

ROAD INFRASTRUCTURE
MANAGEMENT FORUM

Our Carbon Equation

Modelling maintenance costs successfully: A significant step change in performance

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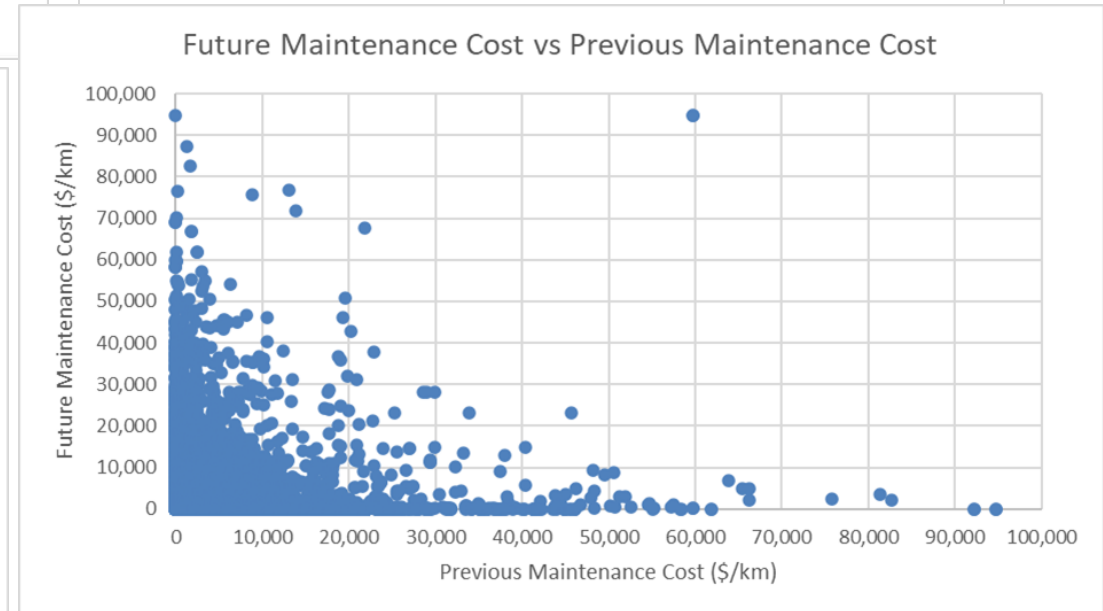
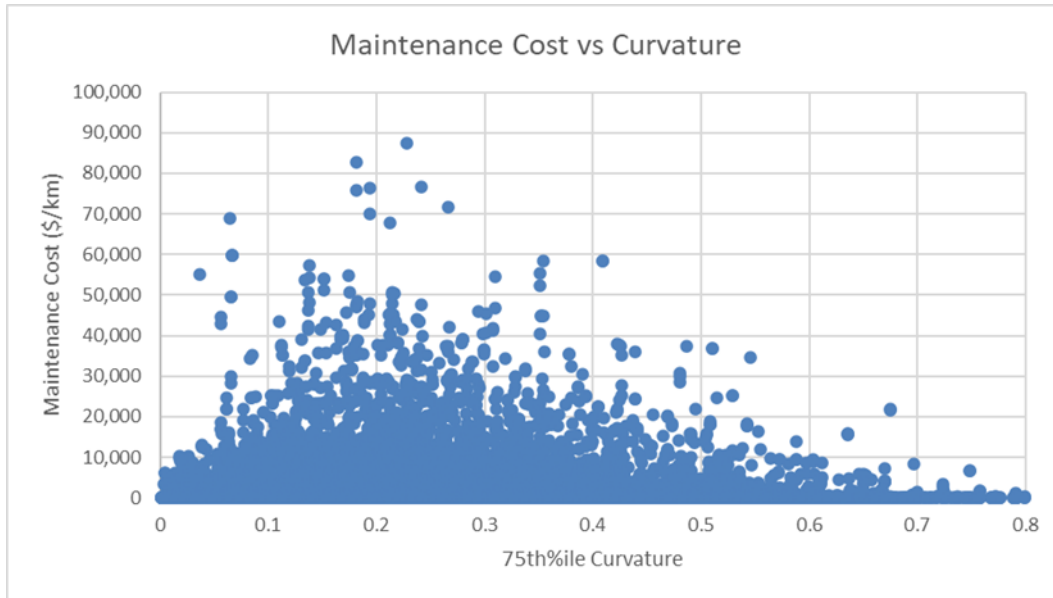
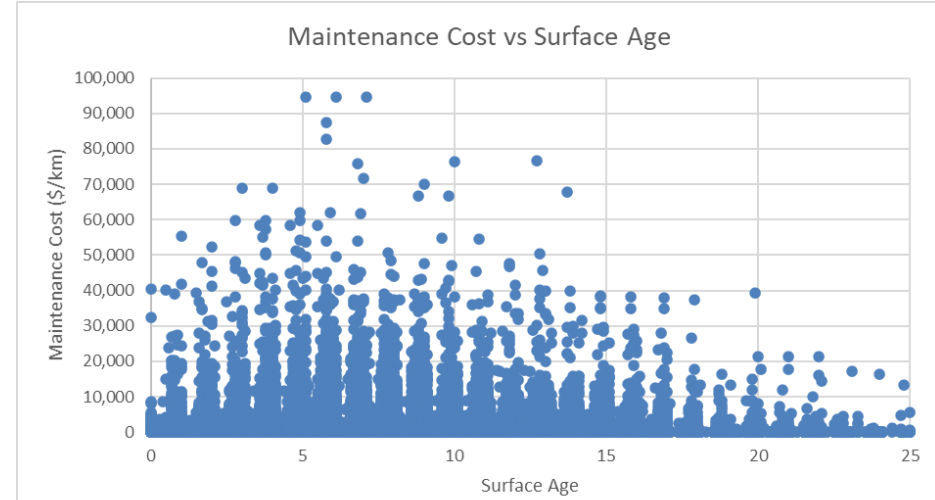
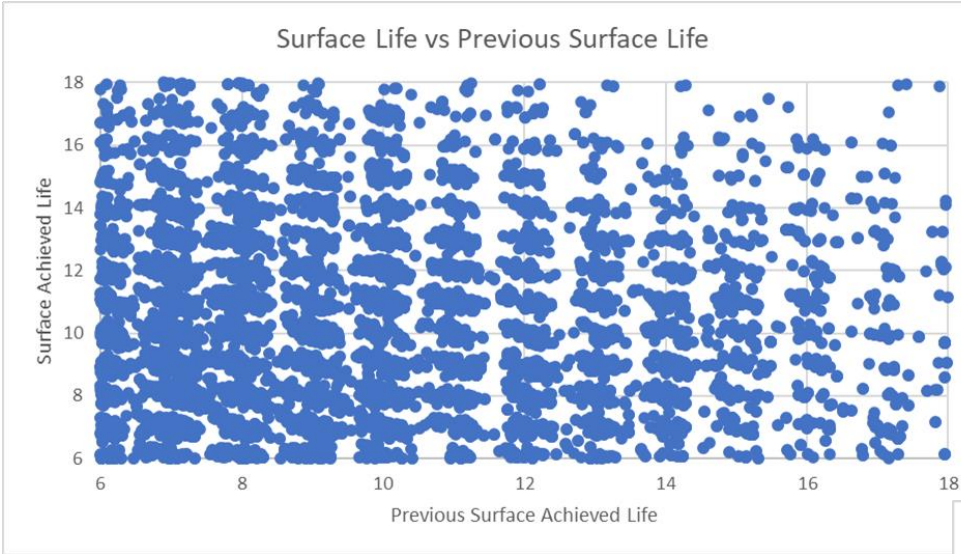
Maintenance Cost Models: Search for the Holy Grail

- Various Variables Varying:
 - Material Properties
 - Construction Profile and Consistency
 - Loading
 - Moisture content (incl Drainage)
- Many Condition Measures/Failure Modes
 - Roughness
 - Rutting
 - Texture
 - Cracking
 - Shoving
- Data Quality/Completeness/Accuracy



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Maintenance Cost Models: No clear causal factors



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Maintenance Cost Models: Time for a new toolkit



Mike's tool kit



Lucien's tool kit

Need a solution,
not an expression or
equation

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Finding Maintenance Cost Equations

Factors that impact maintenance activities

Drainage
Condition

Maintenance
Contract

Weather (Natural
Disaster)

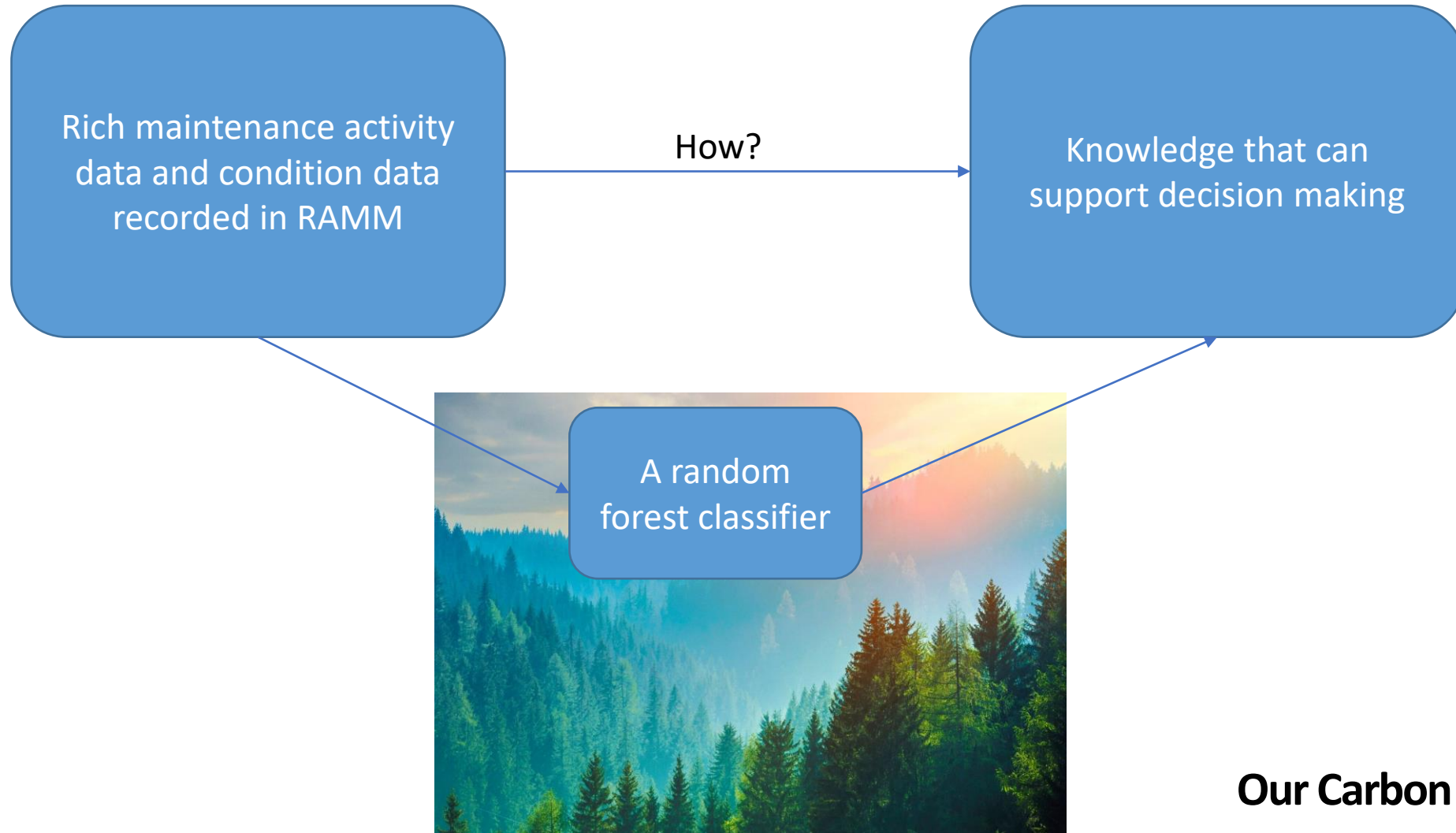
Construction
Consistency

Renewal
Programme

Having all the factors above, it's really challenging to describe the maintenance activities using some mathematical equations.

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A Machine Learning Approach



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Model Input /Output

Input per 100m section

- Surface /Pavement age
- Traffic loading
- Cumulative traffic loading
- High speed condition data
- High speed condition progression
- Surface type
- Number of seal layers
- FWD
- Previous maintenance expenditure (last 3 years)



Output per 100m section

Maintenance Risk
Categories for the near
future (next 3 years)

- High Risk
- Moderate Risk
- Low Risk

21 Variables simultaneously analysed

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Results: Step Change!!

Risk sites identification

Number of test records		Prediction	
		No Risk	Some Risk
Actual	No Risk	4782	611
	Some Risk	610	4205

Class	Precision	Recall
No Risk	88.69%	88.67%
Some Risk	87.31%	87.33%
Overall Accuracy		88.04%



Risk categorisation

Number of test records		Prediction		
		Low	Moderate	High
Actual	Low	429	109	73
	Moderate	131	1247	157
	High	157	350	2163

Class	Precision	Recall
Low	59.83%	70.21%
Moderate	73.09%	81.24%
High	90.39%	81.01%
Overall Accuracy		79.71%

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Some High-Risk Sites Identified by the Model



High-risk sites usually take around 5-10% of the network length but around 80-90% of the maintenance expenditure.

So how have we used it??

Forward Work Programming

- Risk assessment tool for treatment lengths
- Intelligence tool in assessing savings for renewal programmes
- Prioritisation tool for delaying or progressing sites in the programme

- Green equates to strong risk elements and recommend to keep in programme unaltered
- Amber equates to possible opportunity for savings or splitting
- Orange equates to strong opportunity for savings

Road Name Risk Sections (H/M/L)	Start	End	Length	Risk Score	Comments
002-0232 4/1/0	3915	4380	465	5.66	Keep in programme
002-0232 0/0/4	9330	9688	358	2.84	No high maintenance cost triggers. High deflection and curvature. No historic spend, some rutting and rut progression. 9400 – 9600 higher rut depth. 2010 Second coat. Curvature and deflection same for all 400 metres. Possible rehab 9400 – 9600 Possible resurface with Maintenance Check TSD data OK
002-0243 2/0/3	8775	9260	485	2.16	2014 two coat seal. Two high cost sections predicted only out of 4.85. Possible split: resurface 8775 – 9100 with some heavy mtce 8900 – 9000. Possible Pavement Renewal 9100 – 9260

So how have we used it??

- Candidate Site Selection for Auckland Transport
- Assessing future maintenance needs
- Prioritising maintenance treatments and corridors
- 3-year FWP optimisation
- dTIMS (in the future)

Treatment Length Data					Maintenance Risk			3yr FWP Optimisation												
treat_length_id	road_id	road_id	tl_start_m	tl_end_m	% High Risk	% Moderate Risk	% Low Risk	is_AC_Cul_de_Sac	adjacent_cs_row	adjacent_Cul_de_Sac_Row	score_yr1	score_yr2	score_yr3	treatment_Type	draft_treatment_yr	draft_treatment_cost	treatment_review	treatment_year_review	review_notes	
75627	41154	ABBOTLEIGH AVE	20	33	0%	0%	100%	FALSE												
15455	41154	ABBOTLEIGH AVE	33	340	0%	0%	100%	FALSE												
85924	41154	ABBOTLEIGH AVE	340	393	0%	0%	100%	FALSE			8	7.25	6.25	CHIP	2022/23	\$ 4,314	RSM	2022/23		
18579	40186	ABEL TASMAN AVE	17	168	0%	0%	100%	TRUE											Excluded. Maintenance	
37092	30007	ACTON PL	8	80	0%	0%	0%	FALSE												
37093	30007	ACTON PL	80	102	0%	0%	0%	TRUE												
15453	41153	ADAM SUNDE PL	4	193	0%	51%	49%	FALSE			9.0159	8.1389	6.631	CHIP	2022/23	\$ 14,761	RSM	2022/23		
15454	41153	ADAM SUNDE PL	193	223	0%	0%	23%	TRUE												
15452	41152	ADDISON DR	5	229	0%	0%	100%	FALSE			1	2.25	4.25	CHIP	2024/25	\$ 26,192	RSM	2024/25		
15451	41152	ADDISON DR	229	461	0%	0%	100%	FALSE												
37099	30010	ADDISON ST	19	236	0%	83%	0%	FALSE						CHIP	2024/25	\$ 20,051			Excluded. Maintenance	
15504	41186	ADITI CLOSE	5	150	0%	0%	66%	TRUE												
15449	41151	ADRIATIC AVE	5	82	0%	0%	0%	FALSE			6.5	7	6	CHIP	2024/25	\$ 5,167	RSM	2023/24		
15450	41151	ADRIATIC AVE	82	100	0%	0%	0%	TRUE												
72084	41150	AETNA PL	0	126	0%	0%	100%	FALSE												
15448	41150	AETNA PL	126	231	0%	0%	70%	FALSE												

RIMS

Roading Infrastructure Management Support

Thanks!

Q&A

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