Road Asset Management (RAM)

May 2023

# Session: Lifecycle Decision Making & Pavement Prediction Modelling

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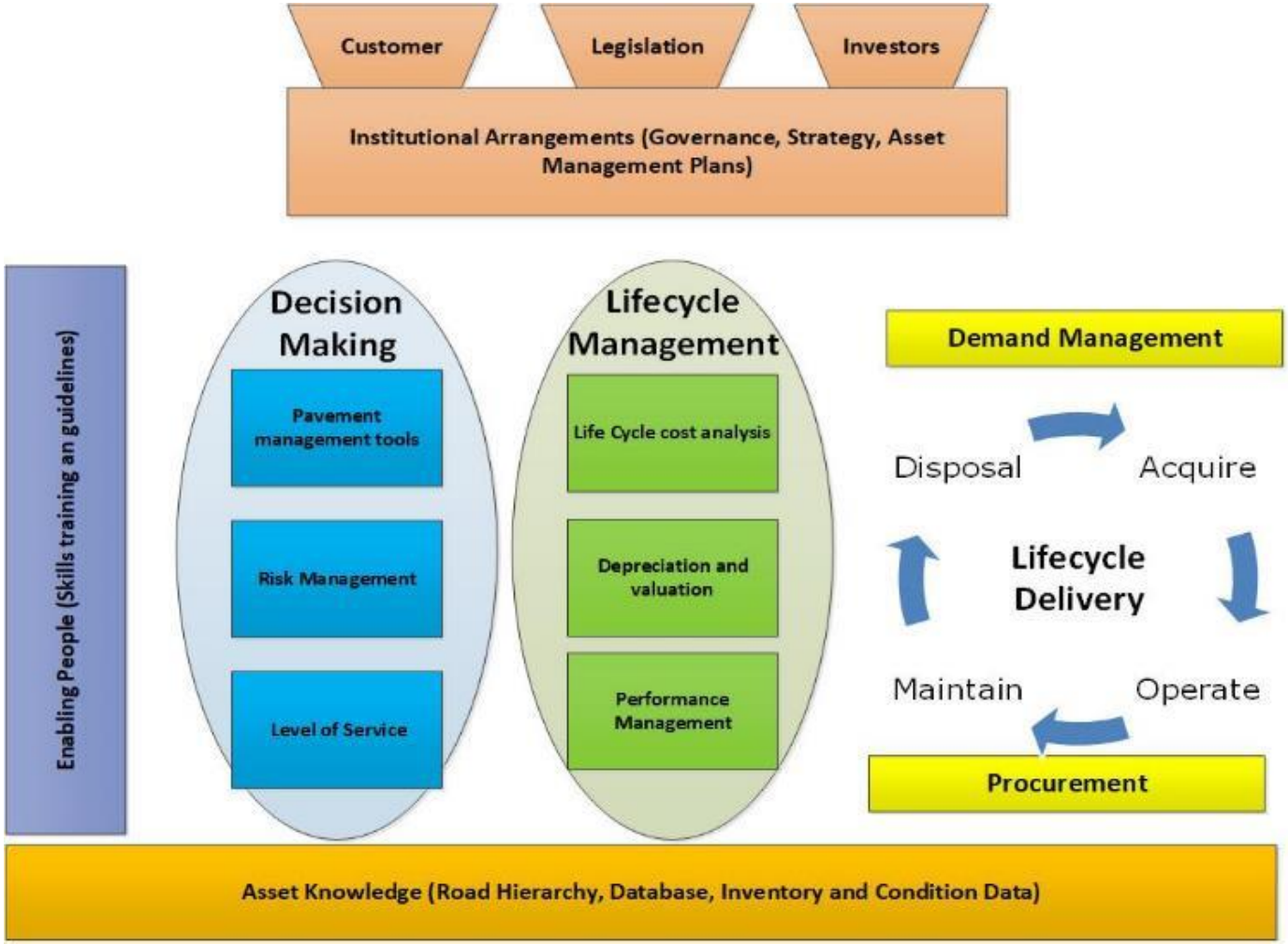
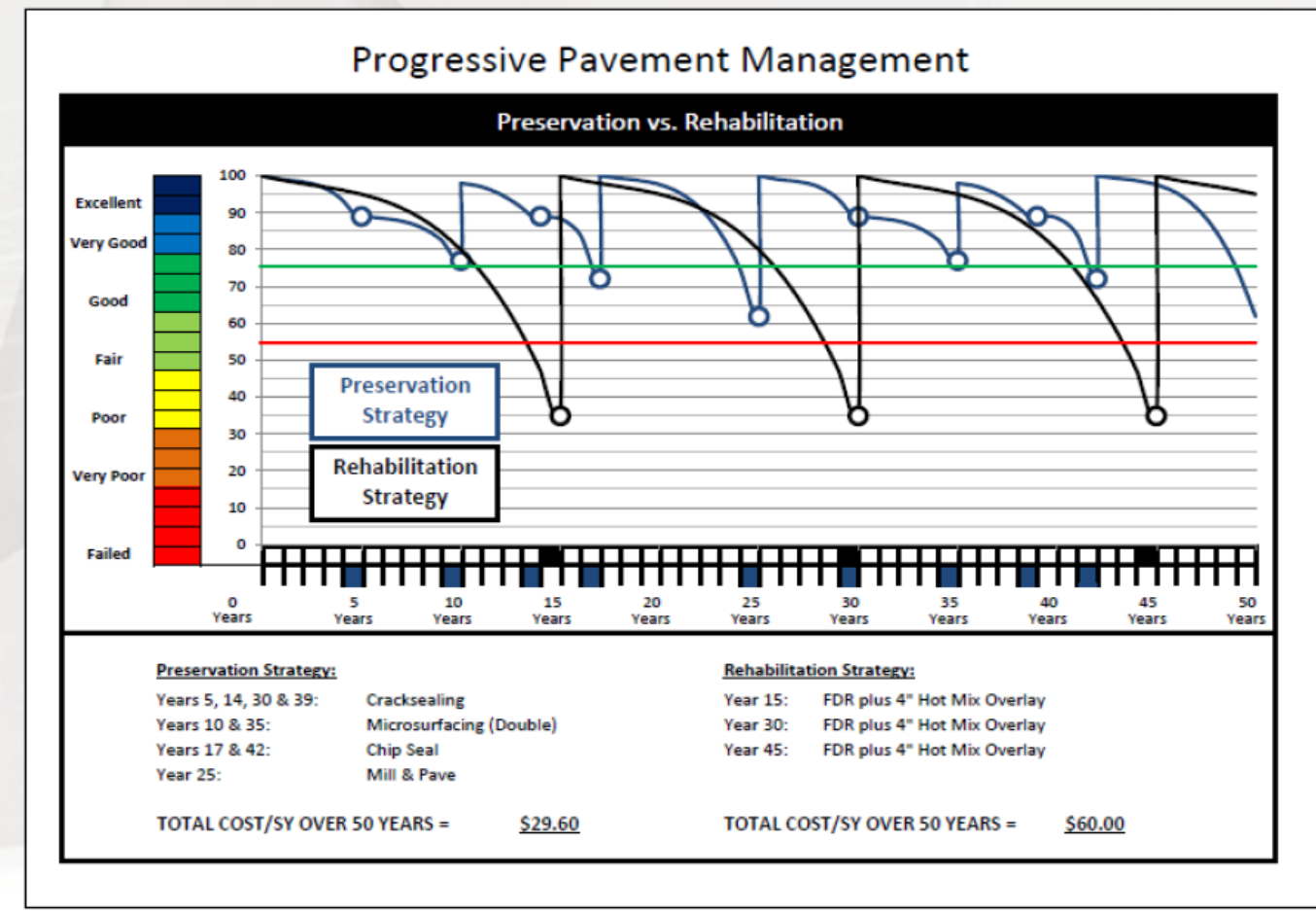
# Life-cycle Management : Getting the most from our Investment

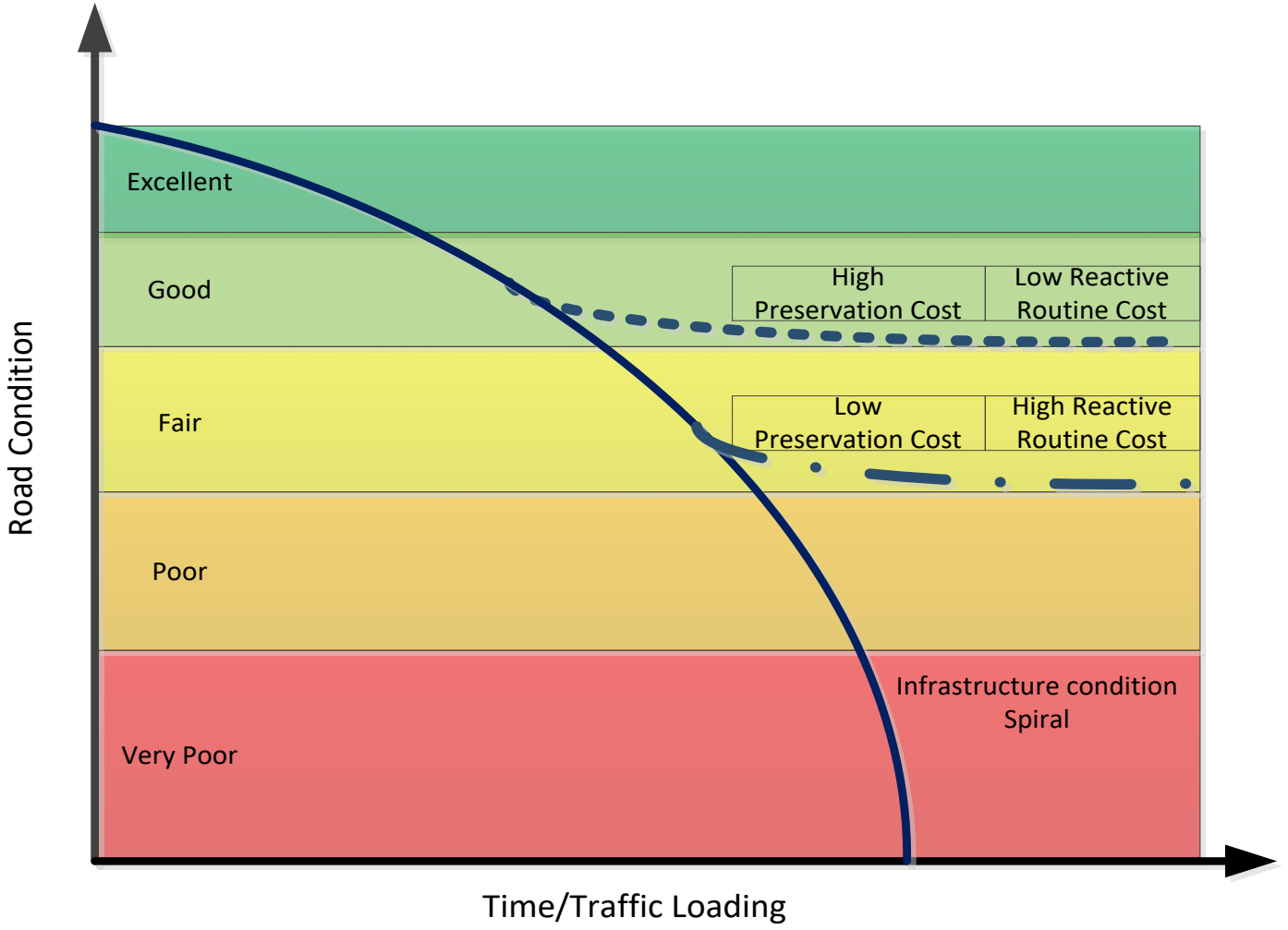


# Life Cycle Cost Consider the Total Cost of Ownership

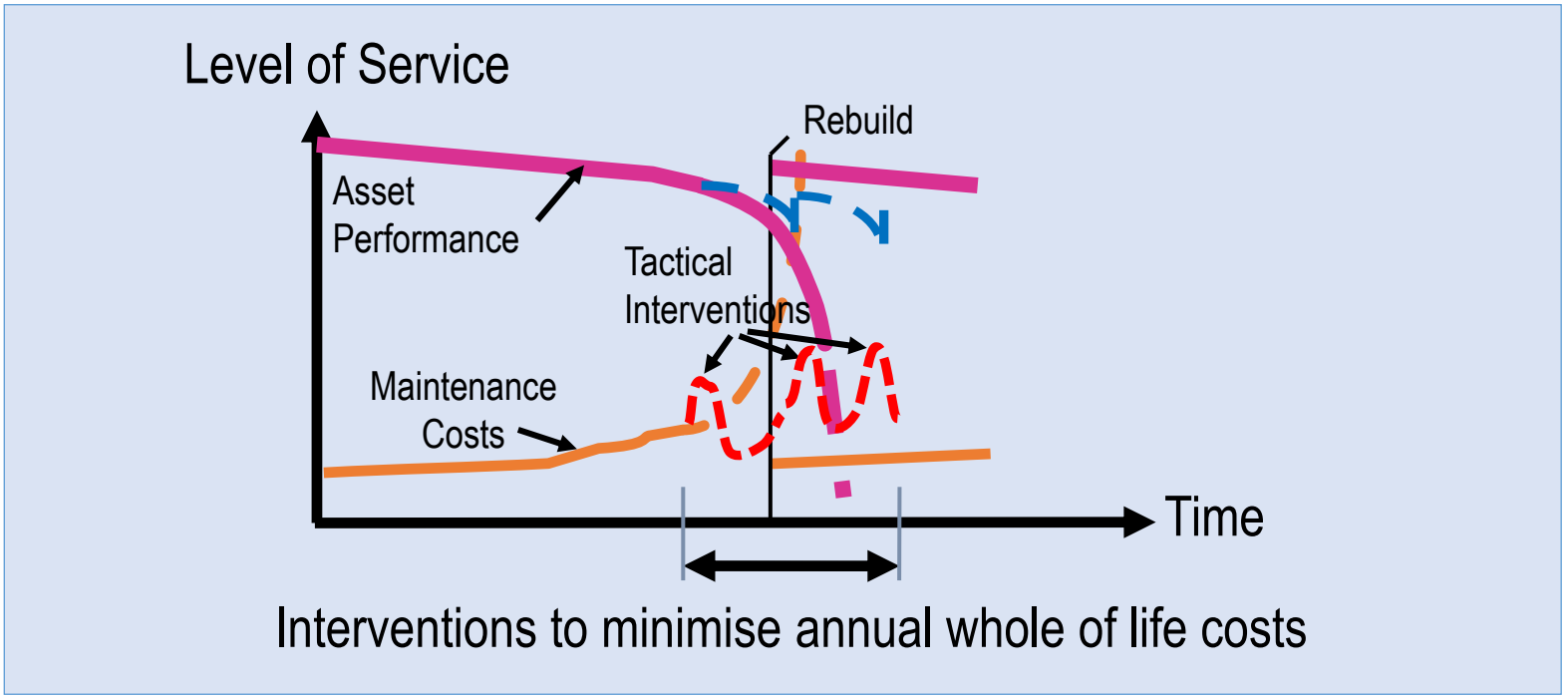
- Preservation approach costs less
- That means we are intervening earlier on roads



# Maintain Infrastructure at Different Levels

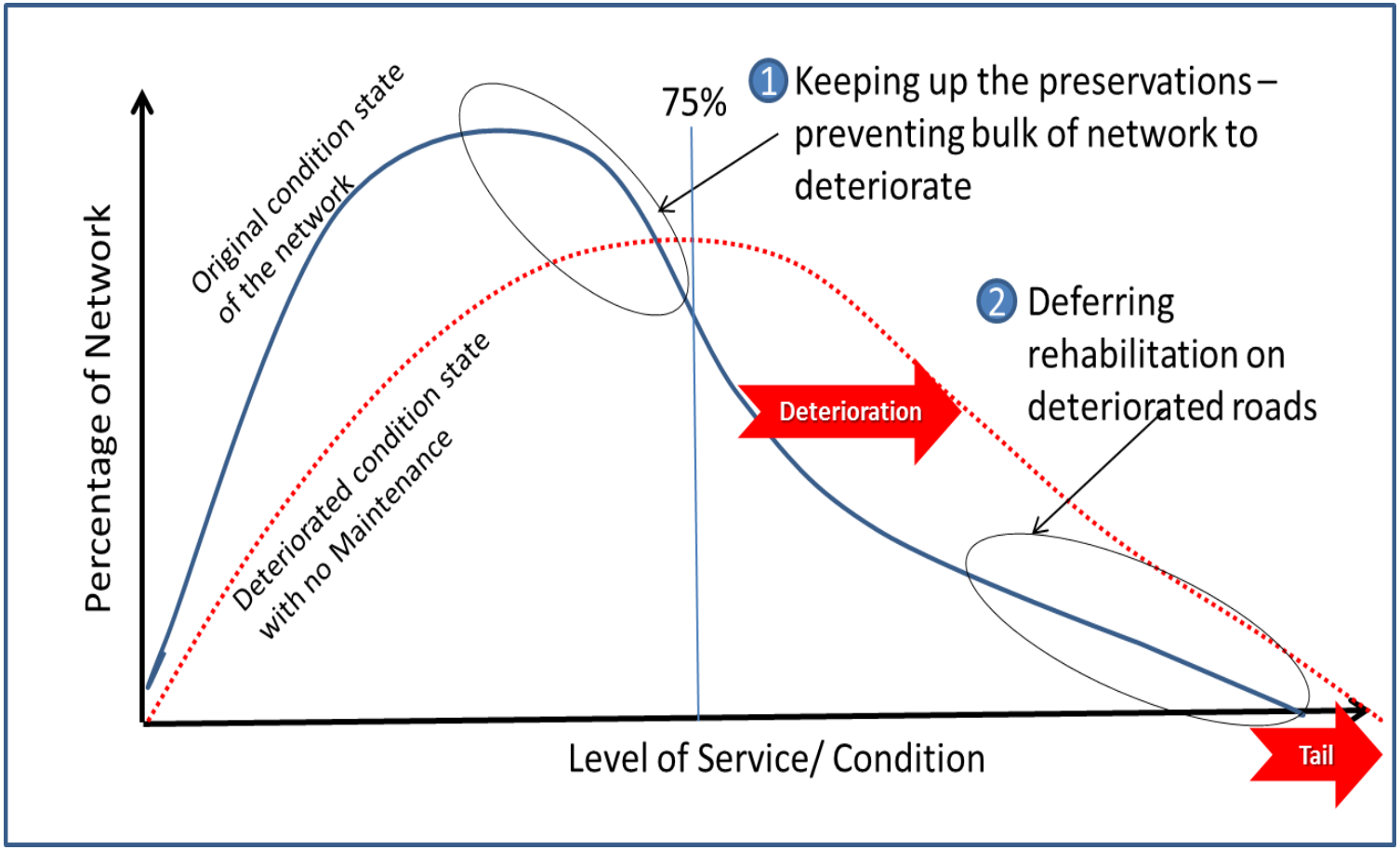


# Optimising Value from Assets



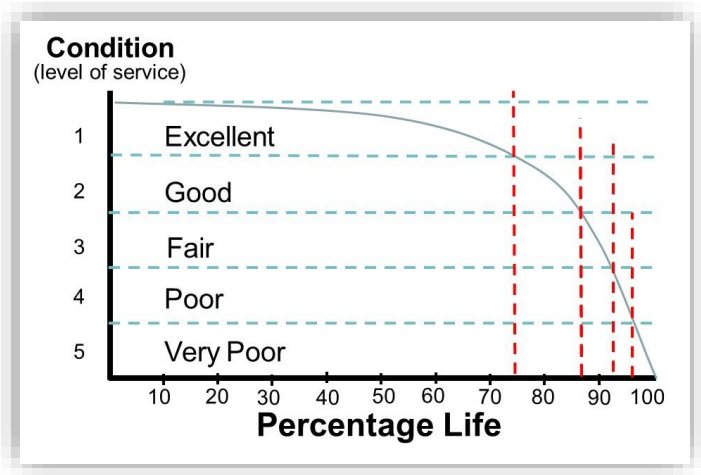

Source: David Fraser

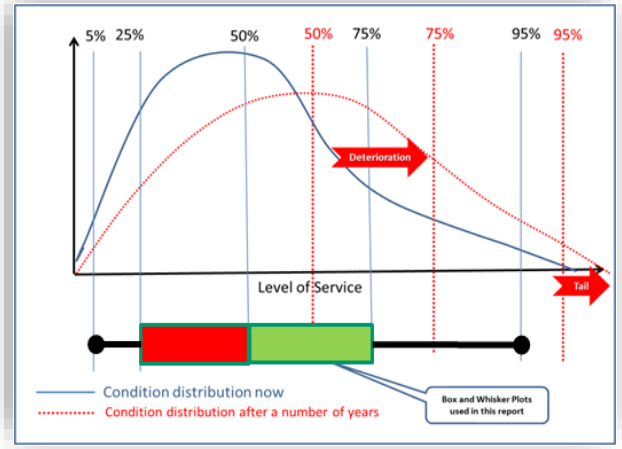
# Theory: How Roads Deteriorate

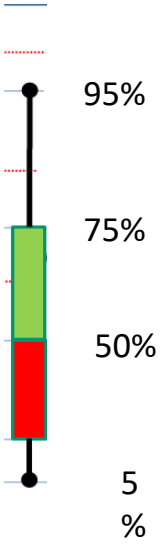


# Think network first – then element

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

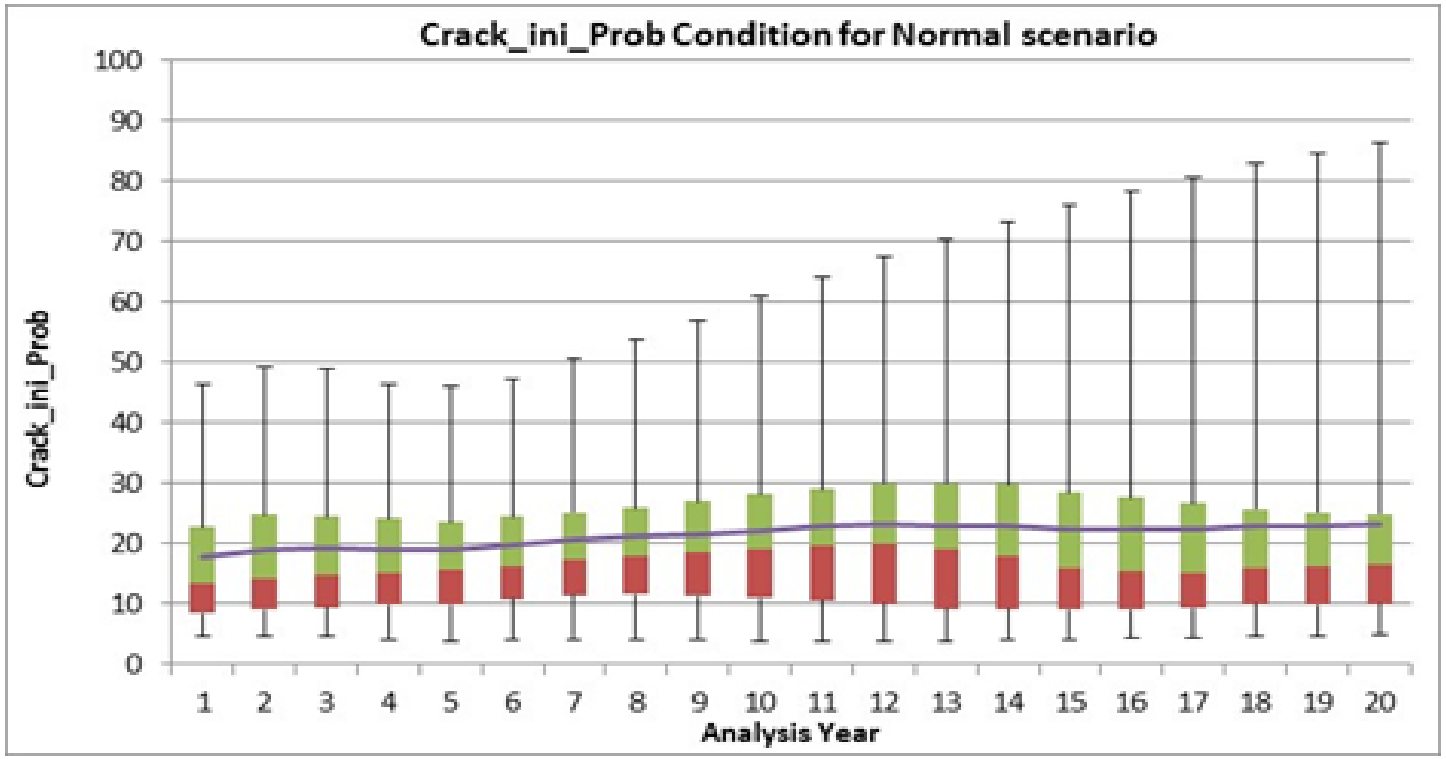


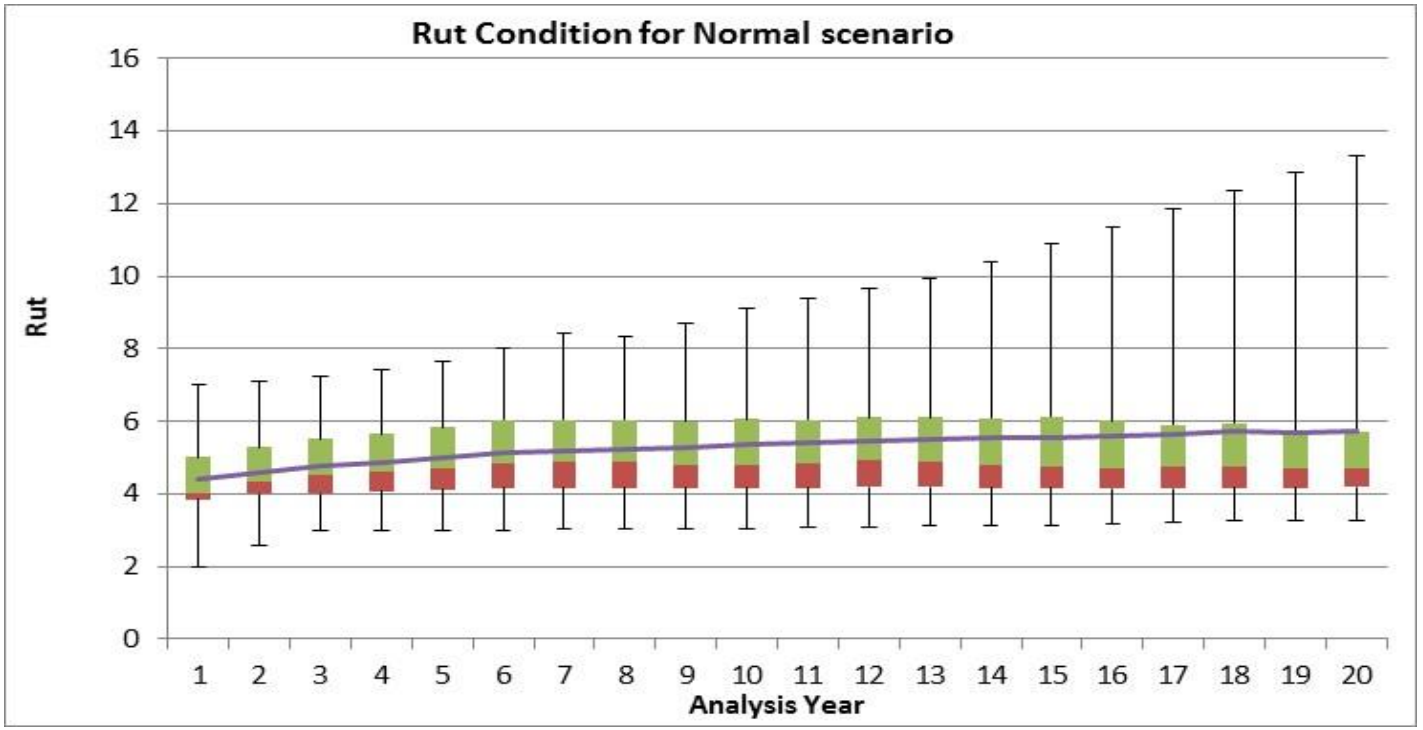




Source: David Fraser

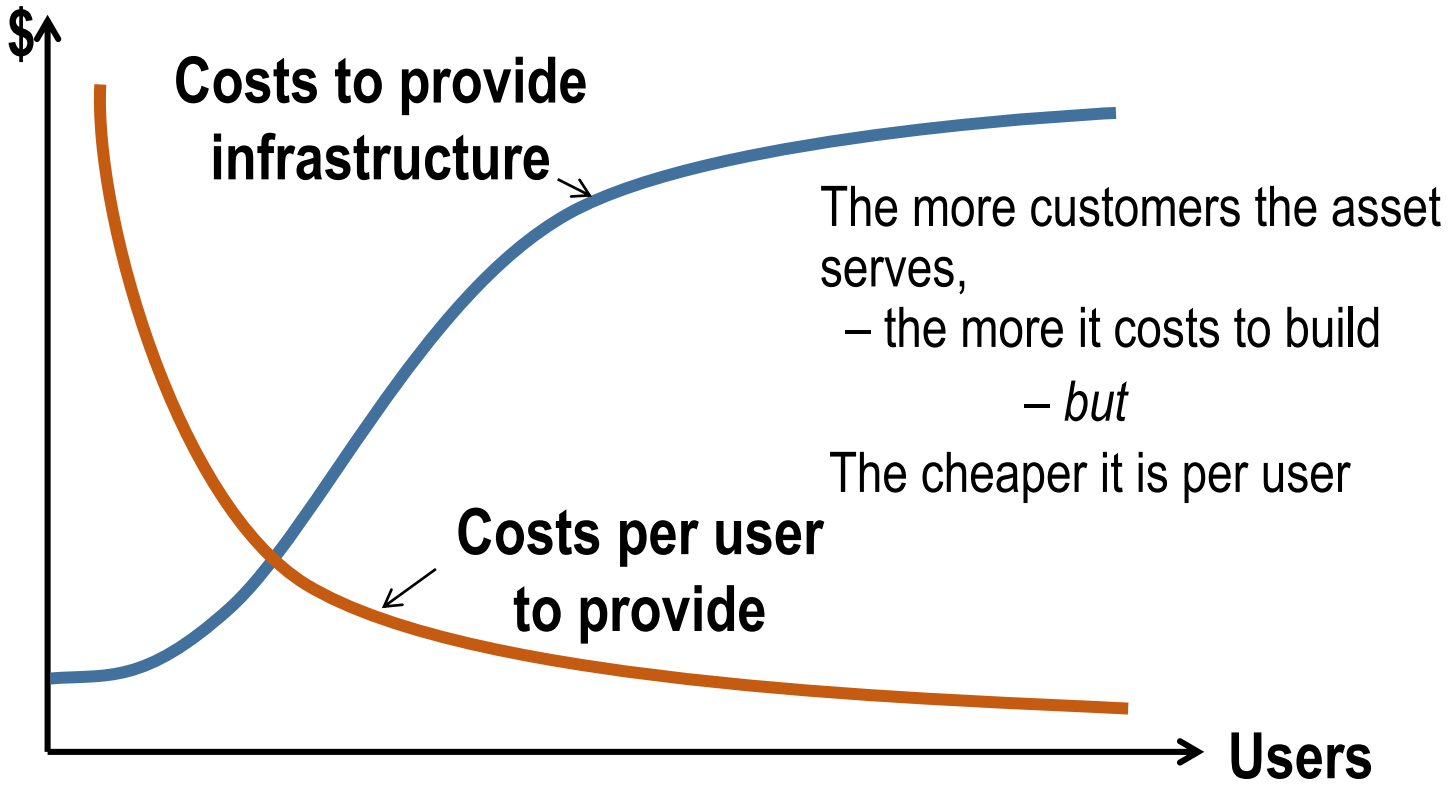
# Results Surface Performance Overlaid



# Pavement Performance Overlaid

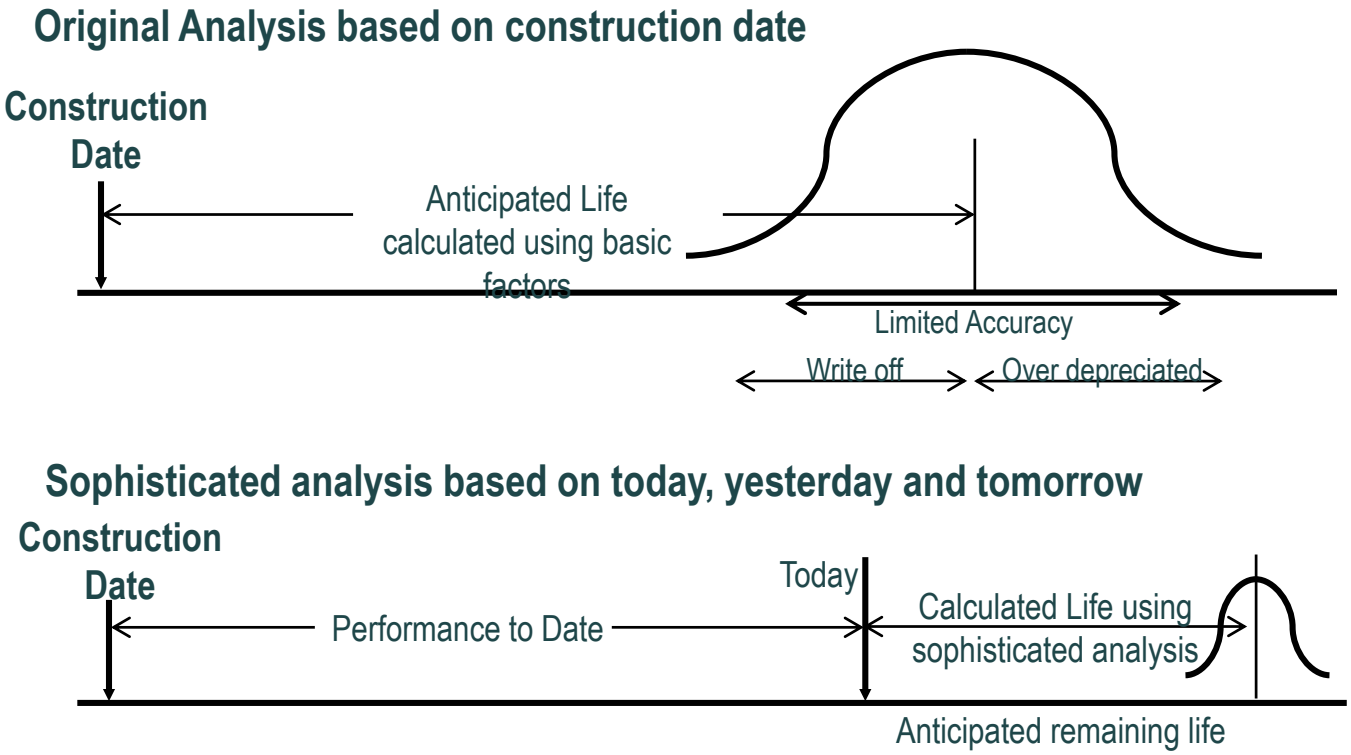


# Asset Cost to User




Source: David Fraser

# Fine Tuning Analysis – Needs Forecasting




Source: David Fraser

# Forecasting Deterioration of Road Assets

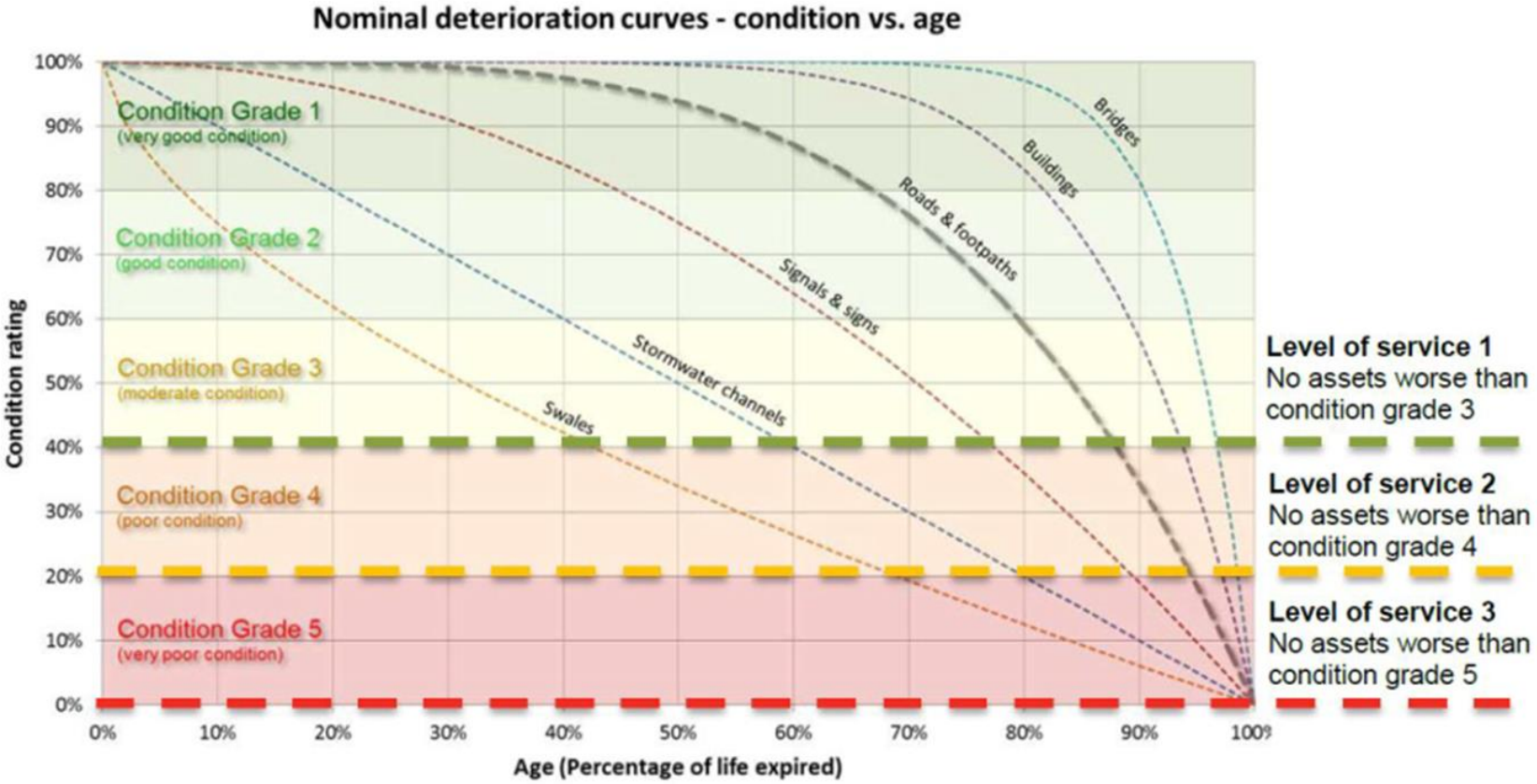
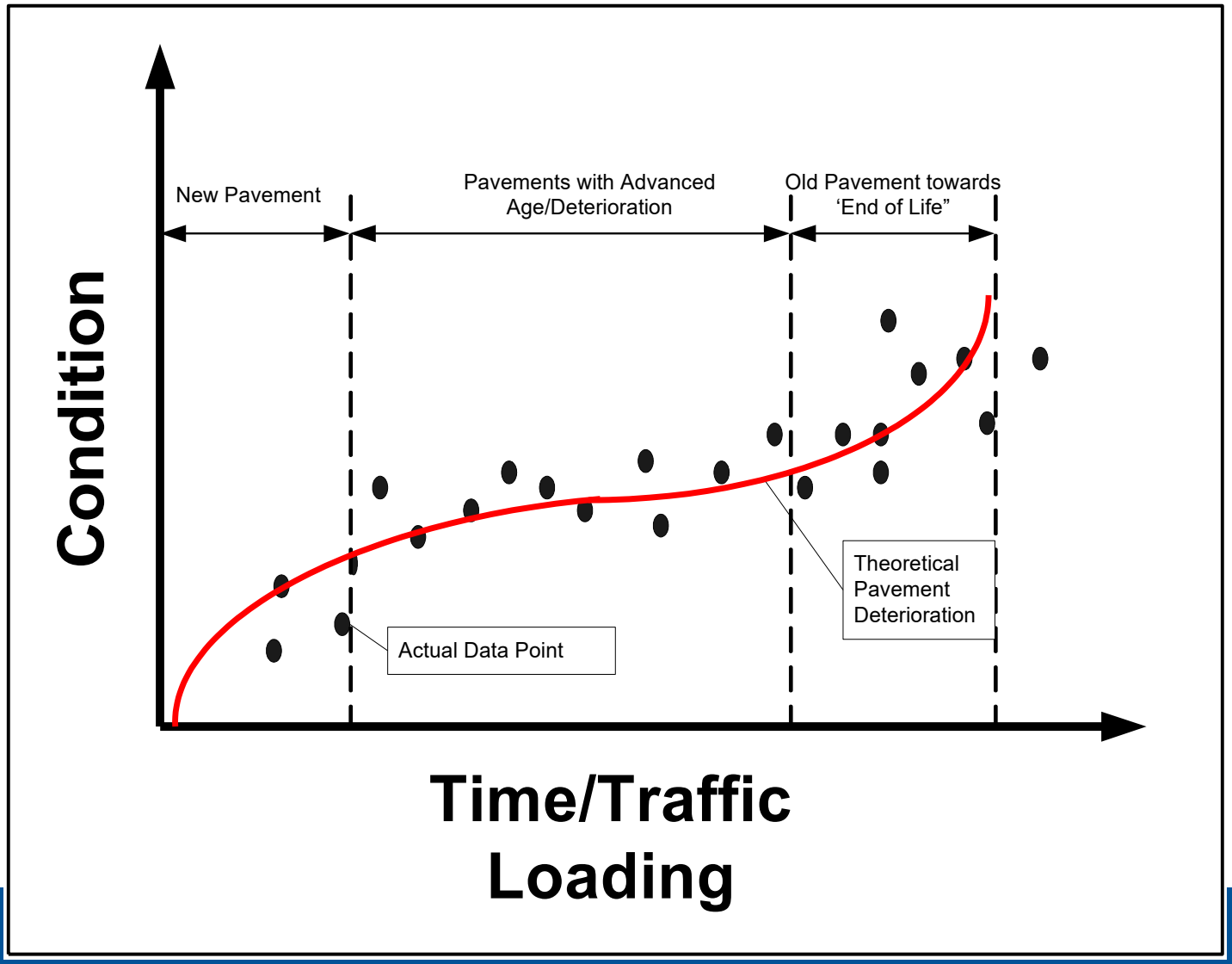


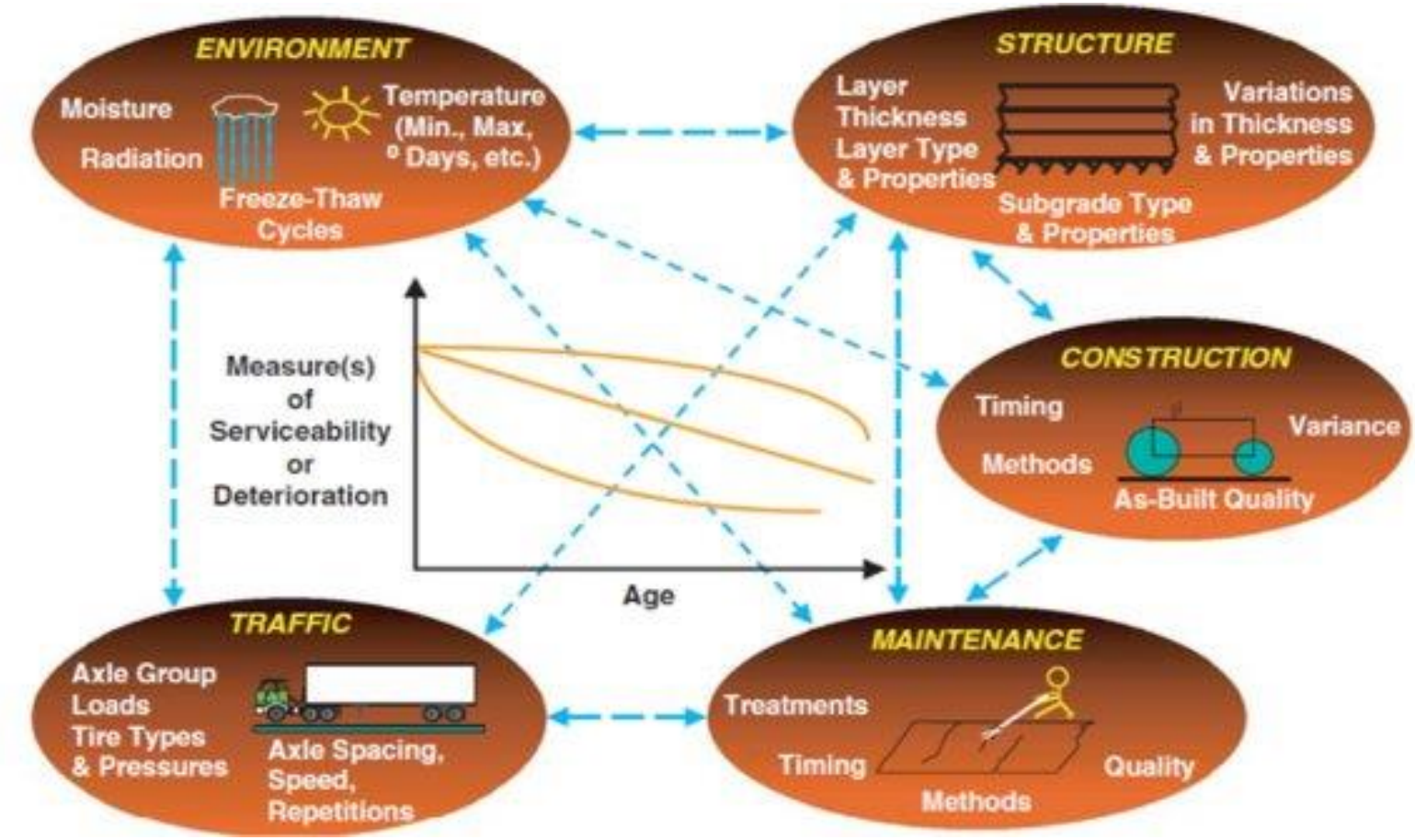

FIGURE 1 Condition grades, deterioration rates and condition-based levels of service.

Source Auckland Transport

# Condition/Age Distribution



# Road Deterioration: Influencing Factors




Source Tighe at al, 2007

# Empirical Model Forms

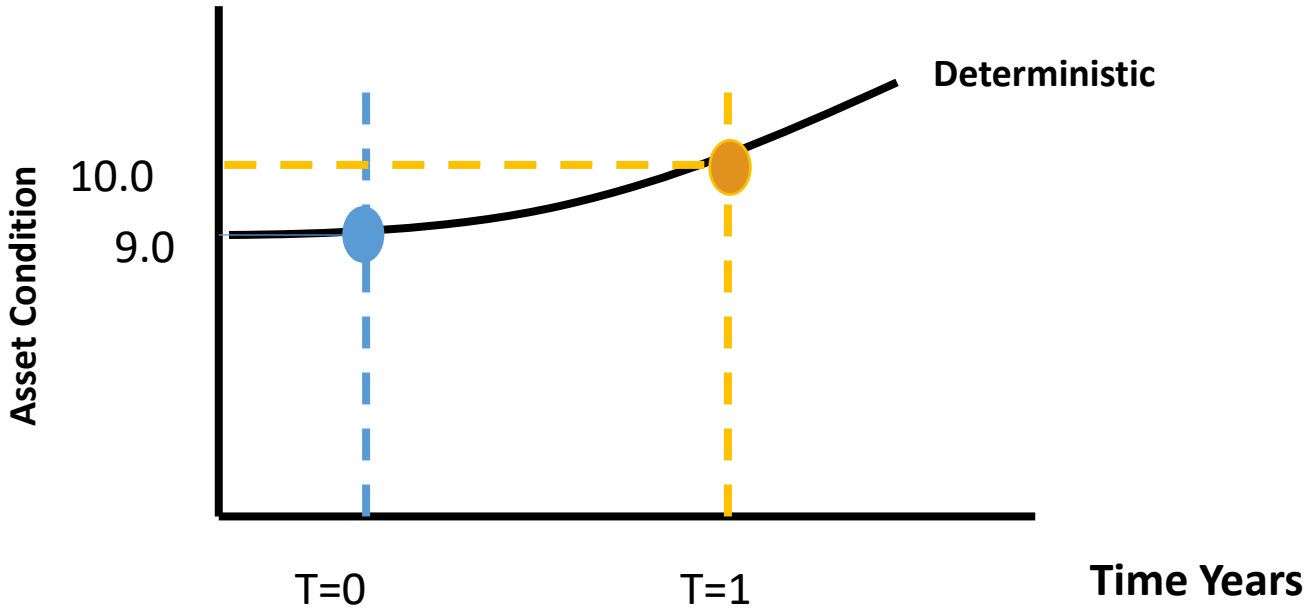
- Deterministic

***"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

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

Source Elke Beca

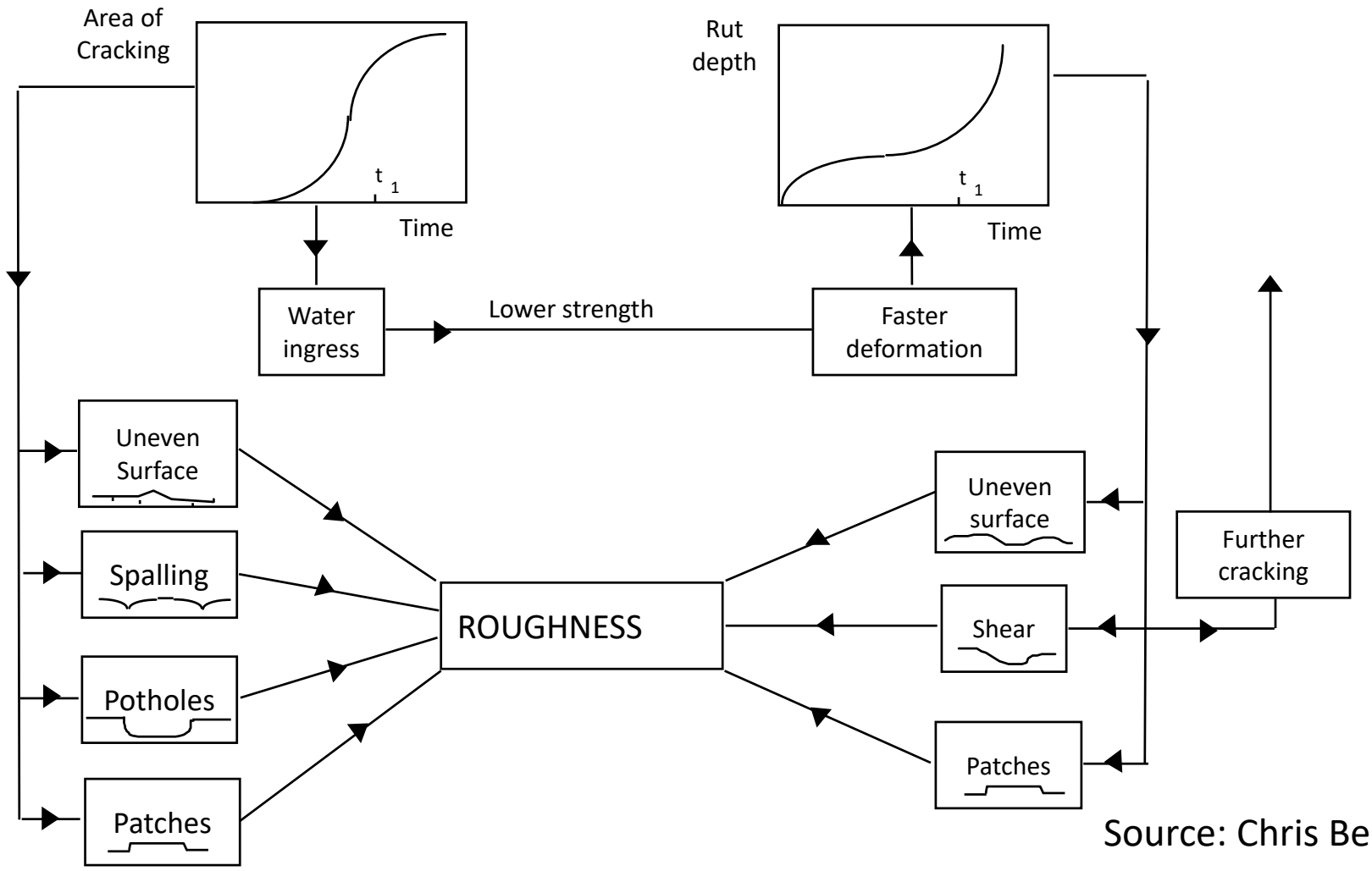
# HDM Models

- 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:

    $\Delta$ 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<br>Rutting<br>Ravelling<br>Potholing<br>Roughness<br><br>Edge break<br>Surface texture<br>Skid resistance | Cracking<br>Joint spalling<br>Faulting<br>Failures<br>Serviceability rating<br>Roughness | Rutting<br>Surface texture<br>Roughness<br><br>*not in software | Gravel loss<br>Roughness |

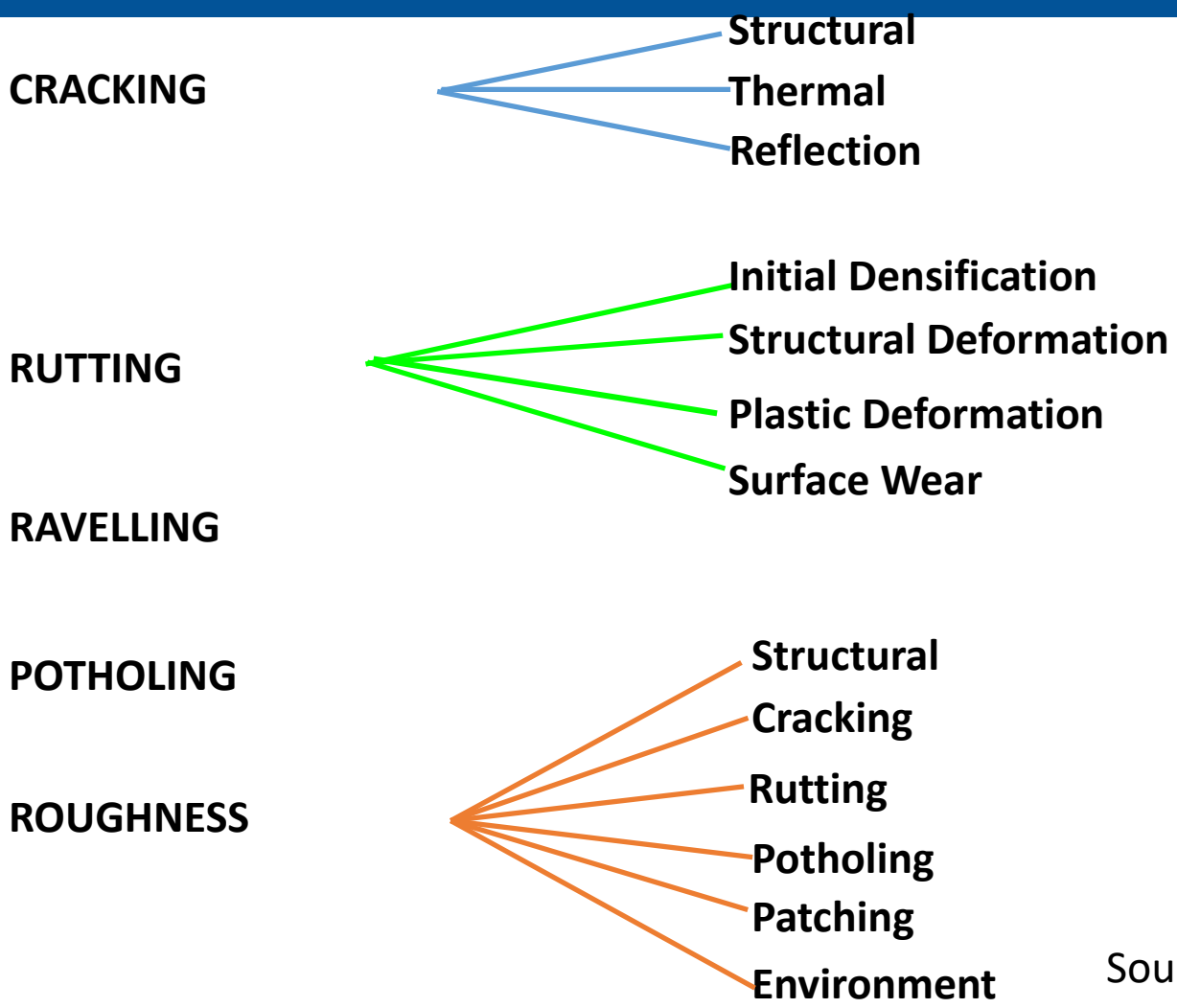
Source: Chris Bennett

# 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



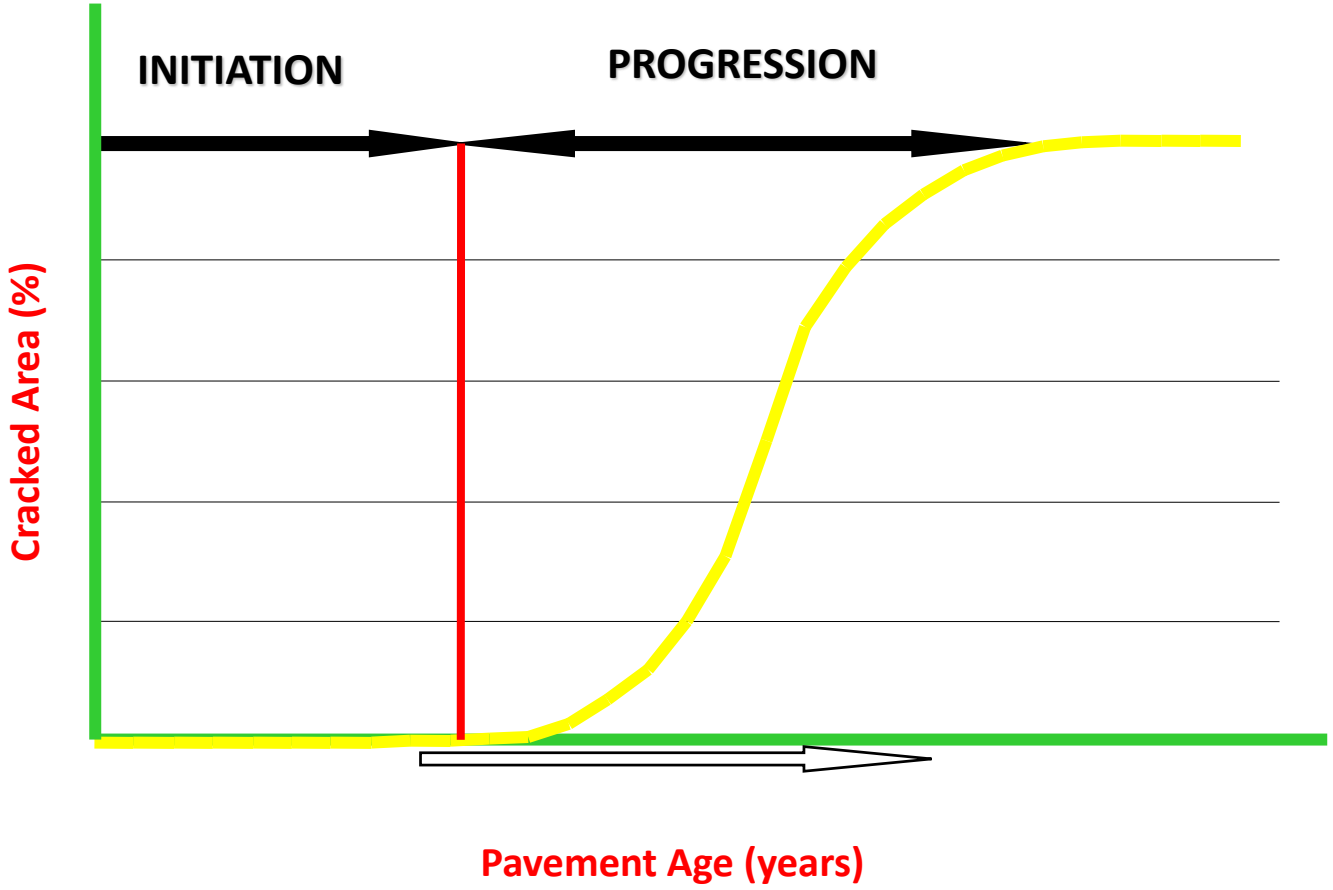

Source: Chris Bennett

# Concrete Models

| | | |
|---|---|---|
| **Cracking** | **% of slabs cracked**<br>**Number per km** | **JP**<br>**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** |

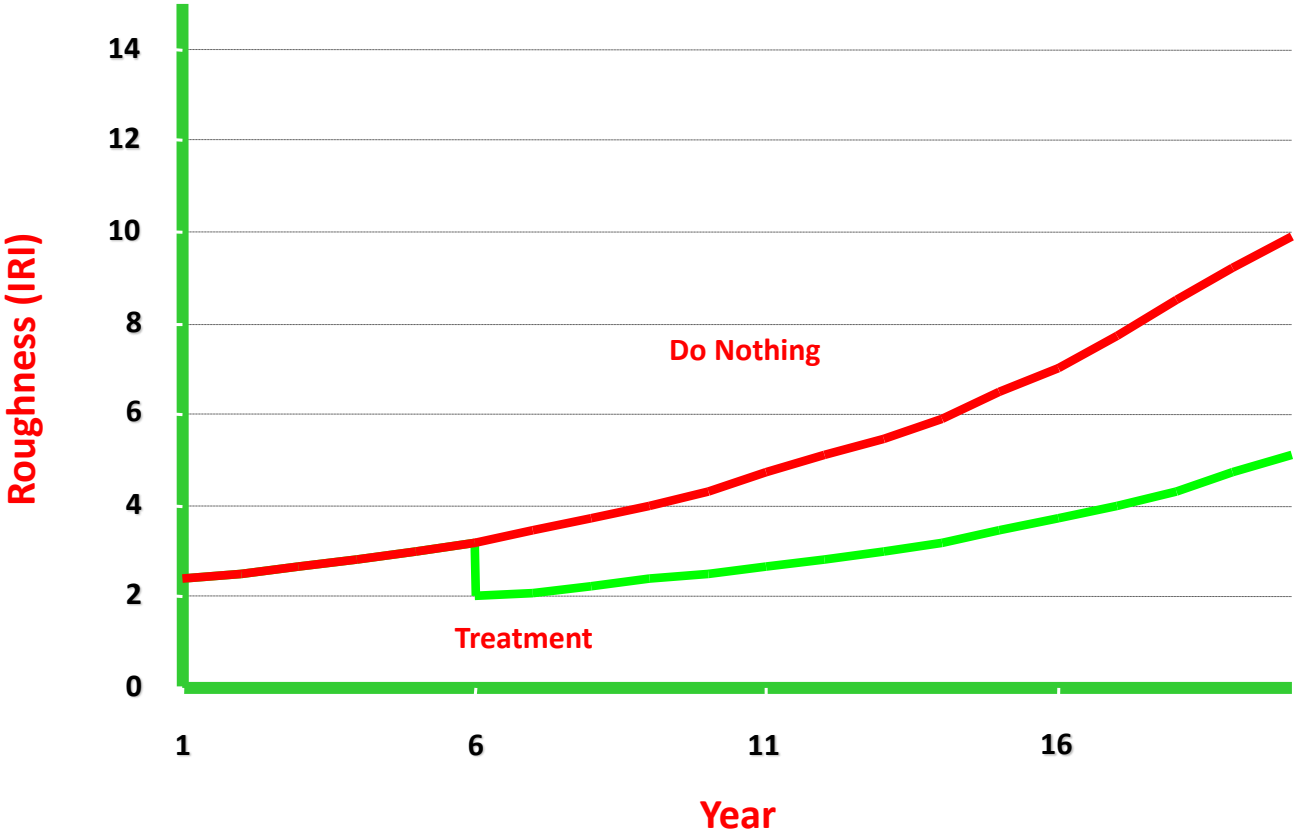
# Initiation and Progression

- Cracking, raveling and potholing have initiation and progression periods



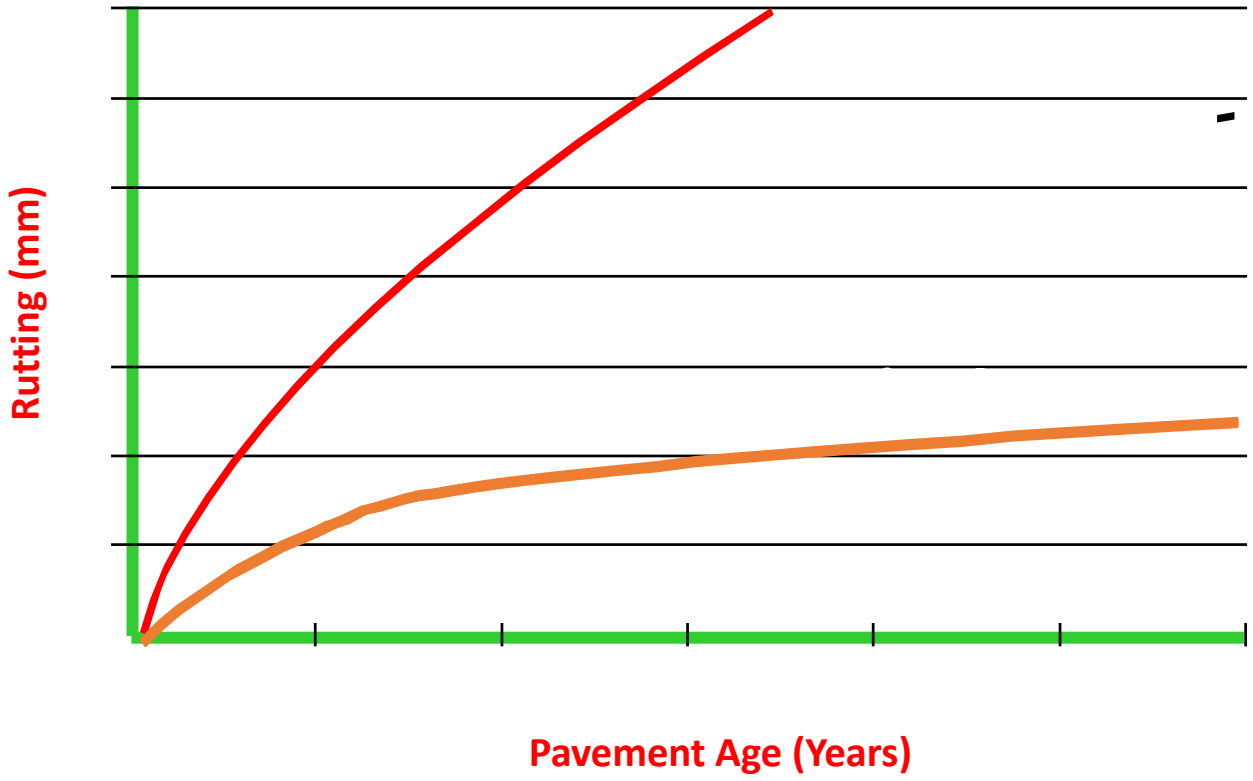
# Roughness

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

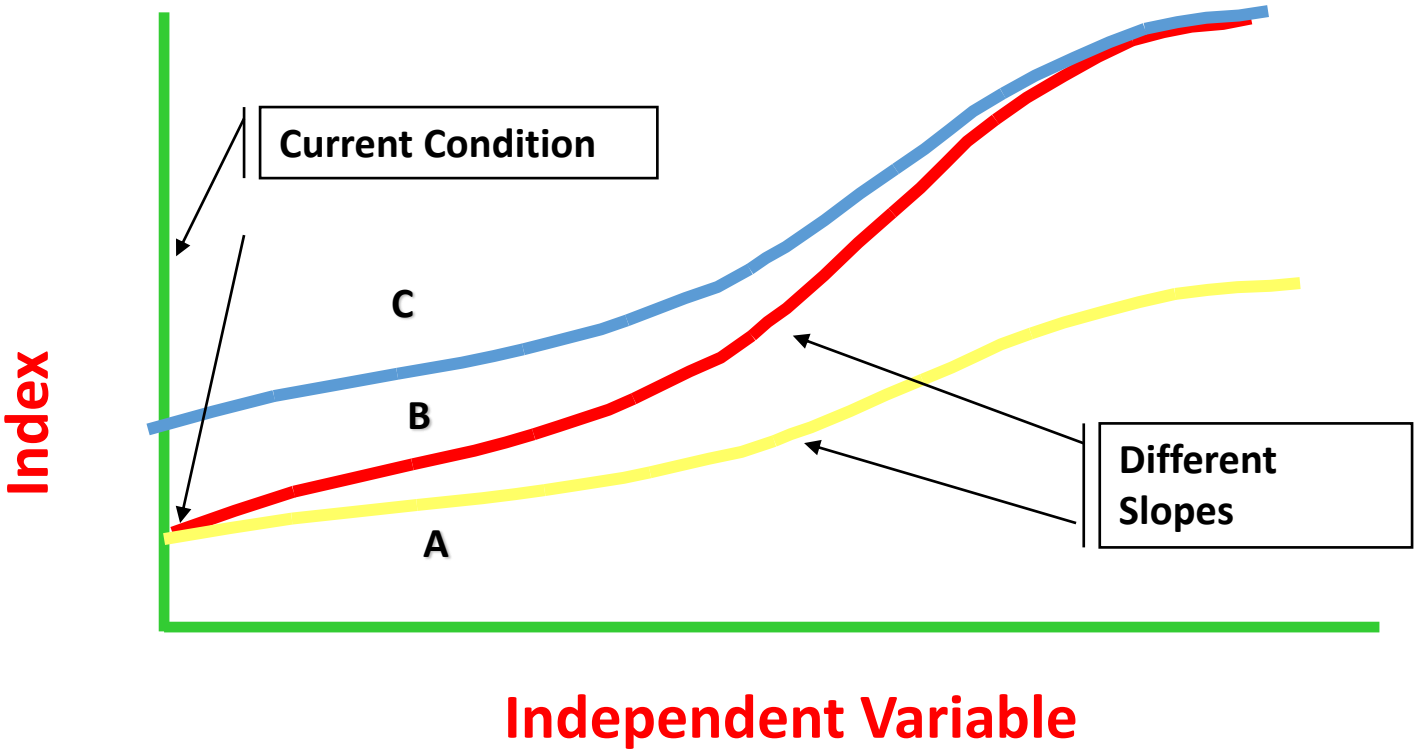


# Rutting

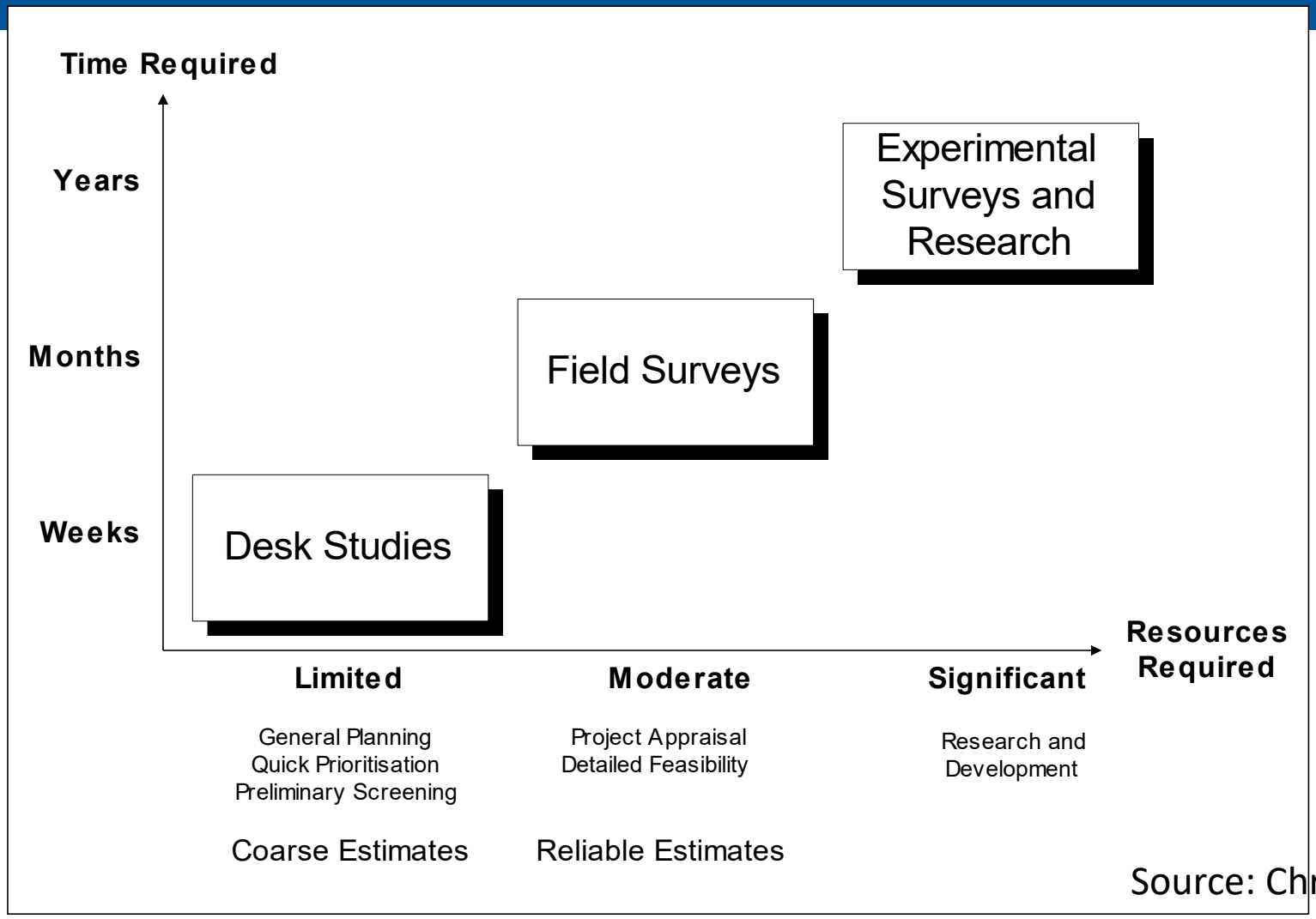
- Rutting = F(age, traffic, strength, compaction)



# Calibration is Needed for Models



# Hierarchy of Effort




Source: Chris Bennett

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