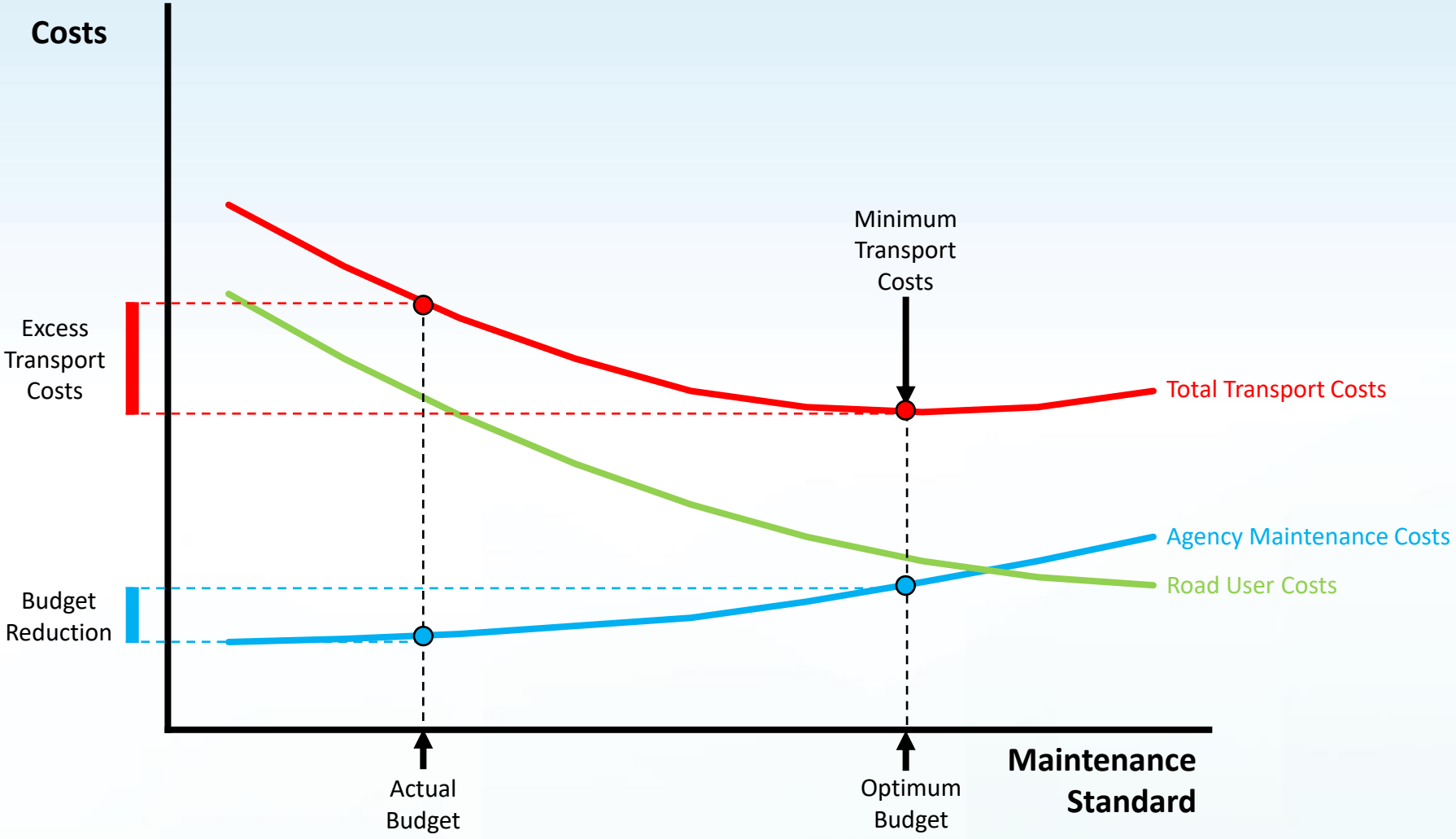
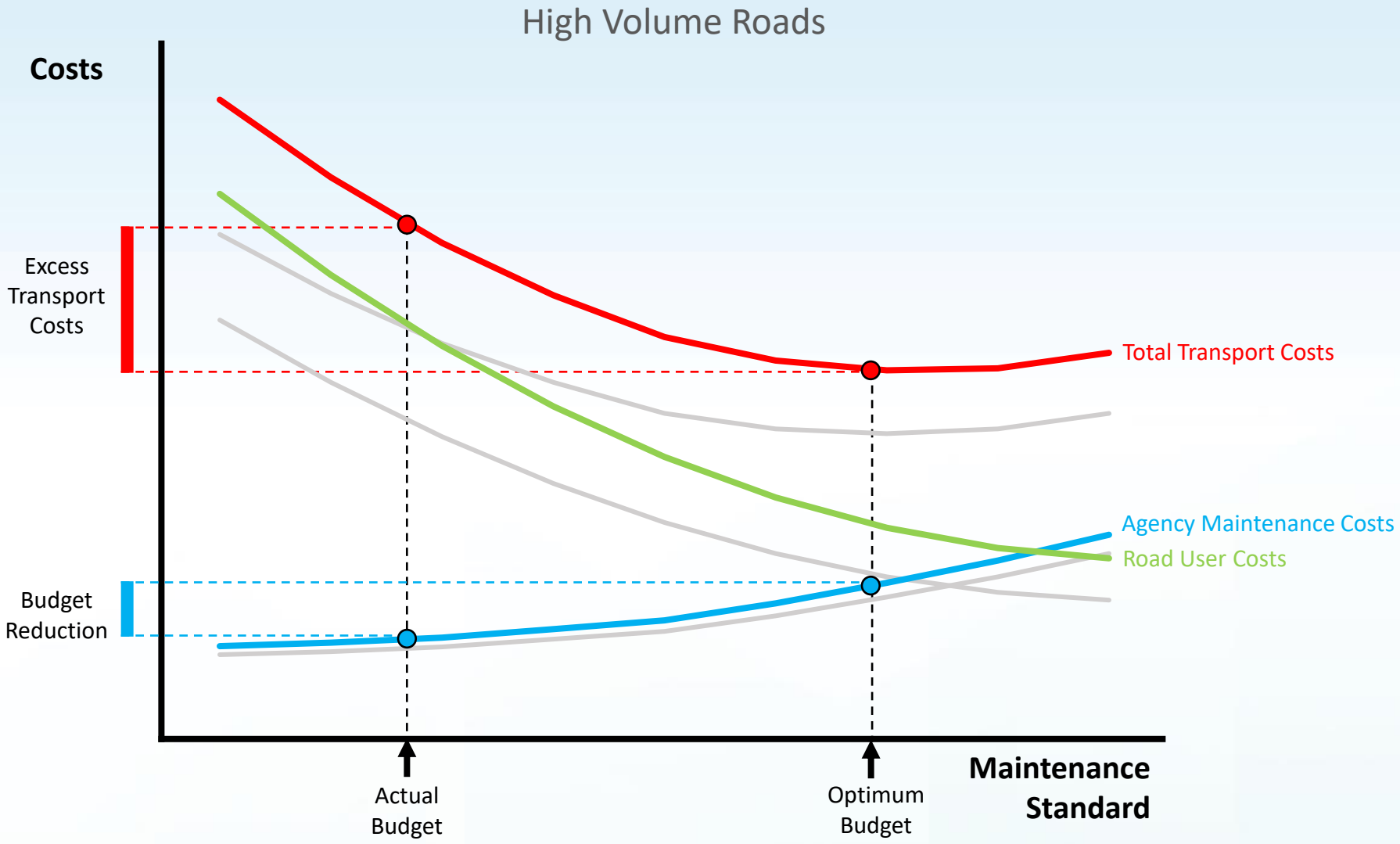


Total Transport Costs



Influence of Traffic



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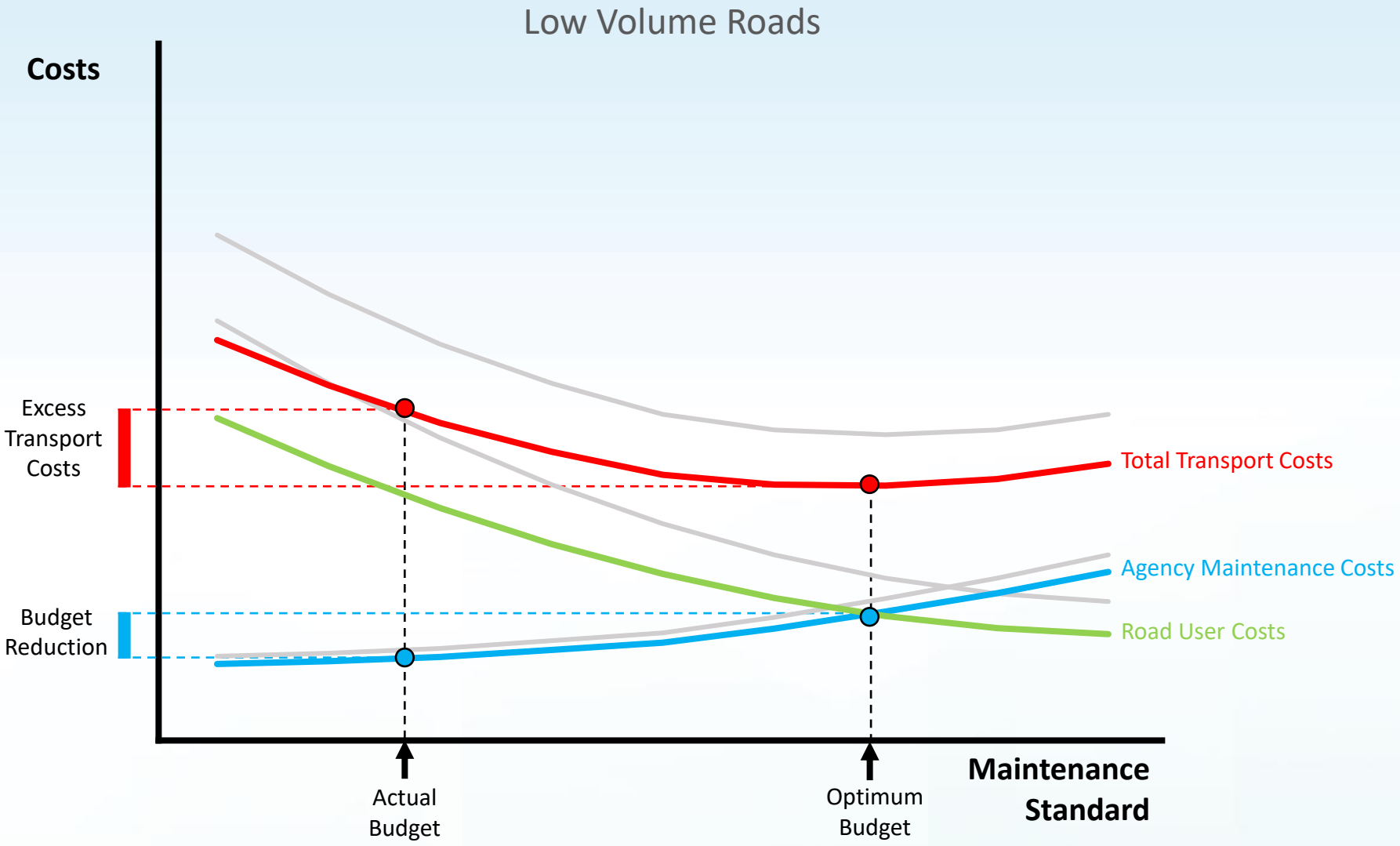


Economic benefits

- We can model the condition of different roads over time
  - Depending on characteristics (design, traffic, climate, topography, etc.)
  - Depending on the maintenance treatments and their timing

- We can estimate the total transport costs
  - Costs of planned treatments and their timing
  - Road user costs
    - Depending on resulting road conditions
    - Depending on traffic volumes

- We can compare costs to benefits
  - Net present value of costs of treatments during planning period
  - Net present value of savings to total transport costs during planning period
  - NPV savings/costs compared to base scenario (do nothing)
  - Road/treatment combination with highest NPV/investment gets highest priority

Example

- High volume road in poor condition
  - Costs: Rehabilitation – NPV is $5.0 million
  - Benefits: Reduced total transport costs – NPV is $8.0 million
  - Benefits/Costs (NPV/CAP): 1.6
- Low volume road in poor condition
  - Costs: Rehabilitation – NPV is $5.0 million
  - Benefits: Reduced total transport costs – NPV is $6.0 million
  - Benefits/Costs (NPV/CAP): 1.2
- High volume road in fair condition
  - Costs: Periodic maintenance – NPV is $0.5 million
  - Benefits: Reduced total transport costs – NPV is $1.0 million
  - Benefits/Costs (NPV/CAP): 2.0
- Low volume road in fair condition
  - Costs: Periodic maintenance – NPV is $0.5 million
  - Benefits: Reduced total transport costs – NPV is $0.8 million
  - Benefits/Costs (NPV/CAP): 1.6

HDM4 – Treatment options

Standard	Surface type	Technique	Trigger	Cost/km
RM only (sealed)	AC/CC/PM	Routine maintenance for sealed road	Every year	$ 1,000
RM only (unsealed)	DBM/GR/ER	Routine maintenance for unsealed road	Every year	$ 1,600
SD25mm@IRI4	AC/PM	25mm Single surface dressing	IRI 4	$ 70,000
SD25mm@IRI5	AC/PM	25mm Single surface dressing	IRI 5	$ 70,000
OL40mm@IRI4	AC/PM	40 mm Asphalt Concrete overlay	IRI 4	$ 100,000
OL40mm@IRI6	AC/PM	40 mm Asphalt Concrete overlay	IRI6	$ 100,000
OL50mm@IRI4	CC	50 mm Asphalt Concrete overlay	IRI4	$ 100,000
OL50mm@IRI6	CC	50 mm Asphalt Concrete overlay	IRI6	$ 100,000
OL60mm@IRI6	AC/CC/PM	60 mm Asphalt Concrete overlay	IRI6	$ 150,000
OL60mm@IRI8	AC/CC/PM	60 mm Asphalt Concrete overlay	IRI 8	$ 150,000
OL80mm@IRI6	AC/CC/PM	80 mm Asphalt Concrete overlay	IRI 6	$ 200,000
OL80mm@IRI8	AC/CC/PM	80 mm Asphalt Concrete overlay	IRI 8	$ 200,000
PM75mm@IRI6	PM	75 mm Penetration Macadam overlay	IRI 6	$ 100,000
GR@30mm	GR/ER	100 mm gravel layer	Gravel thickness < 30mm	$ 45,000
GR@20mm	GR/ER	100 mm gravel layer	Gravel thickness < 20mm	$ 45,000
GR@10mm	GR/ER	100 mm gravel layer	Gravel thickness < 10mm	$ 45,000
REHAB AC@IRI8	AC	100 mm Asphalt Concrete + base	IRI 8	$ 350,000
REHAB AC@IRI10	AC	100 mm Asphalt Concrete + base	IRI 10	$ 350,000
REHAB PM@IRI8	PM	100 mm Penetration Macadam + base	IRI 8	$ 150,000
REHAB PM@IRI10	PM	100 mm Penetration Macadam + base	IRI 10	$ 150,000
REHAB CC@IRI8	CC	2 layer 450mm Cement Concrete + base	IRI 8	$ 1,000,000
REHAB CC@IRI10	CC	2 layer 450mm Cement Concrete + base	IRI 10	$ 1,000,000
Upgrade PM to AC	PM	100 mm Asphalt Concrete + base	IRI 8	$ 350,000
Upgrade to PM	DBM/GR/ER	100 mm Penetration Macadam + base	IRI 8	$ 350,000
Upgrade to AC	DBM/GR/ER	100 mm Asphalt Concrete + base	IRI 8	$ 600,000

HDM4 – Treatment selection

HDM-4 **Economic Indicators Summary**

Section: T3;R3;C4;P4;
Sensitivity: No Sensitivity Analysis Conducted

Alternative	Present Value of Total Agency Costs (RAC)	Present Value of Agency Capital Costs (CAP)	Increase in Agency Costs (C)	Decrease in User Costs (B)	Net Exogenous Benefits (E)	Net Present Value (NPV = B + E- C)	NPV/Cost Ratio (NPV/RAC)	NPV/Cost Ratio (NPV/CAP)	Internal Rate of Return (IRR)
Base Alternative	0.819	0.000	0.000	0.000	0.000	0.000	0,000	0,000	0,000
Regravelling@10mm	5.162	4.213	4.343	31.637	0.000	27.294	5,287	6,479	157,9 (1)
Regravelling@30mm	5.768	4.737	4.949	33.690	0.000	28.741	4,983	6,067	156,3 (1)
Upgrade to AC	28.794	28.609	27.975	54.110	0.000	26.135	0,908	0,914	20,6 (1)
Upgrade to PM	17.476	17.290	16.657	53.778	0.000	37.121	2,124	2,147	30,3 (1)

Figure in brackets is number of IRR solutions in range -90 to +900

Section: T3;R3;C4;P6;
Sensitivity: No Sensitivity Analysis Conducted

Alternative	Present Value of Total Agency Costs (RAC)	Present Value of Agency Capital Costs (CAP)	Increase in Agency Costs (C)	Decrease in User Costs (B)	Net Exogenous Benefits (E)	Net Present Value (NPV = B + E- C)	NPV/Cost Ratio (NPV/RAC)	NPV/Cost Ratio (NPV/CAP)	Internal Rate of Return (IRR)
Base Alternative	0.269	0.000	0.000	0.000	0.000	0.000	0,000	0,000	0,000
OL40mm@IRI6	10.172	10.170	9.903	43.310	0.000	33.408	3,284	3,285	30,2 (1)
OL60mm@IRI6	12.712	12.711	12.443	41.381	0.000	28.937	2,276	2,277	26,2 (1)
OL60mm@IRI8	10.137	10.133	9.868	38.532	0.000	28.664	2,828	2,829	31,6 (2)

Figure in brackets is number of IRR solutions in range -90 to +900

HDM4 – Road ranking (NPV/CAP)

HDM-4
HIGHWAY DEVELOPMENT & MANAGEMENT

Work Programme Unconstrained by Year

Study Name: **Myanmar Strategy ALL 26OCT2015**
Run Date: **05-11-2015**
Currency: **US Dollar**

Year	Section	Road Class	Length (km)	AADT	Surface Class	Work Description	NPV/CAP	Financial Costs	Cum. Costs
2016	T6;R3;C3;P1;	C3	2.0	3330	Bituminous	OL 40@6IRI	40.258	0.220	0.220
	T6;R3;C2;P6;	C2	162.0	3330	Bituminous	OL 40@6IRI	39.597	17.822	18.042
	T6;R2;C2;P6;	C2	315.0	3330	Bituminous	OL 40@4IRI	39.190	34.653	52.695
	T6;R2;C3;P1;	C3	6.0	3330	Bituminous	OL 40@4IRI	38.326	0.660	53.355
	T6;R3;C2;P1;	C2	99.0	3330	Bituminous	OL 40@6IRI	37.605	11.682	65.037
	T6;R2;C2;P1;	C2	145.0	3330	Bituminous	OL 40@4IRI	33.828	18.035	83.072
	T5;R3;C3;P1;	C3	24.0	1942	Bituminous	OL 40@6IRI	22.017	2.640	85.713
	T5;R3;C2;P1;	C2	145.0	1942	Bituminous	OL 40@6IRI	21.956	15.952	101.664
	T5;R3;C3;P6;	C3	54.0	1942	Bituminous	OL 40@6IRI	21.749	5.941	107.605
	T5;R3;C4;P1;	C4	14.0	1942	Bituminous	OL 40@6IRI	21.410	1.540	109.145
	T5;R2;C3;P1;	C3	26.0	1942	Bituminous	OL 40@4IRI	20.568	2.860	112.005
	T5;R2;C2;P1;	C2	371.0	1942	Bituminous	OL 40@4IRI	20.337	40.814	152.819
	T5;R2;C3;P6;	C3	86.0	1942	Bituminous	OL 40@4IRI	20.185	9.461	162.280
	T5;R2;C4;P1;	C4	39.0	1942	Bituminous	OL 40@4IRI	19.644	4.290	166.571
	T4;R3;C3;P1;	C3	43.0	832	Bituminous	OL 40@6IRI	14.937	2.844	169.415
	T6;R5;C3;P1;	C3	29.0	3330	Bituminous	MYA Upgrade Mac to	14.674	11.165	180.580
	T6;R5;C2;P1;	C2	100.0	3330	Bituminous	MYA Upgrade Mac to	14.587	38.500	219.080
	T5;R4;C4;P1;	C4	4.0	1942	Bituminous	Reh PenMac@8	13.904	0.660	219.740
	T5;R4;C2;P1;	C2	51.0	1942	Bituminous	Reh PenMac@8	13.727	8.418	228.158
	T5;R4;C3;P1;	C3	15.0	1942	Bituminous	Reh PenMac@8	13.669	2.476	230.634
	T6;R4;C3;P1;	C3	2.0	3330	Bituminous	MYA Upgrade Mac to	13.255	0.770	231.404
	T6;R4;C2;P1;	C2	41.0	3330	Bituminous	MYA Upgrade Mac to	13.226	15.785	247.189
	T4;R2;C3;P1;	C3	120.0	832	Bituminous	OL 40@4IRI	13.114	7.882	255.070
	T4;R5;C2;P1;	C2	26.0	832	Bituminous	Reh PenMac@10	11.450	2.593	257.663

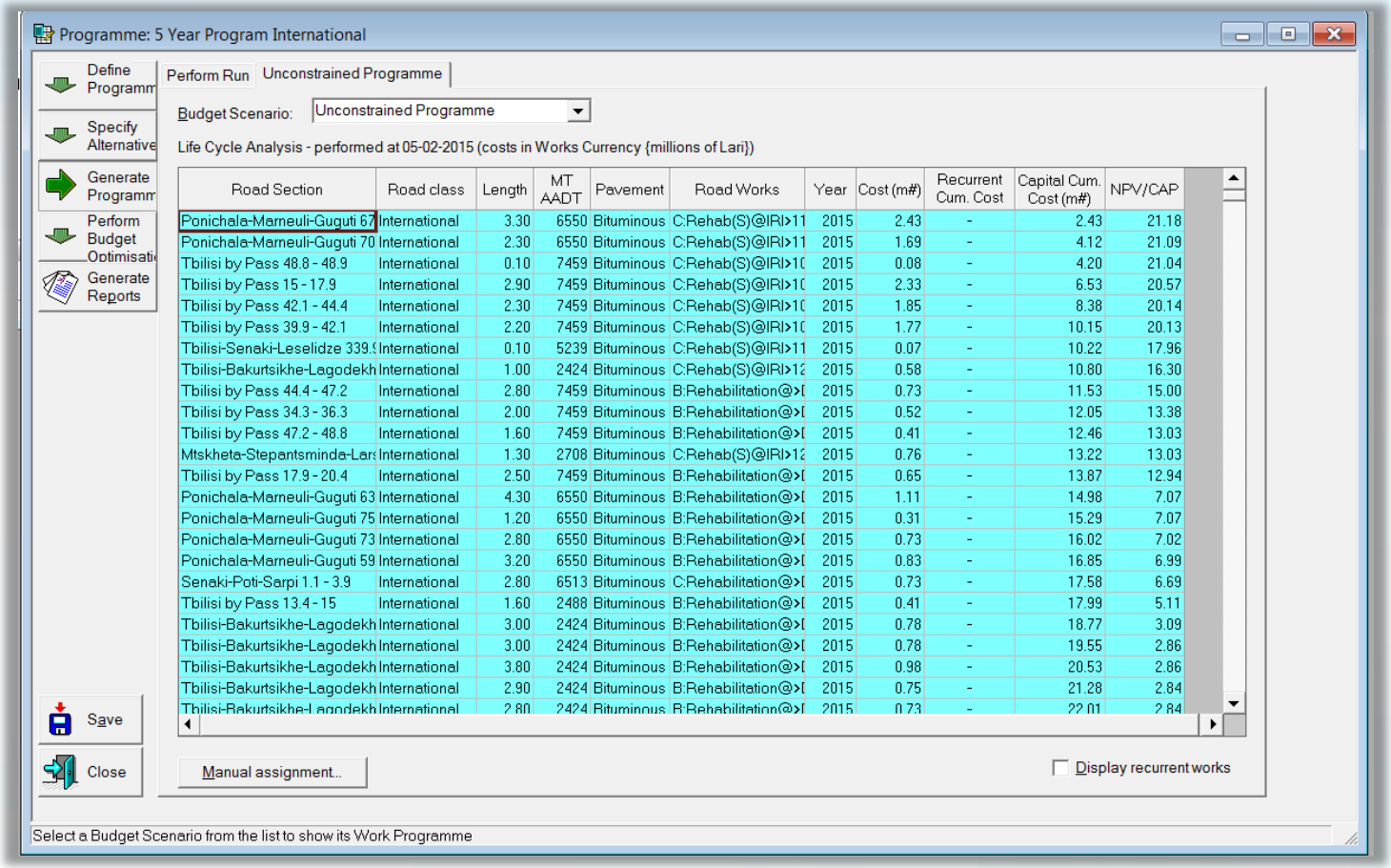
Example: HDM4

HDM-4 Work Programme Unconstrained by Year

2016	T4;R2;C4;P1;	C4	140.0	832	Bituminous	OL 40@4IRI	10.311	11.465	272.171
	T6;R5;C2;P6;	C2	55.0	3330	Bituminous	Rehab (AC) @8	9.966	21.175	293.346
	T4;R3;C4;P1;	C4	186.0	832	Bituminous	OL 40@6IRI	9.458	18.170	311.515
	T4;R2;C2;P1;	C2	192.0	832	Bituminous	OL 40@4IRI	9.180	16.886	328.402
	T4;R5;C4;P1;	C4	66.0	832	Bituminous	Reh PenMac@10	8.653	8.325	336.727
	T4;R4;C3;P1;	C3	13.0	832	Bituminous	Reh PenMac@8	8.589	1.440	338.167
	T6;R4;C2;P6;	C2	29.0	3330	Bituminous	Rehab (AC) @8	8.584	11.165	349.332
	T5;R5;C3;P1;	C3	71.0	1942	Bituminous	MYA Upgrade Mac to	8.018	27.335	376.667
	T5;R5;C4;P1;	C4	42.0	1942	Bituminous	MYA Upgrade Mac to	8.018	16.170	392.837
	T5;R5;C2;P1;	C2	40.0	1942	Bituminous	MYA Upgrade Mac to	7.792	15.400	408.237
	T4;R5;C3;P1;	C3	99.0	832	Bituminous	Reh PenMac@10	7.550	14.163	422.401
	T4;R4;C2;P1;	C2	7.0	832	Bituminous	Reh PenMac@8	7.365	0.879	423.280
	T3;R3;C2;P1;	C2	137.0	388	Bituminous	OL 40@6IRI	6.504	8.350	431.629
	T5;R5;C3;P6;	C3	148.0	1942	Bituminous	Rehab (AC) @8	6.438	56.980	488.609
	T4;R4;C4;P1;	C4	70.0	832	Bituminous	Reh PenMac@8	6.291	9.986	498.596
	T3;R3;C4;P1;	C4	159.0	388	Bituminous	OL 40@6IRI	5.760	10.804	509.400
	T3;R3;C3;P1;	C3	21.0	388	Bituminous	OL 40@6IRI	5.741	1.412	510.812
	T5;R4;C3;P6;	C3	34.0	1942	Bituminous	Rehab (AC) @8	5.420	13.090	523.902
	T6;R4;C1;P2;	C1	2.0	3330	Concrete	Overlay80mm	5.058	2.769	526.671
	T6;R3;C1;P2;	C1	5.0	3330	Concrete	Overlay60mm	5.006	5.190	531.861
	T3;R5;C4;P1;	C4	247.0	388	Bituminous	Reh PenMac@10	4.973	24.276	556.137
	T3;R3;C4;P6;	C4	112.0	388	Bituminous	OL 40@6IRI	4.847	9.283	565.420
	T3;R2;C2;P1;	C2	448.0	388	Bituminous	OL 40@4IRI	4.638	28.967	594.387
	T3;R5;C2;P1;	C2	96.0	388	Bituminous	Reh PenMac@10	4.343	10.492	604.878
	T3;R2;C4;P1;	C4	411.0	388	Bituminous	OL 40@4IRI	4.242	28.317	633.195
	T3;R4;C2;P1;	C2	42.0	388	Bituminous	Reh PenMac@8	4.058	4.077	637.272
	T3;R4;C4;P1;	C4	138.0	388	Bituminous	Reh PenMac@8	4.027	13.419	650.691
	T3;R4;C3;P1;	C3	6.0	388	Bituminous	Reh PenMac@8	3.941	0.597	651.288
	T3;R5;C3;P1;	C3	11.0	388	Bituminous	Reh PenMac@10	3.801	1.337	652.625
	T3;R2;C3;P1;	C3	113.0	388	Bituminous	OL 40@4IRI	3.581	8.833	661.458
	T2;R2;C3;P4;	C3	75.0	138	Unsealed	Gravel Resurface at 3(	2.681	2.200	663.658
	T2;R2;C4;P4;	C4	108.0	138	Unsealed	Gravel Resurface at 3(	2.584	3.255	666.913
	T2;R3;C3;P4;	C3	32.0	138	Unsealed	Gravel Resurface at 3(	2.547	1.015	667.928
	T2;R2;C3;P5;	C3	35.0	138	Unsealed	Gravel Resurface at 3(	2.505	1.154	669.082

Programme Analysis

- Prioritization of individual road segments and related treatments
  - High data requirement (IQL 2 – IQL 3)
  - Preparation of (Multi-)Annual Works Programme



Example: Myanmar

- 5-year works programme

Road code	Road name	RDB Sections	Start (miles/furlongs)	End	Length of works (km) Overlay	Rehab	Upgrade PM	Upgrade AC	Total	Cost of works (MK billion) Overlay	Rehab	Upgrade PM	Upgrade AC	Total
	Ayeyarwady				**357.6**	**34.2**	**27.2**	**-**	**419.0**	**18.9**	**2.7**	**10.5**	**-**	**32.0**
DT162	Pa Thein-Ngwe Saung Road	10-30	0/0	29/1	48.4				48.4	2.6				2.6
DT165	Kyain Pin Sae-Set Kawt- Dana Phyu -Zalun Road	10-40	0/0	27/4	31.0		27.2		58.2	1.6		10.5		12.1
DT204	Hin Tha Da-Do Yar - Daunt Gyi- Da Na Phyu Road	10	0/0	0/5	16.1				16.1	0.8				0.8
DT205	Da Nu Phyu- Thaung Gyi Road	10-30	0/0	24/2		34.2			34.2		2.7			2.7
SR59	Ma Euu Pin-Twan Tay Road	10-20	0/0	23/2	36.8				36.8	1.9				1.9
UR20B	Yangon -Pa Thein Road	10-70	17/4	80/0	104.2				104.2	5.5				5.5
UR8A	Pa Thein - Mon Ywar Road	10-90	0/0	74/5	121.2				121.2	6.4				6.4
	Bago				**636.5**	**136.1**	**-**	**-**	**772.6**	**58.8**	**15.2**	**-**	**-**	**74.0**
DT53	Nyaung lay Pin - Pa Zun Myaung - Shwe Kyinn	10	0/0	12/4		28.1			28.1		3.5			3.5
DT57	Pyay-Pout Kaung-Taung Gu	40	40/0	80/1		64.0			64.0		8.0			8.0
IC25A	Yangon - Maw La Myin - Dewe - Myeik	10	60/5	86/6	42.9				42.9	3.9				3.9
IC25F	Sit Taung Bridge Approach	10	0/0	6/3	9.8				9.8	0.8				0.8
IC41	Yangon - Taungoo - Mandalay Highway Old Road	10-80	0/0	200/1	296.3				296.3	30.8				30.8
NC7E	Shwe Bon Thoor - Sin Del - Padaung - Ohn Ship	40-50	20/1	46/7		44.0			44.0		3.7			3.7
UR8B	Pa Thein - Mon	10-30	135/5	179/1	66.4				66.4	5.0				5.0
UR9B	Yangon - Pyay - Mandalay	10-150	70/6	193/7	199.8				199.8	16.6				16.6
UR9E	Pyay City Out Bound Road	10	0/0	13/2	21.4				21.4	1.8				1.8
	Kayin				**63.2**	**73.2**	**-**	**86.8**	**223.2**	**4.9**	**17.1**	**-**	**33.4**	**55.5**
IC10B	Tha Htone-Ba Ahn-Kokkareit-Myawaddy Road	10-20	8/1	23/6	30.5				30.5	2.7				2.7
IC10F	Tha Htone-Ba Ahn-Kokkareit-Myawaddy Road	10-20	0/0	41/0		36.5		33.7	70.2		14.1		13.0	27.0
IC10G	Tha Htone-Ba Ahn-Kokkareit-Myawaddy Road	10-20	0/2	9/0	12.1			8.3	20.4	0.7			3.2	3.9
IC10H	Tha Htone-Ba Ahn-Kokkareit-Myawaddy Road	10-70	59/0	103/1	20.6			44.8	65.4	1.5			17.3	18.7
NC3C	Hte Lone - Ta Tar Kyae Road	10	0/0	9/4		15.5			15.5		1.3			1.3
TV70	Hteepoekalone – Myinegyinguu – Maethayor road	10	0/0	13/0		21.2			21.2		1.8			1.8
	Magway				**252.0**	**319.6**	**-**	**-**	**571.6**	**17.2**	**38.8**	**-**	**-**	**56.0**
DT59	Min Bu - Sa Linn - Ta Nyaun - Sate Phyu Road	10-50	0/0	45/0		41.6			41.6		4.8			4.8
DT61A	Gway Cho - Chauk - Sate Phyu Road	10	389/5	399/5		17.0			17.0		2.1			2.1
DT71	Sin Paung Wal - Taw Nyaung Pin Road	10	0/0	16/5	28.6				28.6	1.6				1.6
IC23B	Monywa - Pale - Gangaw Road	10-50	67/0	120/0		87.3			87.3		8.3			8.3
IC24A	Kalay - Gangaw Road	10	0/0	8/7		14.7			14.7		1.8			1.8
IC32	Chaung Oo - Pa Koak Khu Road	10	6/4	10/6	7.1				7.1	0.8				0.8
SR19	Pa Koak Khu - Mon Ywa Road	10-30	2/5	24/7	40.3				40.3	3.6				3.6

Strategy Analysis

- Simplification of road network into road cases
  - Reduced data requirements (IQL 3 – IQL 4)
  - Each case represents total length of road segments with those characteristics

1,340 road links 75 road cases			P1 Asphalt Concrete			P2 Surface Treatment			P3 Gravel			P4 Earth			Subtotal	Total
			R1 IRI<=4	R2 4<IRI<=9	R3 IRI>9	R1 IRI<=4	R2 4<IRI<=9	R3 IRI>9	R1 SDI<=2.5	R2 2.5<SDI<=3.5	R3 SDI>3.5	R1 SDI<=2.5	R2 2.5<SDI<=3.5	R3 SDI>3.5		
T6 ADT>5000	C1	Trunk	62	-	-	-	-	-	-	-	-	-	-	-	62	71
	C2	Main	9	-	-	-	-	-	-	-	-	-	-	-	9	
	C3	District	-	-	-	-	-	-	-	-	-	-	-	-	-	
	C4	Feeder	-	-	-	-	-	-	-	-	-	-	-	-	-	
T5 ADT>1000 ADT<=5000	C1	Trunk	515	3	-	52	80	-	-	-	-	-	-	-	651	771
	C2	Main	37	20	-	42	-	-	-	-	-	-	-	-	99	
	C3	District	-	-	-	-	-	-	-	-	-	-	-	21	21	
	C4	Feeder	-	-	-	-	-	-	-	-	-	-	-	-	-	
T4 ADT>500 ADT<=1000	C1	Trunk	852	1	-	1,005	97	-	-	72	-	-	-	21	2,048	3,268
	C2	Main	40	5	-	645	26	-	-	-	169	-	-	-	886	
	C3	District	17	-	-	129	-	-	-	142	46	-	-	-	334	
	C4	Feeder	-	-	-	-	-	-	-	-	-	-	-	-	-	
T3 ADT>100 ADT<=500	C1	Trunk	-	-	-	356	-	-	-	-	-	-	-	-	356	3,728
	C2	Main	386	17	-	904	83	-	-	192	-	-	-	-	1,584	
	C3	District	175	11	-	454	9	3	103	224	735	-	42	33	1,788	
	C4	Feeder	-	-	-	-	-	-	-	-	-	-	-	-	-	
T2 ADT>50 ADT<=100	C1	Trunk	-	-	-	-	-	-	-	-	-	-	-	-	-	3,232
	C2	Main	5	-	-	337	-	-	-	-	168	-	18	25	553	
	C3	District	59	-	-	385	3	-	236	617	736	-	91	553	2,679	
	C4	Feeder	-	-	-	-	-	-	-	-	-	-	-	-	-	
T1 ADT<=50	C1	Trunk	-	-	-	-	-	-	-	-	-	-	-	-	-	8,357
	C2	Main	162	-	-	438	-	-	-	-	-	-	-	-	600	
	C3	District	119	35	-	663	88	17	189	2,357	1,587	8	1,187	1,506	7,757	
	C4	Feeder	6	-	-	39	-	2	634	3,089	1,784	-	4,669	5,429	15,653	
		Subtotal	2,446	93	-	5,448	387	21	1,162	6,693	5,226	8	6,007	7,588	35,080	
		Total	2,539			5,857			13,080			13,604				

Strategy Analysis

- For each case the proposed treatment and threshold are indicated
- Optimize treatment strategies for different budget scenarios
  - Predict resulting road network conditions for each budget scenario

Road case	Length (km)	**Scenario 1A:** MK 100 billion restricted		**Scenario 1B:** MK 100 billion optimized		**Scenario 2:** MK 250 billion optimized		**Scenario 3:** MK 400 billion optimized	
		Standard	Cost (MK billion)	Standard	Cost (MK billion)	Standard	Cost (MK billion)	Standard	Cost (MK billion)
T3;R5;C2;P2;	23	RM only	-	RM only	-	RM only	-	RM only	-
T3;R5;C2;P3;	120	GR@10mm	4.03	GR@10mm	4.03	GR@10mm	4.03	UPGRADE PM	46.20
T3;R5;C2;P5;	85	GR@10mm	7.34	RM only	-	GR@10mm	7.34	UPGRADE PM	32.73
T3;R5;C3;P1;	11	REHAB PM@IRI10	1.34	RM only	-	REHAB PM@IRI10	1.34	REHAB PM@IRI10	1.34
T3;R5;C3;P4;	153	GR@10mm	5.01	GR@10mm	5.01	GR@10mm	5.01	UPGRADE PM	58.91
T3;R5;C3;P5;	35	GR@10mm	1.15	GR@10mm	1.15	GR@10mm	1.15	UPGRADE PM	13.48
T3;R5;C4;P1;	247	REHAB PM@IRI10	24.28	RM only	-	REHAB PM@IRI10	24.28	REHAB PM@IRI10	24.28
T3;R5;C4;P3;	48	GR@10mm	1.57	GR@10mm	1.57	GR@10mm	1.57	UPGRADE PM	18.48
T3;R5;C4;P4;	65	GR@10mm	2.13	GR@10mm	2.13	GR@10mm	2.13	UPGRADE PM	25.03
T3;R5;C4;P6;	112	RM only	-	RM only	-	RM only	-	REHAB AC@IRI10	43.12
T4;R1;C2;P1;	201	RM only	-	RM only	-	RM only	-	RM only	-
T4;R1;C3;P1;	93	RM only	-	RM only	-	RM only	-	RM only	-
T4;R1;C4;P1;	60	RM only	-	RM only	-	RM only	-	RM only	-
T4;R2;C2;P1;	192	SD25mm@IRI5	11.82	SD25mm@IRI5	11.82	SD25mm@IRI5	11.82	OL40mm@IRI4	16.89
T4;R2;C3;P1;	120	OL40mm@IRI4	7.88	SD25mm@IRI5	5.52	SD25mm@IRI5	5.52	OL40mm@IRI4	7.88
T4;R2;C4;P1;	140	SD25mm@IRI5	8.03	SD25mm@IRI5	8.03	SD25mm@IRI5	8.03	OL40mm@IRI4	11.46
T4;R3;C2;P1;	36	OL40mm@IRI6	3.04	OL40mm@IRI6	3.04	OL40mm@IRI6	3.04	OL40mm@IRI6	3.04
T4;R3;C3;P1;	43	OL40mm@IRI6	2.84	OL40mm@IRI6	2.84	OL40mm@IRI6	2.84	OL40mm@IRI6	2.84
T4;R3;C4;P1;	186	OL40mm@IRI6	18.17	OL40mm@IRI6	18.17	OL40mm@IRI6	18.17	OL40mm@IRI6	18.17
T4;R4;C2;P1;	7	REHAB PM@IRI8	0.88	REHAB PM@IRI8	0.88	REHAB PM@IRI8	0.88	REHAB PM@IRI8	0.88
T4;R4;C3;P1;	13	REHAB PM@IRI8	1.44	REHAB PM@IRI8	1.44	REHAB PM@IRI8	1.44	REHAB PM@IRI8	1.44
T4;R4;C4;P1;	70	REHAB PM@IRI8	9.99	RM only	-	REHAB PM@IRI8	9.99	REHAB PM@IRI8	9.99
T4;R5;C2;P1;	26	REHAB PM@IRI10	2.59	REHAB PM@IRI10	2.59	REHAB PM@IRI10	2.59	REHAB PM@IRI10	2.59
T4;R5;C3;P1;	99	REHAB PM@IRI10	14.16	REHAB PM@IRI10	14.16	REHAB PM@IRI10	14.16	REHAB PM@IRI10	14.16
T4;R5;C4;P1;	66	REHAB PM@IRI10	8.33	REHAB PM@IRI10	8.33	REHAB PM@IRI10	8.33	REHAB PM@IRI10	8.33
T5;R1;C2;P1;	326	RM only	-	SD25mm@IRI4	25.11	SD25mm@IRI4	25.11	OL40mm@IRI4	35.86
T5;R1;C3;P1;	9	RM only	-	SD25mm@IRI4	0.69	OL40mm@IRI4	0.99	OL40mm@IRI4	0.99
T5;R1;C3;P6;	91	RM only	-	RM only	-	RM only	-	OL40mm@IRI4	10.01
T5;R1;C4;P1;	16	SD25mm@IRI4	1.23	SD25mm@IRI4	1.23	SD25mm@IRI4	1.23	SD25mm@IRI4	1.23
T5;R2;C2;P1;	371	RM only	-	SD25mm@IRI5	28.57	SD25mm@IRI5	28.57	OL40mm@IRI4	40.81
T5;R2;C3;P1;	26	RM only	-	SD25mm@IRI5	2.00	SD25mm@IRI5	2.00	OL40mm@IRI4	2.86
T5;R2;C3;P6;	86	RM only	-	SD25mm@IRI5	6.62	SD25mm@IRI5	6.62	OL40mm@IRI4	9.46
T5;R2;C4;P1;	39	OL40mm@IRI4	4.29	SD25mm@IRI5	3.00	OL40mm@IRI4	4.29	OL40mm@IRI4	4.29
T5;R3;C2;P1;	145	RM only	-	OL40mm@IRI6	15.95	OL40mm@IRI6	15.95	OL40mm@IRI6	15.95
T5;R3;C3;P1;	24	RM only	-	OL40mm@IRI6	2.64	OL40mm@IRI6	2.64	OL40mm@IRI6	2.64

Strategy Analysis

- Can be used to prepare a decision matrix for selection of treatments
  - Based on expected budget
  - Based on optimum use of that budget
- Can be used as basis for further planning
  - Integrated into RAMS

Решения о работах в зависимости от состояния

Инт-ть дв. (СГС	Трещины	Колея / Ямы	0-1 IRI: 0-1	0-1 IRI: 2	0-1 IRI: 3-4	2 IRI: 0-1	2 IRI: 2	2 IRI: 3-4	3 IRI: 0-1	3 IRI: 2	3 IRI: 3-4
< 1000	0-1	0 - 1	СОД	СОД	МР	СОД	СОД	МР	МР	РЕК1	РЕК1
		2	ЯР	ЯР	МР	ЯР	ЯР	МР	ПИ	РЕК1	РЕК1
		3	ЯР	ЯР	МР	ЯР	МР	МР	ПИ	РЕК1	РЕК1
	2 - 3	0 - 1	ЗТ	ШПО	Ф308	ШПО	ШПО	Ф308	РЕК1	РЕК1	РЕК1
		2	ШПО	ШПО	Ф308	ШПО	Ф304	Ф308	РЕК1	РЕК1	РЕК1
		3	ШПО	ШПО	Ф308	Ф304	Ф306	Ф308	РЕК1	РЕК1	РЕК1
	4	0 - 1	ШПО	ШПО	ПИ	ШПО	Ф304	ПИ	РЕК1	РЕК1	РЕК1
		2	ШПО	Ф304	ПИ	Ф304	Ф306	ПИ	РЕК1	РЕК1	РЕК1
		3	РЕК1	РЕК1	РЕК1	РЕК1	РЕК1	РЕК1	РЕК1	РЕК1	РЕК1
1000-3000	0-1	0 - 1	СОД	СОД	МР	СОД	ШПО	АБ08	МР	РЕК2	РЕК2
		2	ЯР	ЯР	АБ08	МР	МР	АБ08	ПИ	РЕК2	РЕК2
		3	ЯР	ЯР	АБ08	МР	АБ08	АБ08	ПИ	РЕК2	РЕК2
	2 - 3	0 - 1	ЗТ	ДШПО	АБ08	ШПО	АБ04	АБ08	РЕК2	РЕК2	РЕК2
		2	ШПО	Ф304	АБ11	Ф304	АБ08	АБ11	РЕК2	РЕК2	РЕК2
		3	Ф304	АБ08	АБ11	АБ08	АБ11	АБ11	РЕК2	РЕК2	РЕК2
	4	0 - 1	ШПО	Ф304	АБ11	Ф304	АБ08	АБ11	РЕК2	РЕК2	РЕК2
		2	Ф304	АБ08	РЕК2	АБ08	АБ11	РЕК2	РЕК2	РЕК2	РЕК2
		3	РЕК2	РЕК2	РЕК2	РЕК2	РЕК2	РЕК2	РЕК2	РЕК2	РЕК2
>3000	0-1	0 - 1	СОД	СОД	МР	СОД	ШПО	АБ11	МР	РЕК3	РЕК3
		2	ЯР	ЯР	АБ11	МР	МР	АБ11	ПИ	РЕК3	РЕК3
		3	ЯР	ЯР	АБ11	МР	АБ11	АБ11	ПИ	РЕК3	РЕК3
	2 - 3	0 - 1	ЗТ	АБ04	АБ11	ШПО	АБ04	АБ11	РЕК3	РЕК3	РЕК3
		2	ШПО	Ф304	АБ13	Ф304	АБ11	АБ13	РЕК3	РЕК3	РЕК3
		3	Ф304	АБ11	АБ13	АБ11	АБ13	АБ13	РЕК3	РЕК3	РЕК3
	4	0 - 1	ШПО	Ф304	АБ13	Ф304	АБ11	АБ13	РЕК3	РЕК3	РЕК3
		2	Ф304	АБ11	РЕК3	АБ11	АБ13	РЕК3	РЕК3	РЕК3	РЕК3
		3	РЕК3	РЕК3	РЕК3	РЕК3	РЕК3	РЕК3	РЕК3	РЕК3	РЕК3

Unsealed	Good	Fair	Poor	Bad	Very Bad
AADT<50	Routine				
50<AADT<200	Regravel				
200<AADT<500					

Penmac	Good	Fair	Poor	Bad	Very Bad
AADT<50	Routine				
50<AADT<200					
200<AADT<500		Seal	Overlay	Rehab PM	
500<AADT<1000					
1000<AADT<2500					
AADT>2500					

Asphalt concrete	Good	Fair	Poor	Bad	Very Bad
AADT<50	Routine				
50<AADT<200					
200<AADT<500		Seal	Overlay	Rehab AC	
1000<AADT<2500					
AADT>2500					

Cement concrete	Good	Fair	Poor	Bad	Very Bad
AADT<50	Routine				
50<AADT<200					
200<AADT<500		Overlay			
500<AADT<1000					
1000<AADT<2500					
AADT>2500					

First Priority, Second Priority, Third Priority, Routine maintenance only

Decision Matrix

- Depends on expected funding versus expected needs
  - Current budget

Paved	R1 IRI<=4.5	R2 4.5<IRI<=6	R3 6<IRI<=9	R4 IRI>9
T4 ADT>1000	Routine	OL40mm@IRI5	OL60mm@IRI9	RHAC50mm@IRI11
T3 250<ADT<=1000	Routine	Routine	OL60mm@IRI9	RHAC50mm@IRI11
T2 50<ADT<=250	Routine	Routine	Routine	Holding
T1 10<ADT<=50	No Works	No Works	No Works	No Works
T1 ADT<=10	No Works	No Works	No Works	No Works

Unpaved	R1 GR>100mm	R2 50<GR<100	R3 GR<50mm	R4 ER
T4 ADT>1000	Routine	Routine	Routine	UGSD25mm@ADT250
T3 250<ADT<=1000	Routine	Routine	Routine	Holding
T2 50<ADT<=250	No Works	No Works	No Works	No Works
T1 10<ADT<=50	No Works	No Works	No Works	No Works
T1 ADT<=10	No Works	No Works	No Works	No Works

  - Increased budget

Paved	R1 IRI<=4.5	R2 4.5<IRI<=6	R3 6<IRI<=9	R4 IRI>9
T4 ADT>1000	Routine	OL60mm@IRI5	OL60mm@IRI7	RHAC50mm@IRI11
T3 250<ADT<=1000	Routine	OL40mm@IRI5	OL60mm@IRI7	RHAC50mm@IRI11
T2 50<ADT<=250	Routine	Routine	OL40mm@IRI7	RHST25mm@IRI11
T1 10<ADT<=50	Routine	Routine	Routine	RHST25mm@IRI11
T1 ADT<=10	Routine	Routine	Routine	Holding

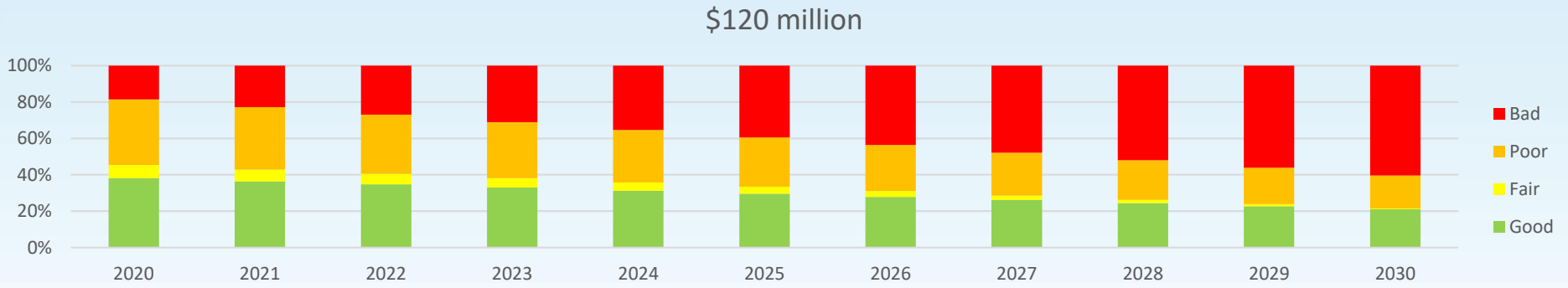
Unpaved	R1 GR>100mm	R2 50<GR<100	R3 GR<50mm	R4 ER
T4 ADT>1000	Routine	Routine	Routine	UGSD25mm@ADT250
T3 250<ADT<=1000	Routine	Routine	Routine	UGSD25mm@ADT250
T2 50<ADT<=250	Routine	Routine	GR150mm@50mm	RHGR150mm@GR=0 UGGR150mm@ADT25
T1 10<ADT<=50	Routine	Routine	Routine	Holding
T1 ADT<=10	No Works	No Works	No Works	No Works

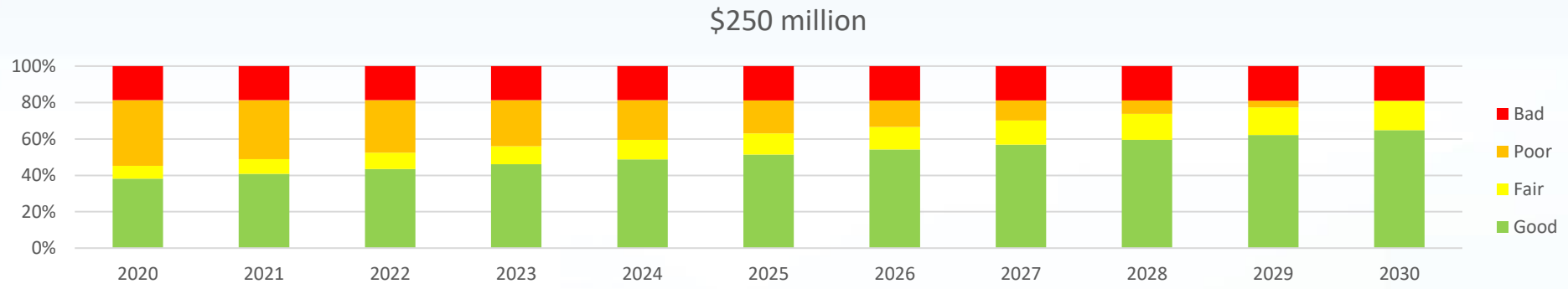
  - Optimal budget

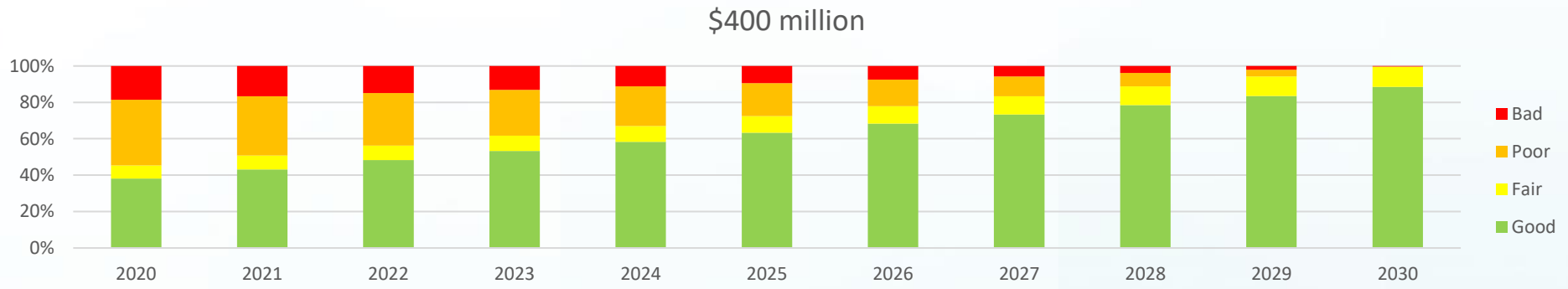
Paved	R1 IRI<=4.5	R2 4.5<IRI<=6	R3 6<IRI<=9	R4 IRI>9
T4 ADT>1000	Routine	OL60mm@IRI5	OL80mm@IRI7	RHAC50mm@IRI11
T3 250<ADT<=1000	Routine	OL60mm@IRI5	OL60mm@IRI7	RHAC50mm@IRI11
T2 50<ADT<=250	Routine	OL40mm@IRI5	OL40mm@IRI7	RHST25mm@IRI11
T1 10<ADT<=50	Routine	Routine	Routine	RHST25mm@IRI11
T1 ADT<=10	Routine	Routine	Routine	RHST25mm@IRI11

Unpaved	R1 GR>100mm	R2 50<GR<100	R3 GR<50mm	R4 ER
T4 ADT>1000	Routine	Routine	Routine	UGAC50mm@ADT1000
T3 250<ADT<=1000	Routine	Routine	Routine	UGSD25mm@ADT250
T2 50<ADT<=250	Routine	Routine	GR150mm@50mm	RHGR150mm@GR=0
T1 10<ADT<=50	Routine	Routine	GR150mm@50mm	RHGR150mm@GR=0 UGGR150mm@ADT25
T1 ADT<=10	Routine	Routine	Routine	Holding

Budget impact







RAMS analysis and planning

- Results of the RAMS analysis form the basis for planning
  - They are not necessarily the end result
- Combination of treatments into suitable packages
  - Avoiding very short treatment lengths
  - Creating more unified treatment approaches
- Combine economic criteria with other criteria
  - Use of other criteria will result in some changes to the ranking and selection
  - Changes should be limited to avoid much lower efficiency of investments

Example: Georgia

- HDM4 results for basis for planning
- Other criteria also applied
  - Difficulties getting objective data
- Final plan 80% in line with HDM4 results

Rehabilitation of: Sh37 Sadakhlo-Tsopi-Askhepi secondary road km3-km8 Section

Project Description

Following road section is part of rolling program for year 2018, section connects international road S07 Marneuli-Sadakhlo to Armenia border and provides access to social services to more than 1500 people. Road is considered importan in terms of Agriculture as well as providing minimum standard of mobility and integration.

Utilization		Class	Economic Indicators (mln. Gel) / Road Works			
Traffic (AADT)	250	1	Total Capital Cost	3.0	Pavement structure	n/a
Heavy Vehicles (%)	2.5		NPV	0.14	Bridge/Culvert/structure	n/a
[1]Condition	10.91	4	NPV/Cost Ratio	0.03	Traffic Safety	n/a
[2]Population Density	227	4	Cost/Pop. Ratio	0.002	Environment	n/a

Socio Economic Impact Assesment

Objective	Indicator	Unit
Enhanced National Connectivity	Part of Secondary Road connecting two international roads.	N
Enhanced Regional Connectivity	Distance from the centre of section to closest city centre.	34km
Enhanced economic activities	Number of registered businesses in the district where the section is located.	347
Population	Number of people living within 2km buffer along the road section.	1520
Education	Number of schools within 2 km buffer along the road section.	7
Tourism	Number of attraction within 2 km buffer along the road section.	2
Poverty	Percentage of people receiving government support within district where road section is located.	n/a
Life Line Road	The road is the only possibility for connecting the village to outside world.	y

Project Area Map

[1]Description of Condition Classes (Good, Fair; poor and Bad) is found in Chapter 4, section 1.1

Integrated or Separate

- The analysis/planning can be integrated or separate from the RAMS

- Separate (e.g. HDM4, dTIMS)
  - Data is exported from RAMS and imported into pavement management system (PMS)
  - PMS is used to carry out analysis
  - Results are exported from PMS and imported into RAMS
  - Results can be adjusted using other criteria (e.g. multicriteria analysis)
  - Results are shown in the RAMS (tables/maps)

- Integrated
  - RAMS includes planning module – often simplified (e.g. decision matrix)
  - Analysis is carried out using RAMS data
  - Results can be adjusted using other criteria (e.g. multicriteria analysis)
  - Results are shown in the RAMS (tables/maps)

Example: Kyrgyz

- HDM4 Strategy Analysis to determine optimal treatments
  - Depending on traffic volume and road condition

- Basis for planning module in RAMS
  - RM: Routine maintenance
  - CS: Crack Sealing
  - PAT: Patching
  - LR: Local Repair
  - EB: Edge Break Repair
  - REP: Reprofiling
  - SBST: single surface dressing
  - DBST: double surface dressing
  - AC0x: x cm asphalt concrete overlay
  - MR0x: x cm milling + replacing of asphalt
  - AC13: asphalt surface and base overlay
  - RECY: recycling of asphalt layers
  - RECO: reconstruction

		Rut	Rut < 20 mm			Rut > 20 mm		
Traffic (AADT)	Cracks	Potholes	IRI: < 3.5	IRI: 3.5 - 5.5	IRI: > 5.5	IRI: < 3.5	IRI: 3.5 - 5.5	IRI: > 5.5
< 300	< 40 m2	0 - 1	RM	RM	LR	LR	LR	MR4
		2	PAT	PAT	LR	LR	REP	MR4
		3	PAT	PAT	LR	LR	MR4	RECO1
	40-200 m2	0 - 1	CS	CS	SBST	LR	REP	MR4
		2	CS+PAT	CS+PAT	SBST	LR	MR4	MR4
		3	SBST	SBST	SBST	RECO1	RECO1	RECO1
	> 200 m2	0 - 1	SBST	SBST	MR4	MR4	MR4	MR4
		2	SBST	SBST	MR4	MR4	MR4	MR4
		3	RECO1	RECO1	RECO1	RECO1	RECO1	RECO1
300- 1000	< 40 m2	0 - 1	RM	RM	LR	LR	LR	RECO1
		2	PAT	PAT	LR	LR	REP	RECO1
		3	PAT	PAT	LR	LR	MR4	RECO1
	40-200 m2	0 - 1	CS	CS	DBST	LR	REP	RECO1
		2	CS+PAT	CS+PAT	DBST	LR	MR6	RECO1
		3	DBST	DBST	DBST	RECO1	RECO1	RECO1
	> 200 m2	0 - 1	DBST	DBST	MR6	MR6	MR6	RECO1
		2	DBST	DBST	MR6	MR6	MR6	RECO1
		3	RECO1	RECO1	RECO1	RECO1	RECO1	RECO1
1000-3000	< 40 m2	0 - 1	RM	RM	LR	LR	REP	RECO2
		2	PAT	PAT	LR	MR4	MR6	RECO2
		3	PAT	PAT	OL4	MR6	MR6	RECO2
	40-200 m2	0 - 1	CS	CS	OL4	RECO2	RECO2	RECO2
		2	CS+PAT	CS+PAT	OL6	RECO2	RECO2	RECO2
		3	OL4	OL6	OL6	RECO2	RECO2	RECO2
	> 200 m2	0 - 1	DBST	DBST	MR6	RECO2	RECO2	RECO2
		2	DBST	MR6	RECO2	RECO2	RECO2	RECO2
		3	RECO2	RECO2	RECO2	RECO2	RECO2	RECO2
>3000	< 40 m2	0 - 1	RM	RM	LR	LR	REP	RECO3
		2	PAT	PAT	LR	MR4	MR6	RECO3
		3	PAT	PAT	OL6	MR6	RECO3	RECO3
	40-200 m2	0 - 1	CS	OL4	OL6	MR6	RECO3	RECO3
		2	OL4	OL6	OL8	RECO3	RECO3	RECO3
		3	OL6	OL8	OL11	RECO3	RECO3	RECO3
	> 200 m2	0 - 1	MR4	MR6	MR8	RECO3	RECO3	RECO3
		2	MR6	MR8	RECO3	RECO3	RECO3	RECO3
		3	RECO3	RECO3	RECO3	RECO3	RECO3	RECO3

Example: Afghanistan

- Several selection/prioritization criteria

- Selection of roads in secure areas (security rating)
  - Other roads postponed till later years
- Selection of roads with high PASER score (8-10)
  - Focusing on good condition roads requiring routine maintenance
  - Extended to lower PASER categories if implementation capacity allows
  - Extended to lower PASER categories if budget allows
- Ranking of roads within specific PASER category
  - By cost/vehicle-km (cost per kilometre divided by number of vehicles)
  - Priority to low cost maintenance and/or roads with high traffic volumes

PASER score	Intervention	Estimated cost
9	Routine	$ 750/km
8	Routine	$ 1,500/km
7	Routine	$ 2,250/km
6	Seal	$ 5,455/km
5	Thin overlay	$ 81,822/km
4	Structural overlay	$ 130,910/km

Case Study Afghanistan

- ADB Road Asset Management Project
- Data collection
  - Mapping of 25,103 km of roads
  - PASER data for 3,700 km of SRN roads
  - Inventory and condition data for 500 bridges
- Data management
  - Currently: Geoserver + Postres
  - Planned: ESRI Enterprise Web + Microsoft SQL Server custom-made database
  - Pavement management system + bridge management system
- Data analysis
  - Road prioritization based on PASER rating and cost/vehicle-km
  - Bridge prioritization based on Bridge Condition Index + Priority Condition Index
- Counterpart
  - Road Asset Management Directorate