Road Asset Management (RAM)
Azerbaijan
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Session: Lifecycle Decision Making & Pavement Prediction Modelling

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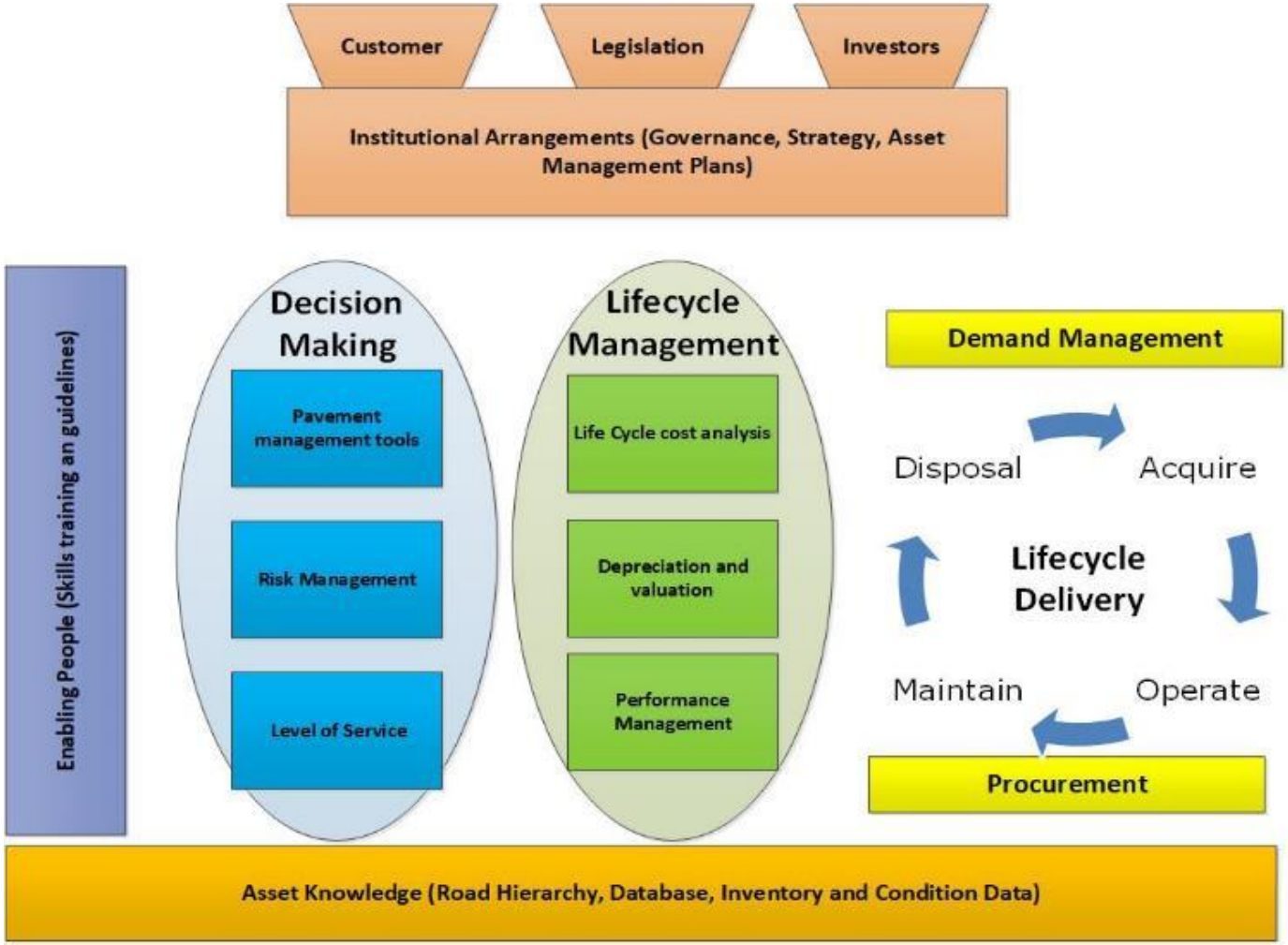
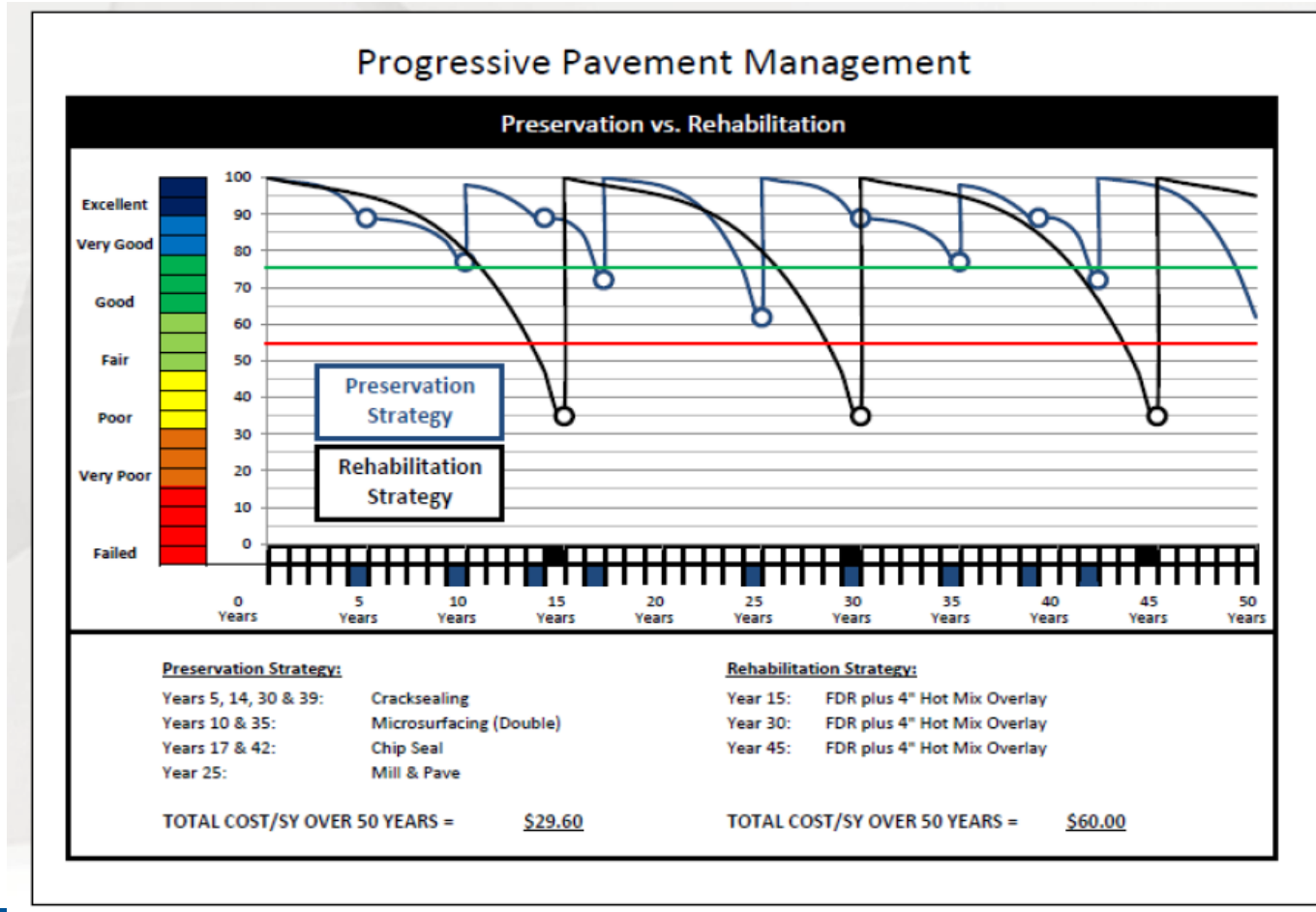
Life-cycle Management : Getting the most from our Investment

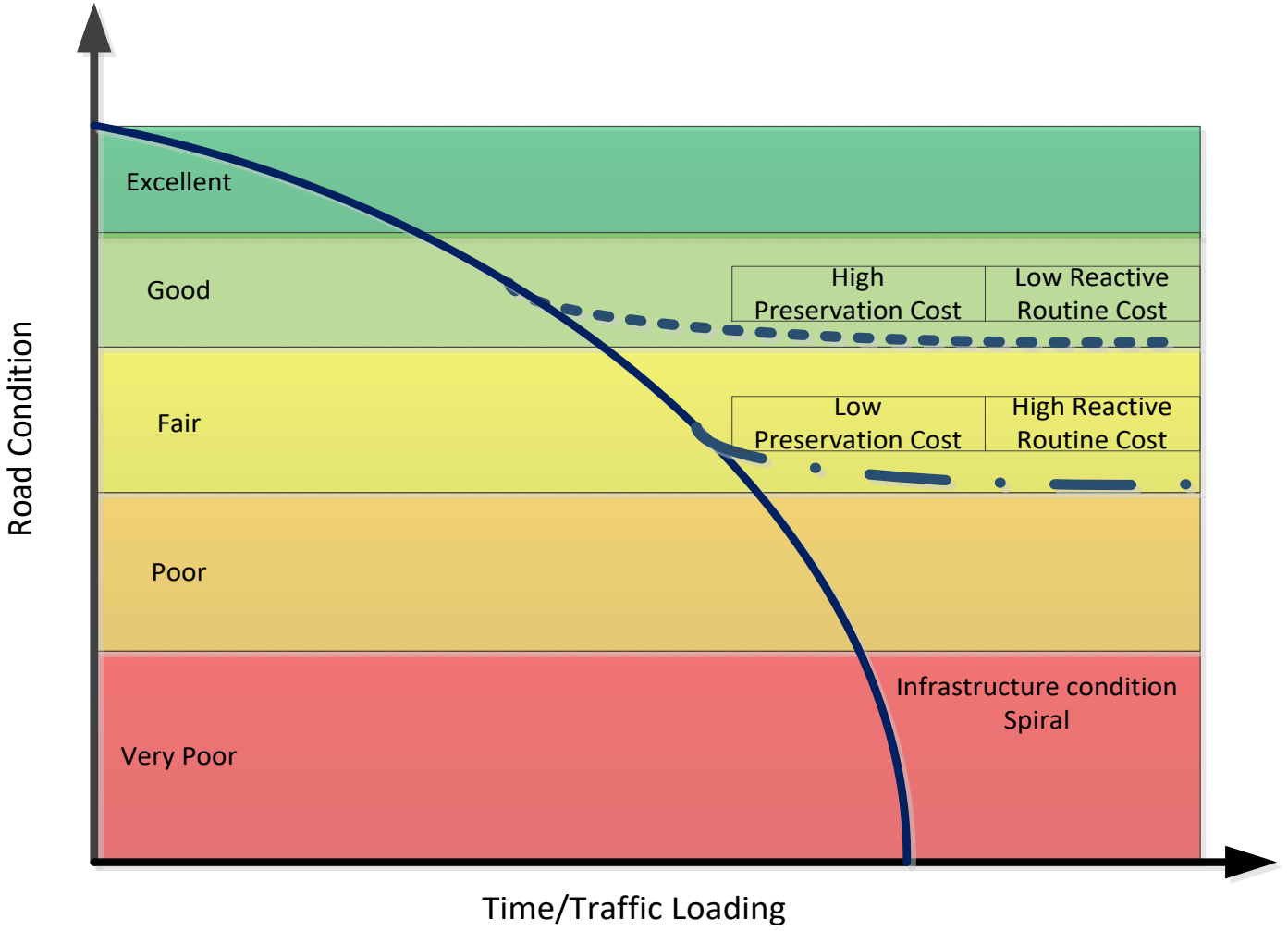


Life Cycle Cost Consider the Total Cost of Ownership

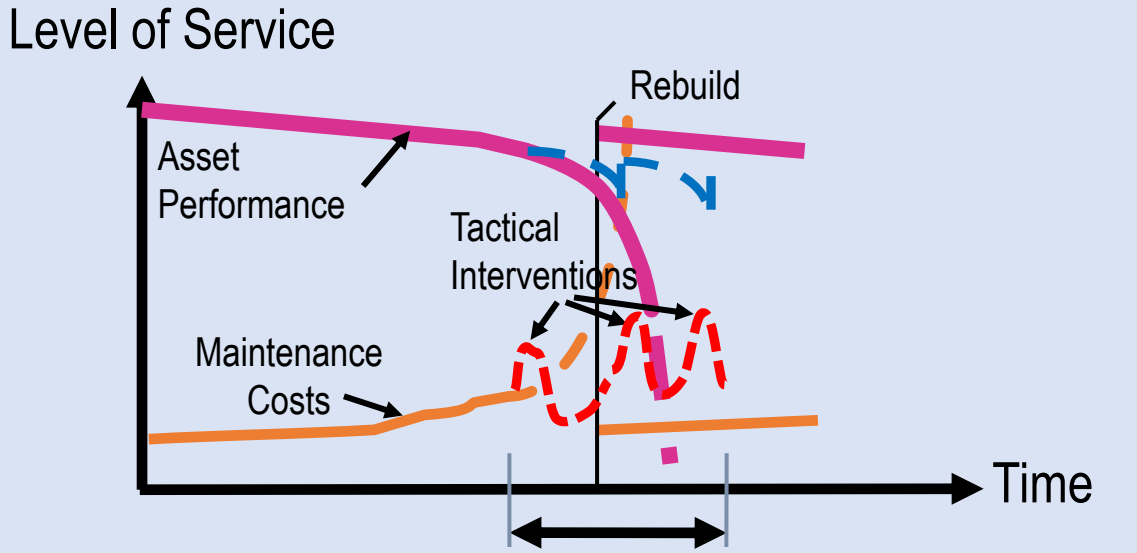
- Preservation approach costs less
- That means we are intervening earlier on roads



Maintain Infrastructure at Different Levels



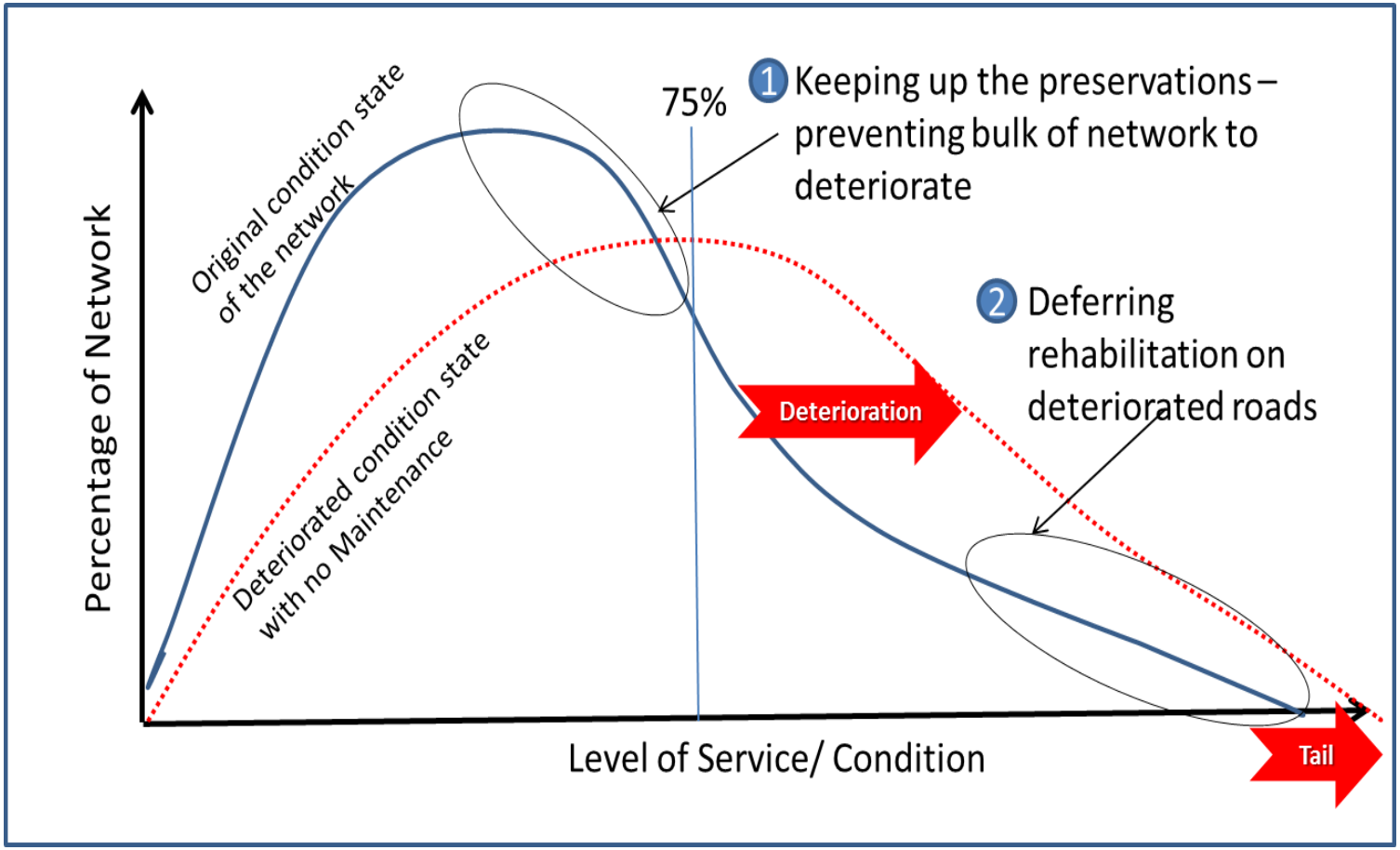
Optimising Value from Assets



Interventions to minimise annual whole of life costs

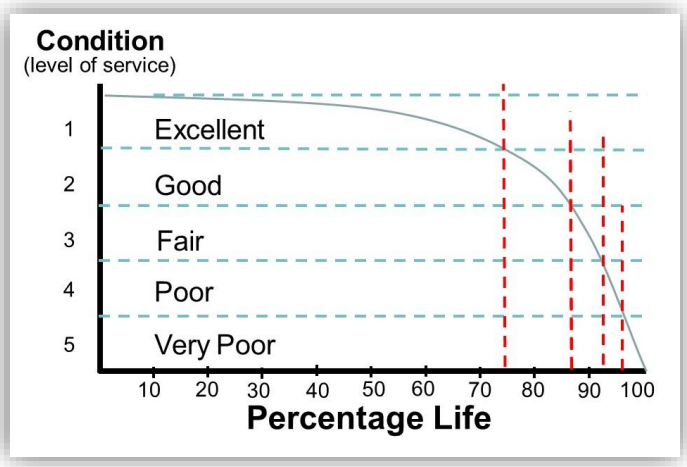
Source: David Fraser

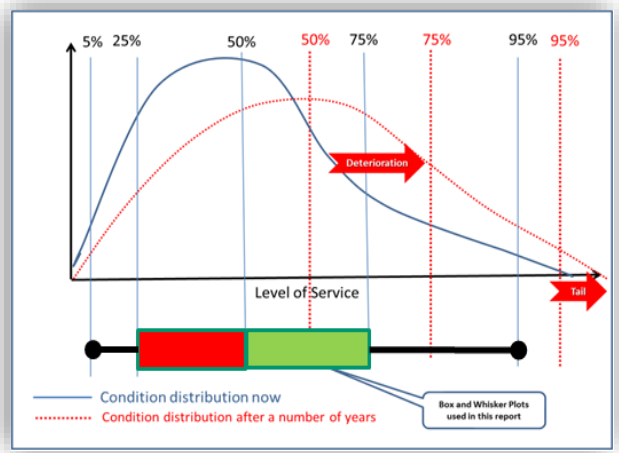
Theory: How Roads Deteriorate

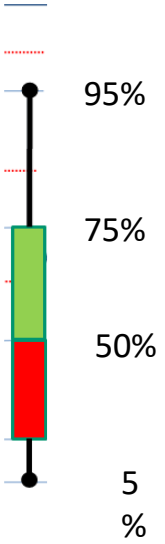


Think network first – then element

- Keeping an eye on the 75th percentile trend is a useful network indicator

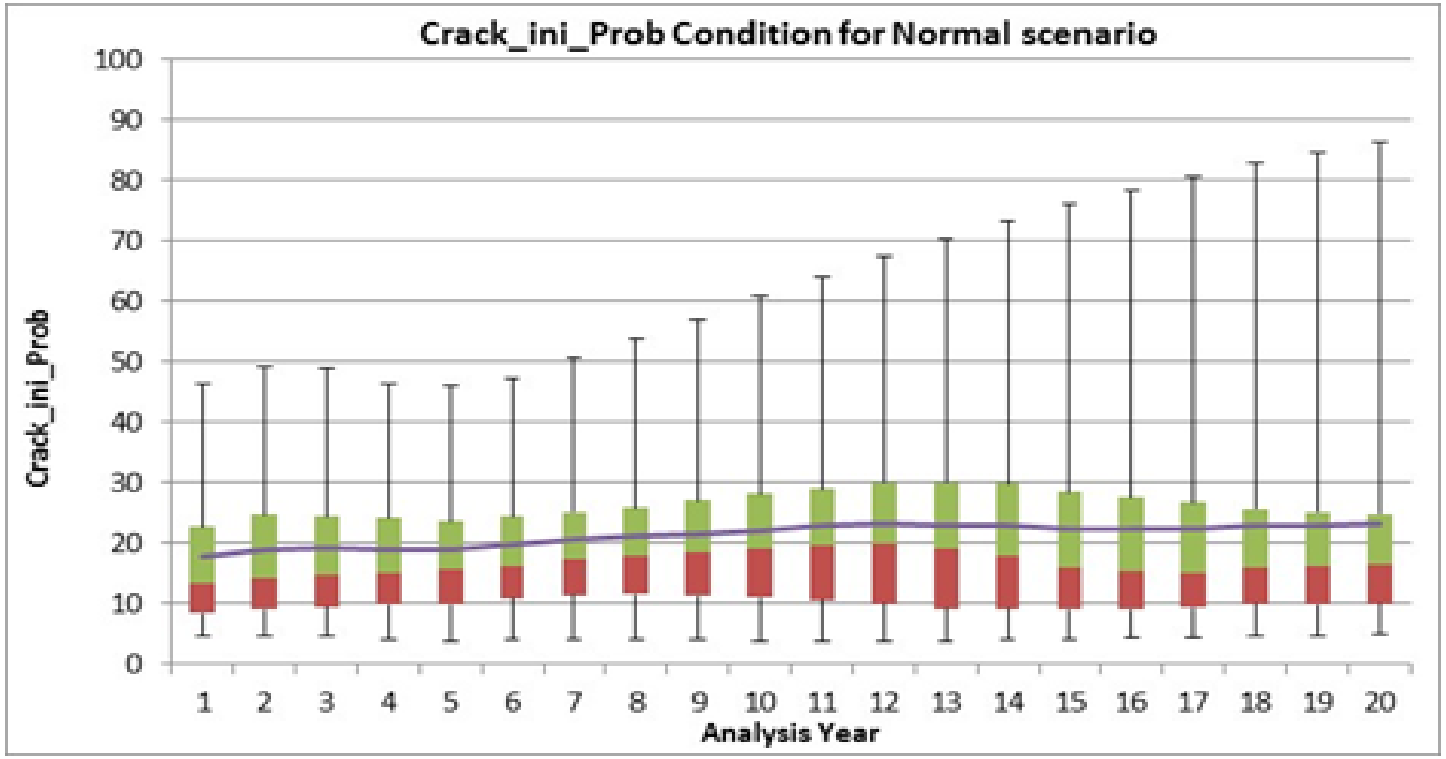




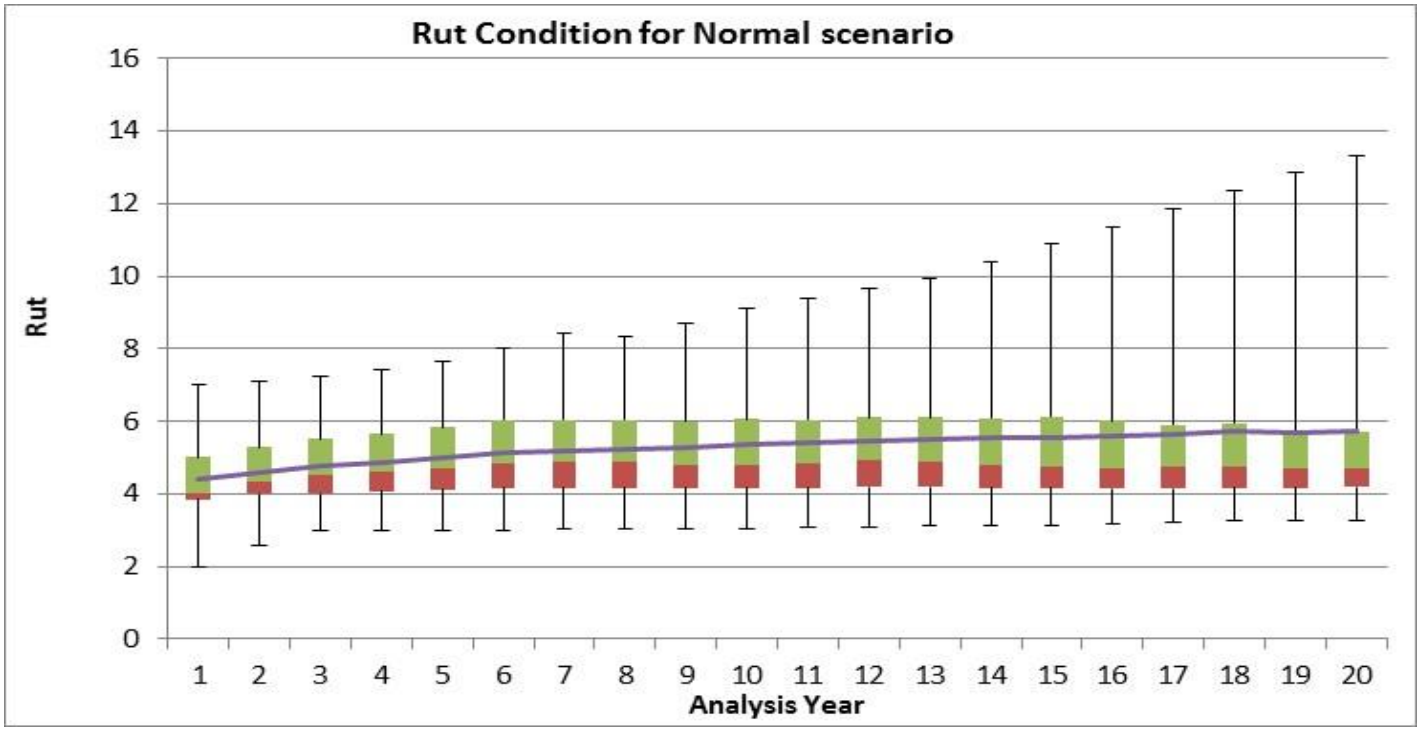


Source: David Fraser

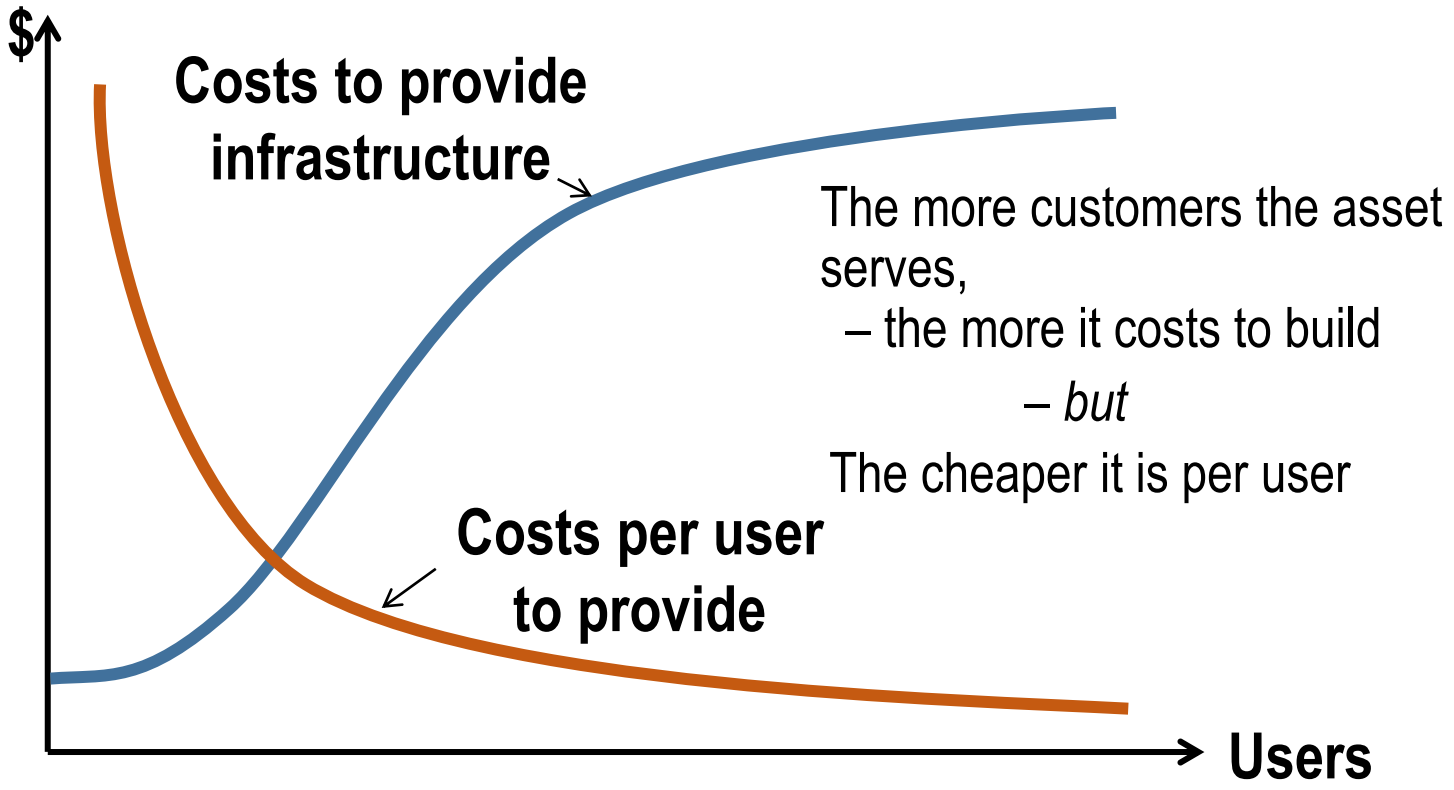
Results Surface Performance Overlaid



Pavement Performance Overlaid



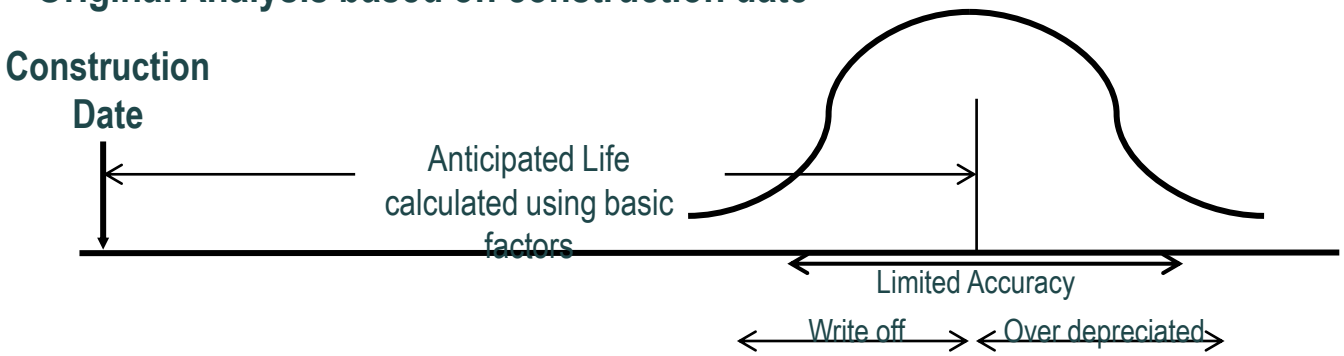
Asset Cost to User



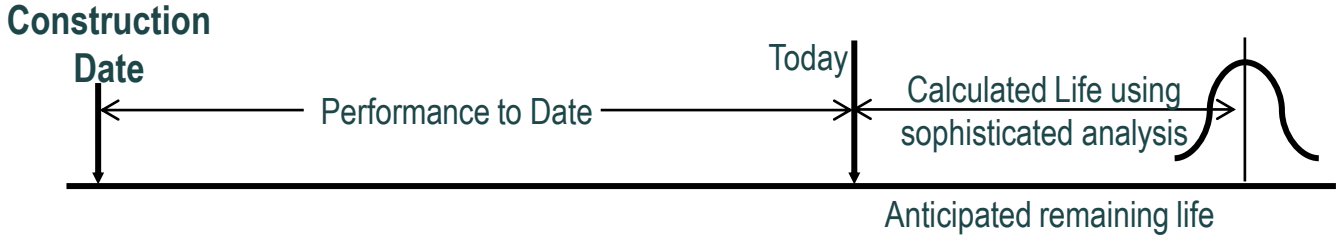
Source: David Fraser

Fine Tuning Analysis – Needs Forecasting

Original Analysis based on construction date



Sophisticated analysis based on today, yesterday and tomorrow



More accurate, with improved confidence in anticipated life and Condition!

Source: David Fraser

Forecasting Deterioration of Road Assets

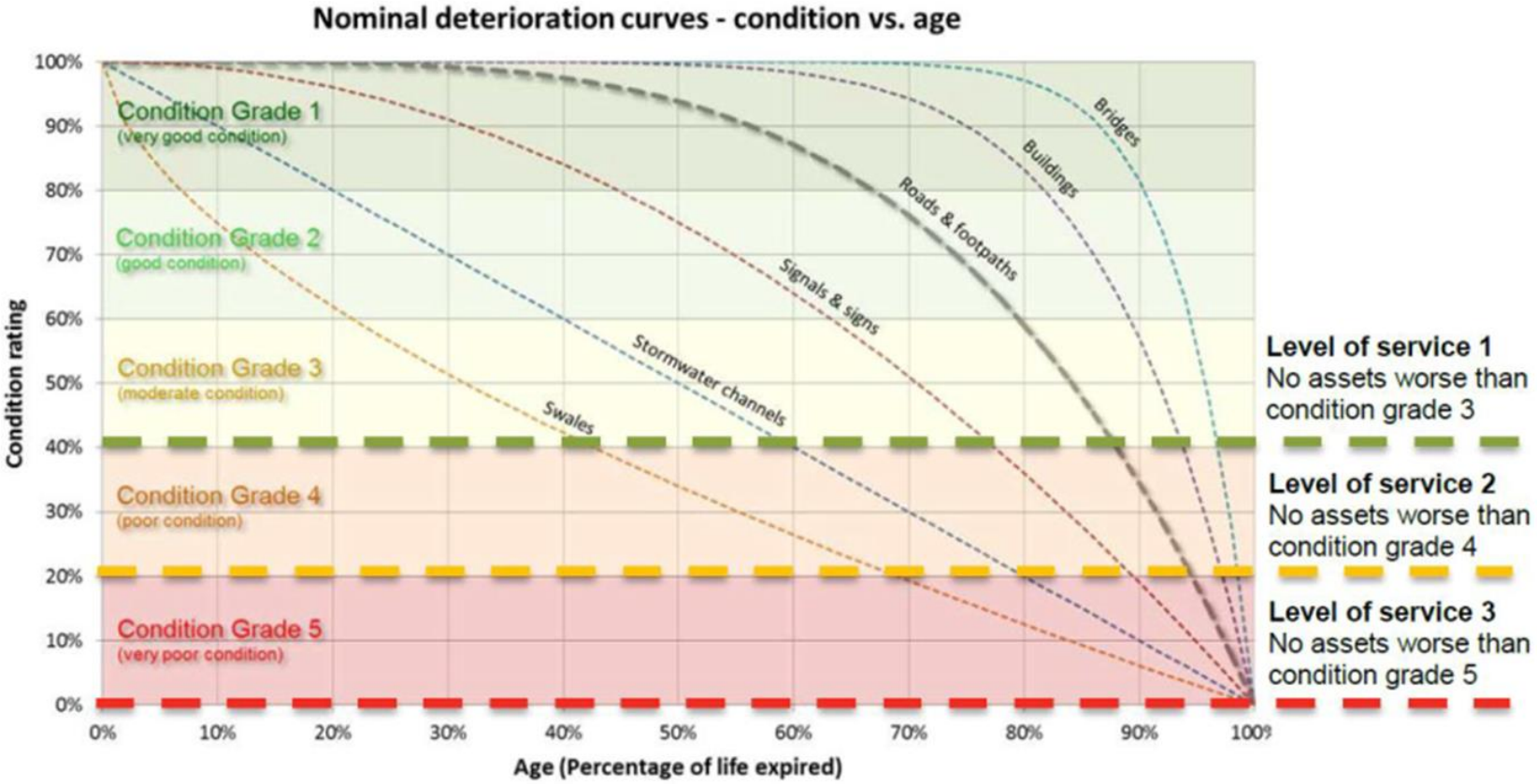
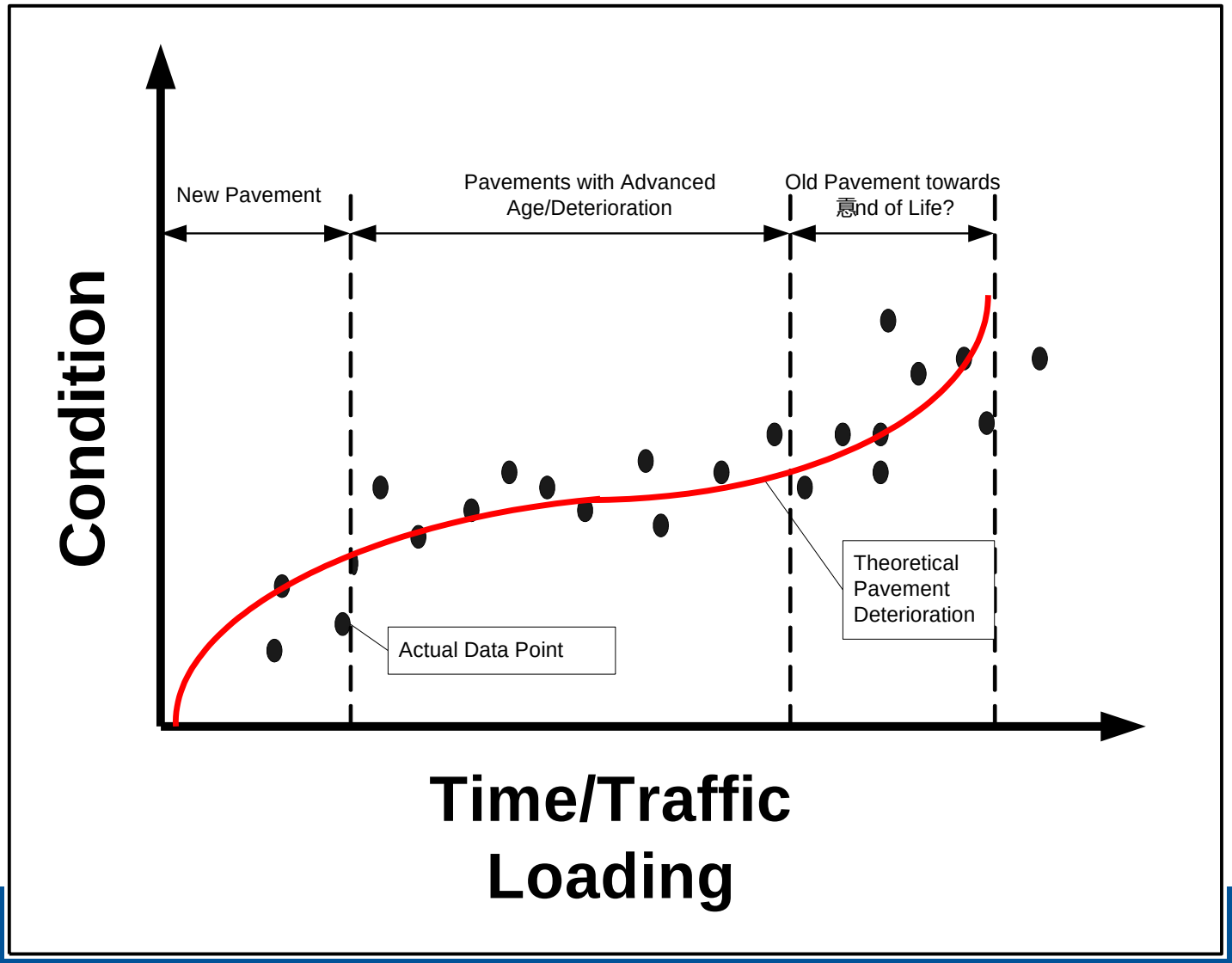


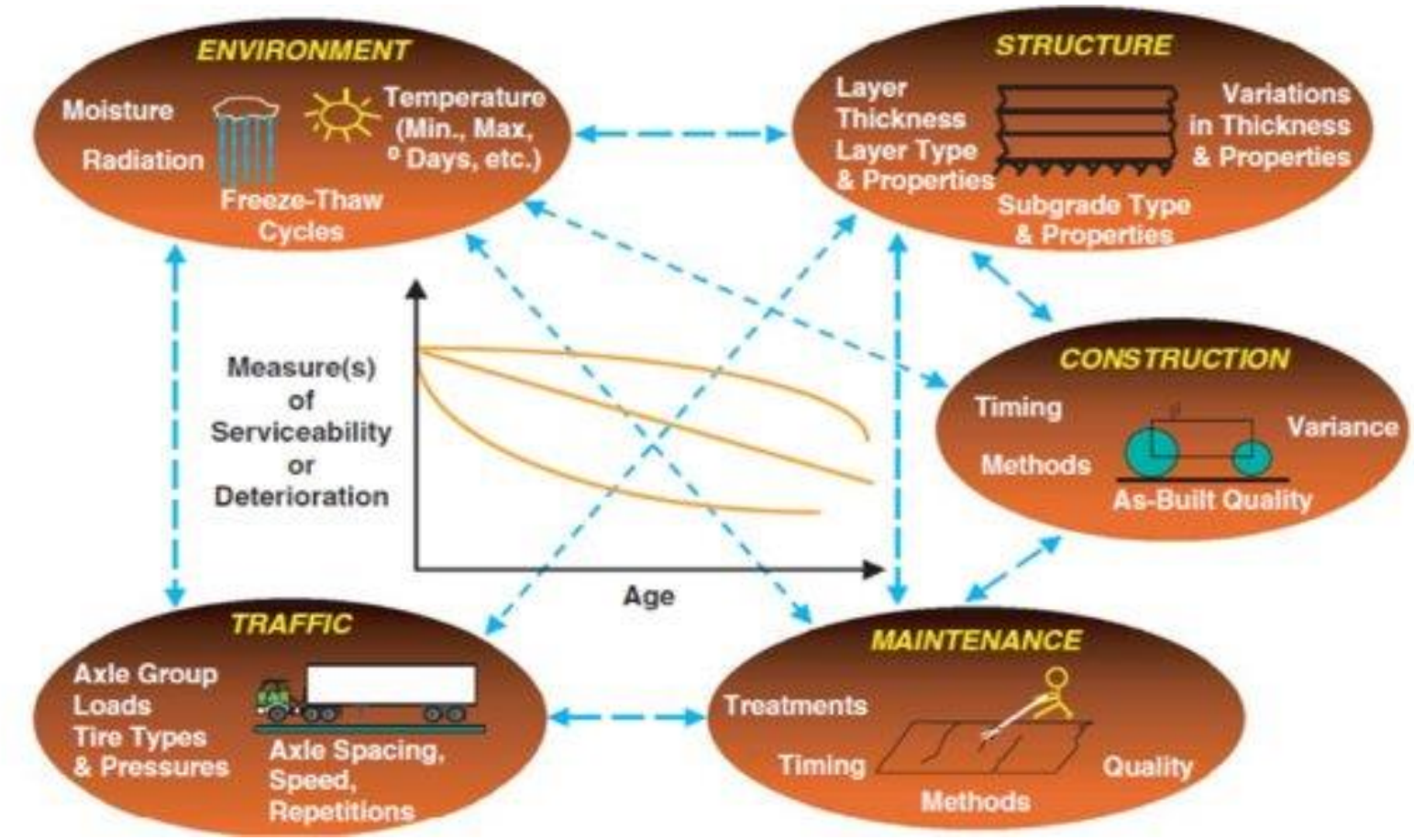
FIGURE 1 Condition grades, deterioration rates and condition-based levels of service.

Source Auckland Transport

Condition/Age Distribution



Road Deterioration: Influencing Factors



Source Tighe at al, 2007

Empirical Model Forms

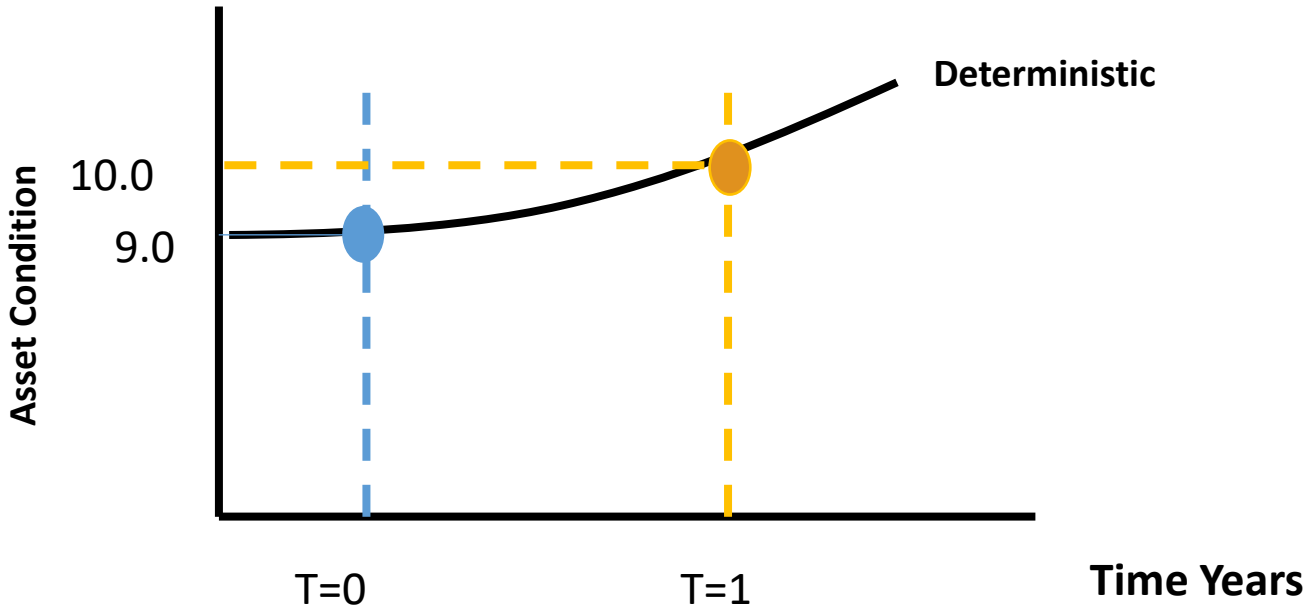
- Deterministic

"Predict future as a precise value on the basis of mathematical functions of observed or measured deterioration"

- Probabilistic (Stochastic)

"Predict future as the probability of occurrence of a range of possible outcomes"

Stochastic Modelling – TMP Example



Source: Elke Beca

Stochastic Example

Today	Any Other Day: Tomorrow			Day After Big Game: Tomorrow		
	80%	19%	1%	90%	0%	10%
	50%	45%	5%	90%	0%	10%
	25%	25%	50%	90%	0%	10%

Source Elke Beca

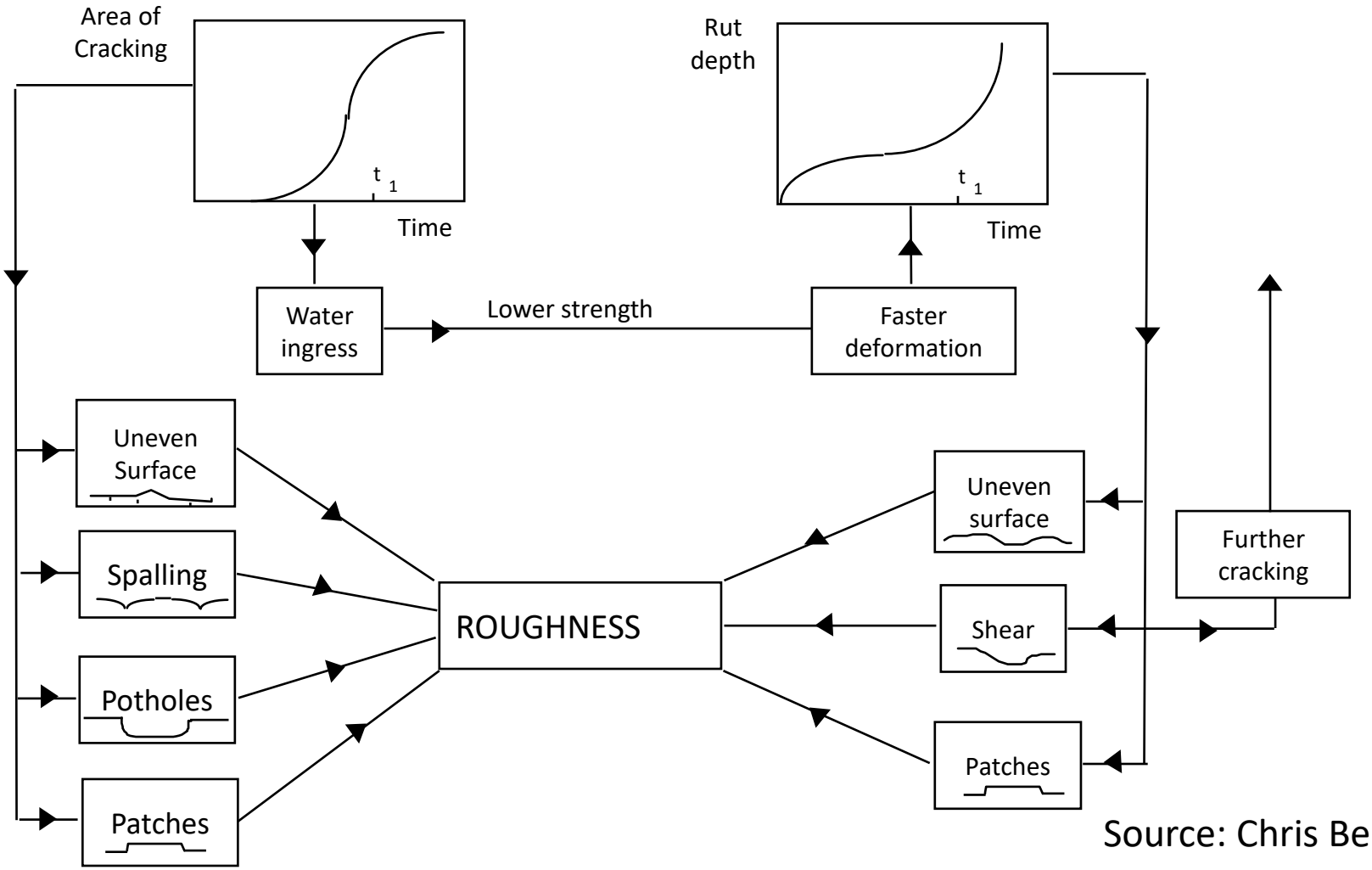
HDM Models

- HDM uses ‘Deterministic Models’
- Predicts a single future outcome based on current situation
- Developed using ‘structured empirical approach’
  - Knowledge of how pavements perform used to set framework for statistical analysis
- Incremental
  - Change in condition based on current condition:

    Δ CONDITION = f(a0, a1, a2)
  - Can use any start point so flexible

Source: Chris Bennett

HDM-4 Interactions Between Distresses



Source: Chris Bennett

Distresses Modeled

Bituminous	Concrete	Block*	Unsealed
Cracking Rutting Ravelling Potholing Roughness Edge break Surface texture Skid resistance	Cracking Joint spalling Faulting Failures Serviceability rating Roughness	Rutting Surface texture Roughness *not in software	Gravel loss Roughness

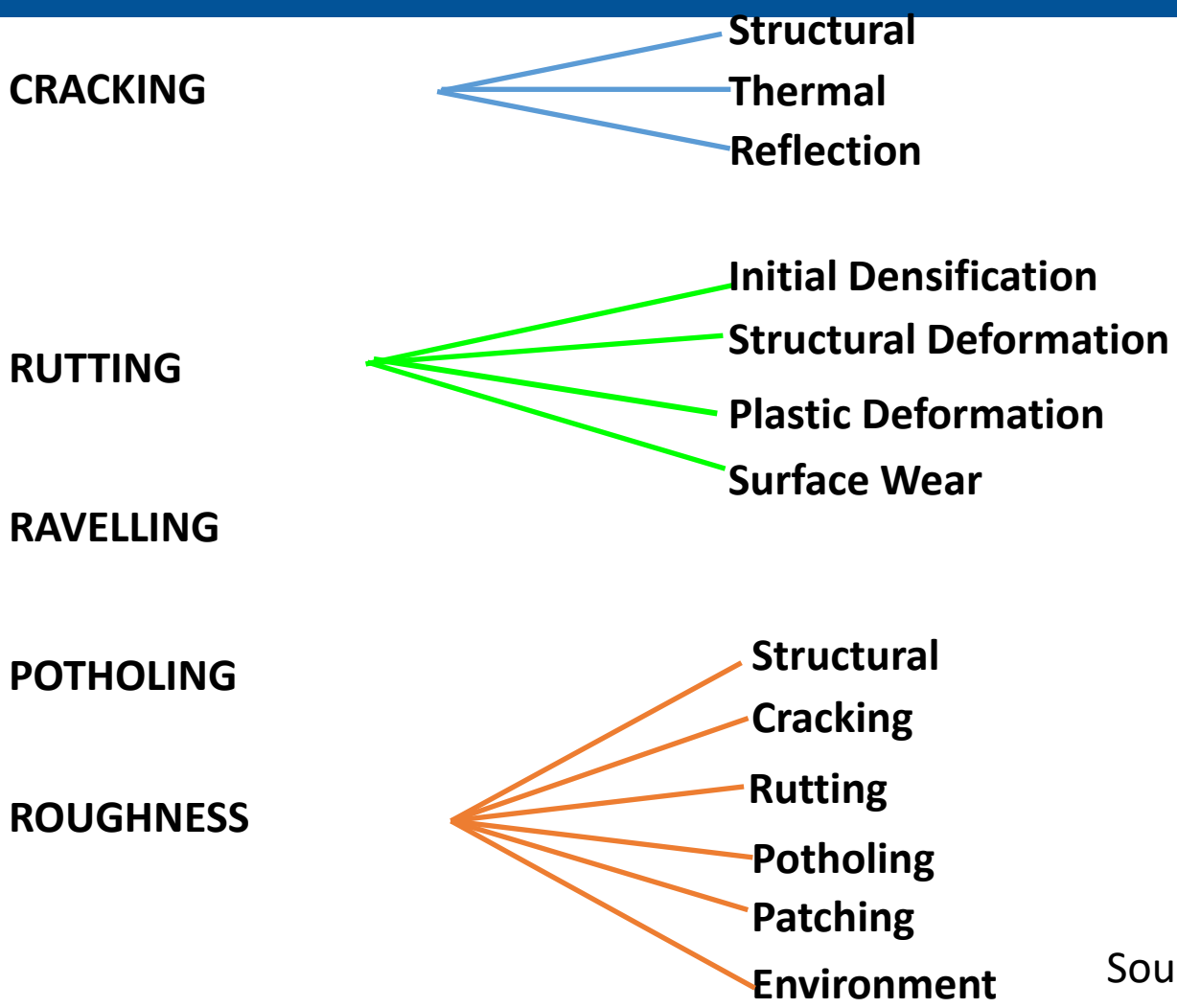
Source: Chris Bennett

Models Designed for Range of Conditions

- Moisture
  - Arid
  - Semi-arid
  - Sub-humid
  - Humid
  - Per-humid
- Temperature
  - Tropical
  - Sub-Tropical hot
  - Sub-Tropical Cool
  - Temperate Cool
  - Temperate Frees

Source: Chris Bennett

Deterioration Models - Bituminous



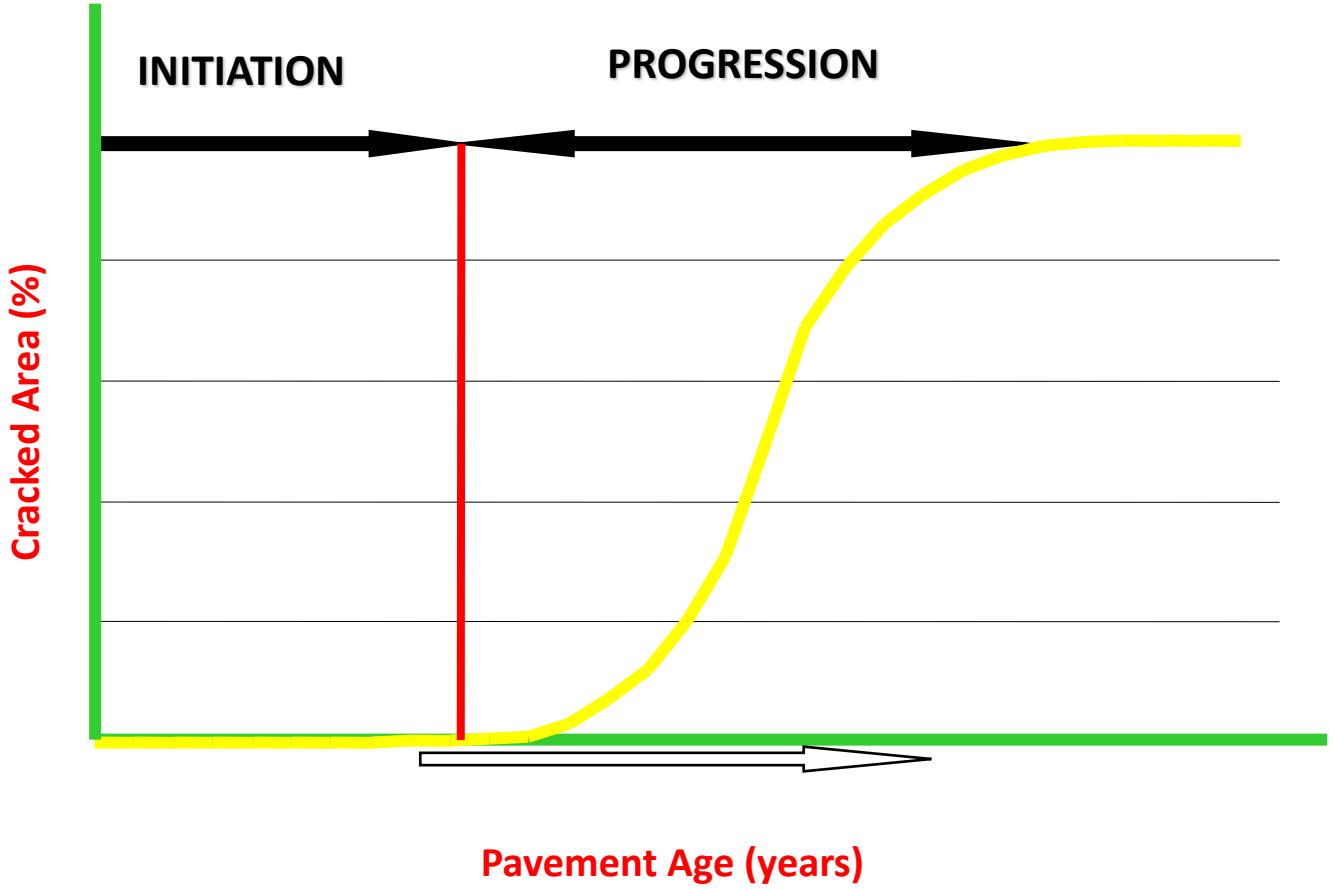
Source: Chris Bennett

Concrete Models

Cracking	**% of slabs cracked** **Number per km**	**JP** **JR**
Faulting	**mm**	**JP,JR**
Spalling joints	**% of transverse**	**JP,JR**
Failures	**Number per km**	**CR**
Serviceability	**Dimensionless**	**JR,CR**
Roughness	**m/km IRI**	**All**

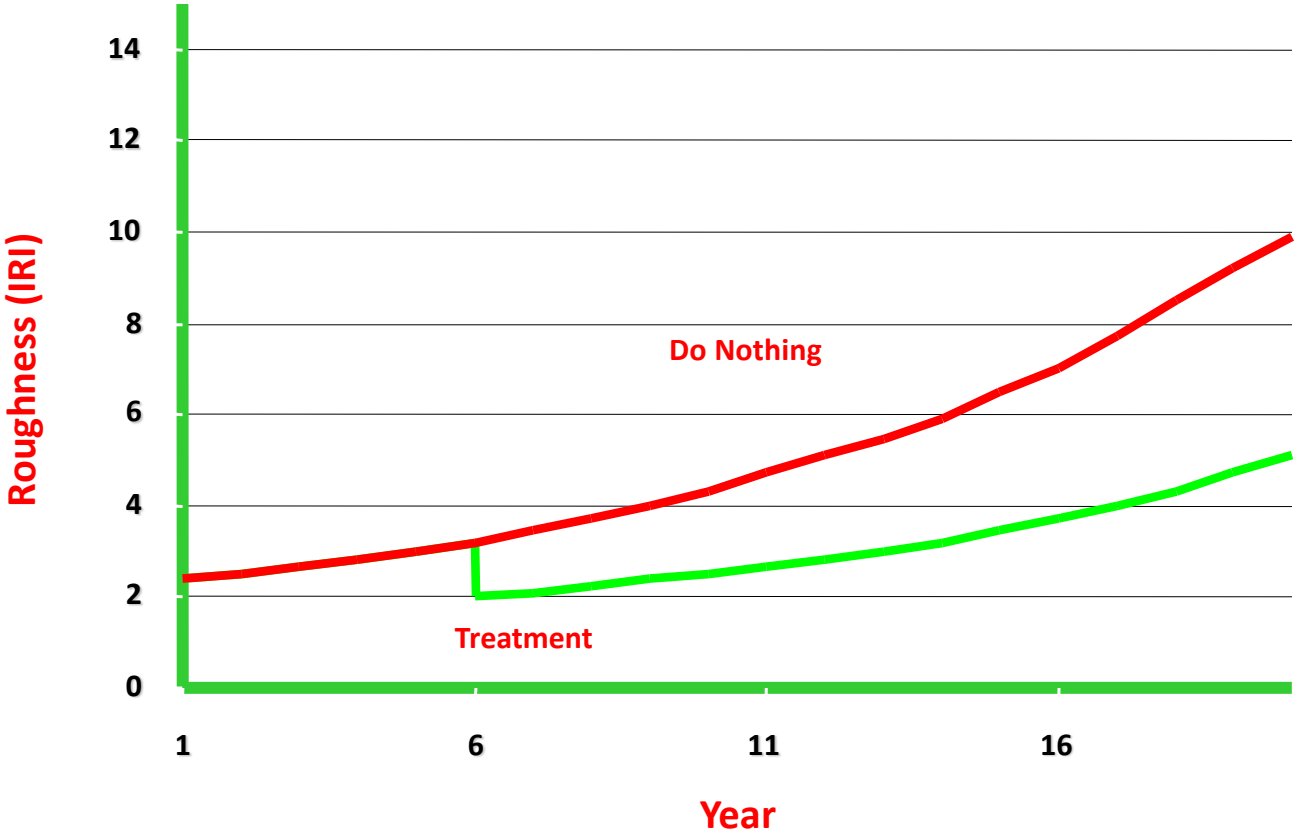
Initiation and Progression

- Cracking, raveling and potholing have initiation and progression periods



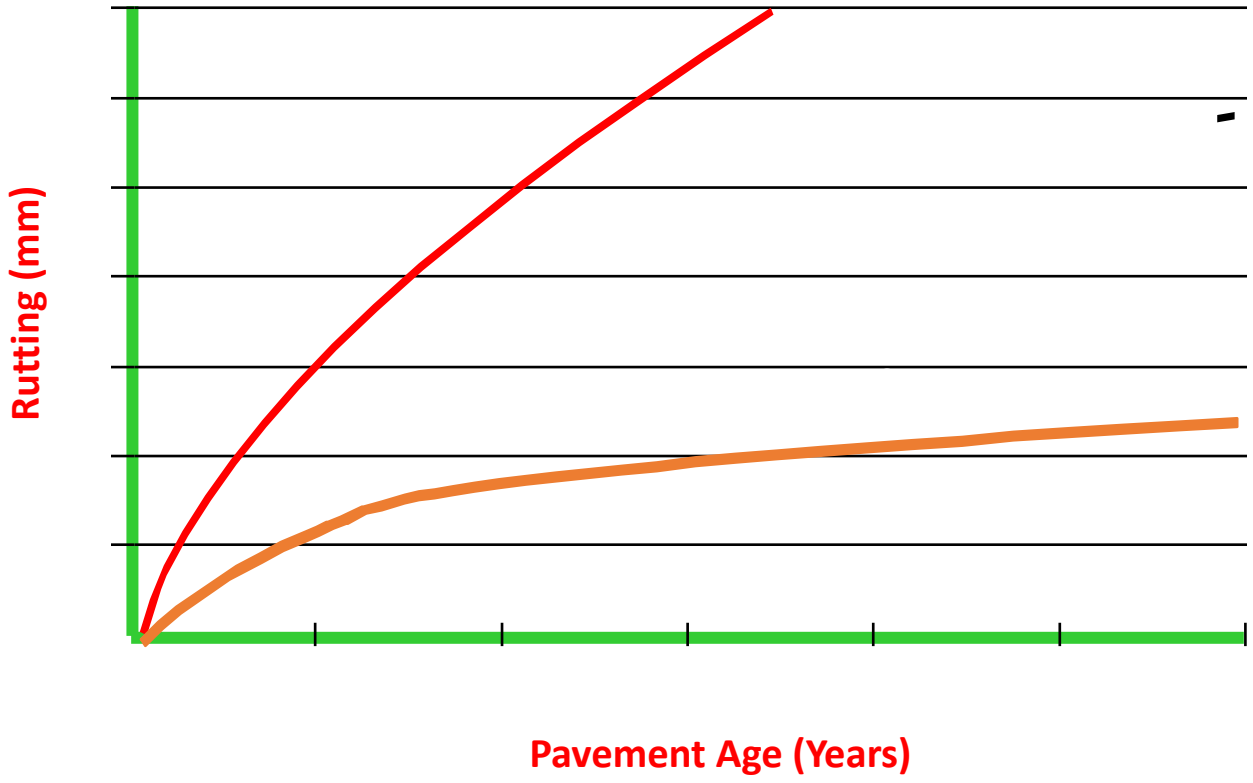
Roughness

- Roughness = F(age, strength, potholes, cracking, raveling, rutting)

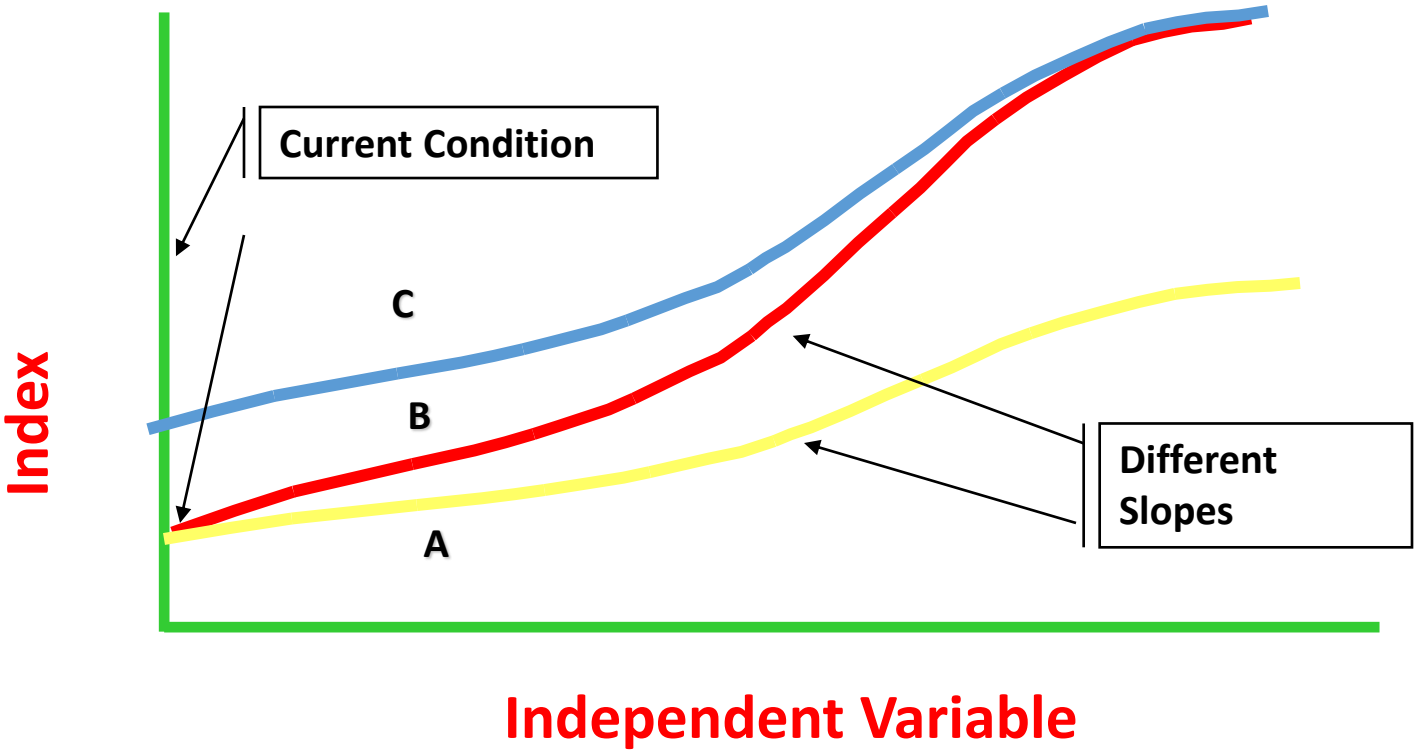


Rutting

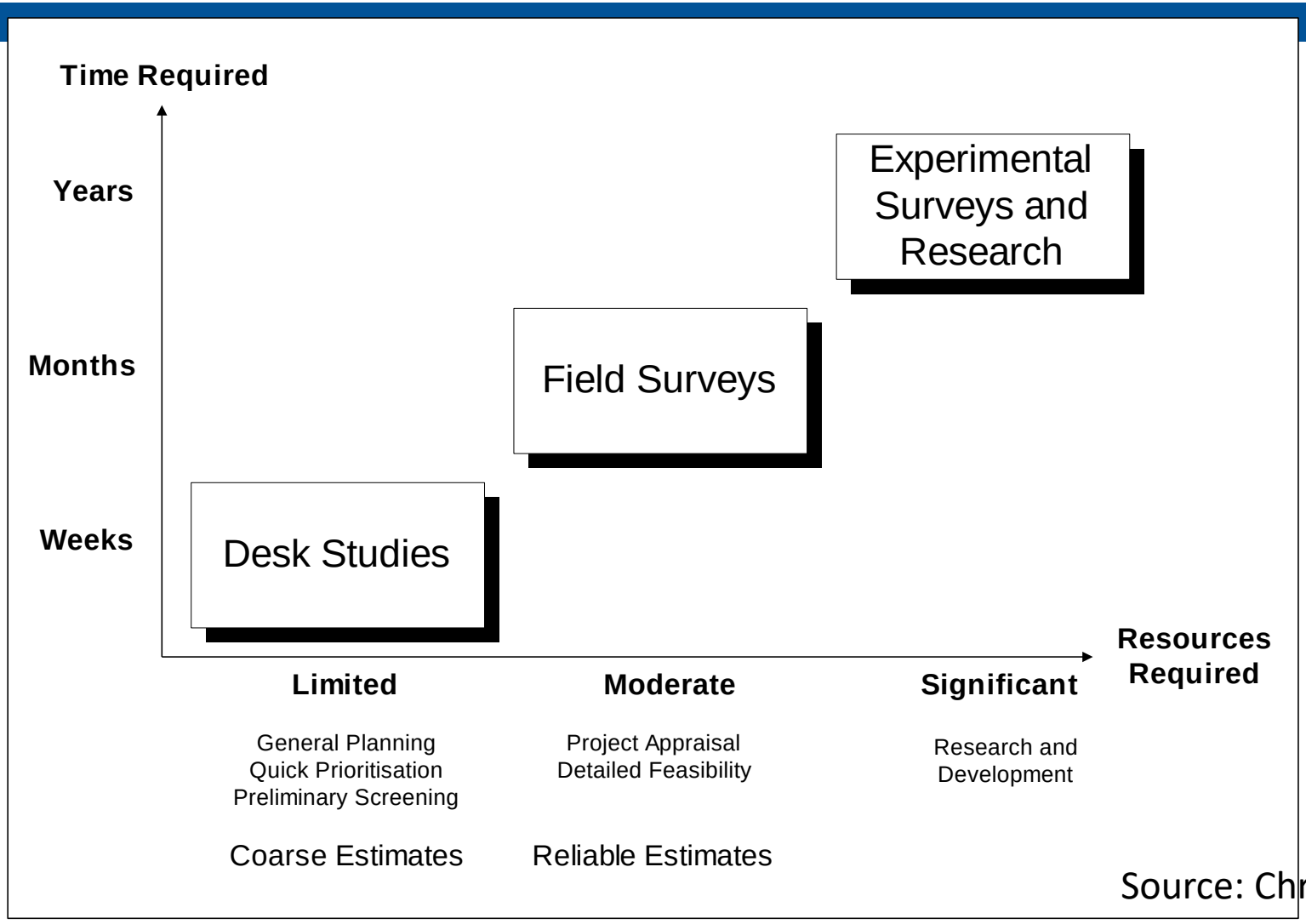
- Rutting = F(age, traffic, strength, compaction)



Calibration is Needed for Models



Hierarchy of Effort



Source: Chris Bennett

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