

# PAVEMENT MANAGEMENT – LET US STOP RE-INVENTING THE WHEEL

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## Abstract

Performance models for road networks have been developed and finessed by road authorities for decades. Yet, in spite of some sophisticated work in this area, the majority of councils still haven't reached a level of '**reasonable confidence**' in the prediction capability of their models.

What is more of a concern for us as a local government group is that we keep re-inventing the wheel and expect software systems to magically manage our assets.

The answer is **not** in the software tools, where unfortunately the largest effort is spent, but rather the answers lie in the model characteristics, model set-up and how we measure the data that drives the models. Software is simply a tool that mirrors existing processes and enables rigorous analysis at an infinitely greater speed than the good old pen and paper, but it does little in terms of thinking and defining what the rules of prioritisation, modelling and treatment optimisation ought to be.

**Key Words: Pavement Management, Fit for purpose data, Optimised decision making, treatment matrix, road performance models, intervention levels**

## Introduction

Performance models for road networks have been developed and finessed by road authorities for decades. Yet, in spite of some sophisticated work in this area, the majority of councils still haven't reached a level of '**reasonable confidence**' in the prediction capability of their models. There is still a large level of scepticism in the practical application of what is in theory an acceptable science.

What is more of a concern for us as a local government group is that we keep re-inventing the wheel and expect software systems to magically manage our assets.

Is this because too much emphasis is on sophistication rather than simplicity or is it because we tend to use software analysis tools that are too data hungry or too complex to value add to the asset management process? Is it because our models are not local government oriented or is it because our data does not support our model's performance features?

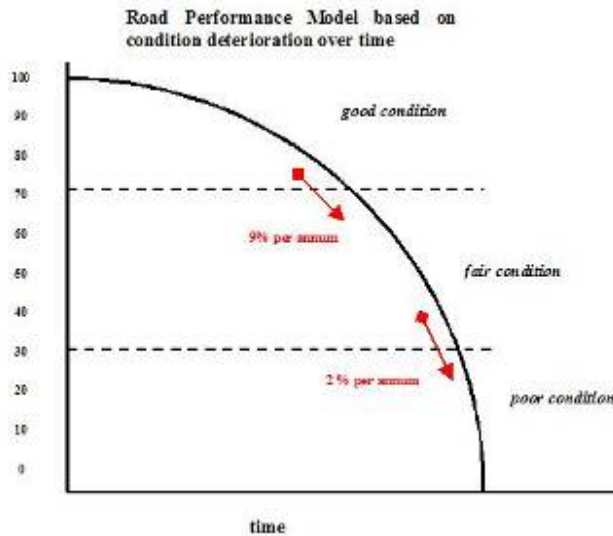
The real issues are all of the above - and a whole lot more. There is no reason why any council should have any difficulty in developing robust models. The answer is **not** in the software tools, where unfortunately the largest effort is spent, but rather the answers lie in the model characteristics, model set-up and how we measure the data that drives the models. Software is simply a tool that mirrors existing processes and enables rigorous analysis at an infinitely greater speed than the good old pen and paper, but it does little in terms of thinking and defining what the rules of prioritisation, modelling and treatment optimisation ought to be.

## What is a Road Performance Model?

A road performance model is a mathematical simulation of road performance characteristics that encompass the essence of how roads behave over time. The most common characteristics are physical condition based and include criteria such as rutting, roughness, pavement strength, age, deformation, cracking, surface texture, defects and oxidation.

In the following example, a typical Council's 'performance model' (Graph 1) can be represented graphically, clearly defining how their roads deteriorate from good to fair to poor condition over time. The knowledge behind this remaining life profile (often referred to as a 'deterioration curve') is

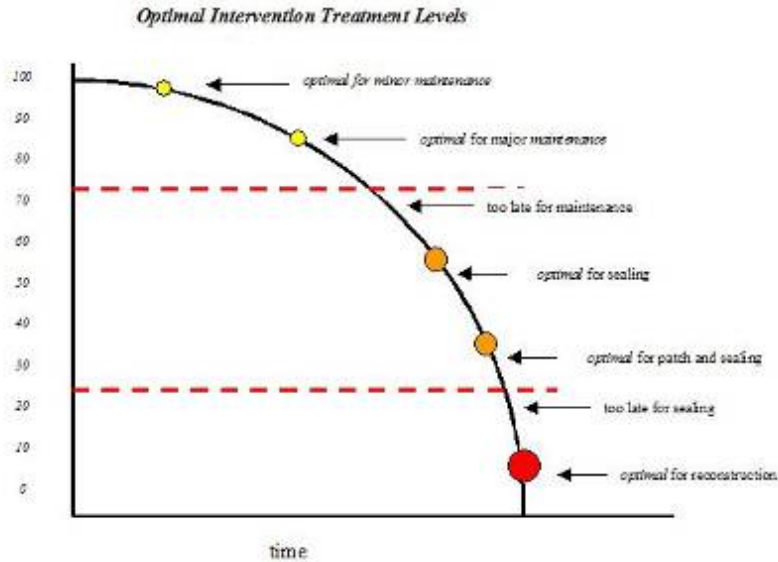
based on a combination of data (historic records), local knowledge (field staff) and industry 'standards'. In this example, 9% of their road assets deteriorate from good to fair condition each year and 2% of their assets deteriorate from fair to poor condition each year.



**GRAPH 1**

A performance model will also identify optimal treatment interventions built into it, as shown graphically in Graph 2 below. Again, the knowledge behind these

interventions is based on a combination of data (historic treatments), local knowledge (field staff) and industry 'standards'.



**GRAPH 2**

**What is a robust performance model?**

For the model to be representative of pragmatic road behaviour, the treatment interventions must be based on specific knowledge of council’s treatments and the effects of these treatments on the various condition criteria being modelled (eg a crack seal treatment will ‘renew’ linear cracking but have no affect on ravelling or crocodile cracking).

Therefore a robust performance model is one that in general has the following characteristics:

1. The models are based on specific condition data that best represents treatment performance in their council.
2. There is an established relationship between condition scores and treatments i.e. an optimal intervention matrix has been established and zones of optimal influence have been identified.
3. They have a documented, organisation specific condition measurement method that is reliable, repeatable and simple to use.

4. They have good quality, network representative and treatment related condition data.
5. Most importantly they have site-tested the outputs of their models and refined the parameters based on its findings.

Once these parameters are established, very little can go wrong in terms of prediction, prioritisation or optimisation. A robust model, which has rigour in its content, will always provide objective outputs with high integrity and repeatability.

**Determining Data Needs: condition, capacity and functionality**

Council’s spend tens of thousands of dollars each year in collecting road condition and inventory data. Some council’s collect this data every year whilst others may have a two to three year cycle.

This data is extremely important to councils and is the foundation block of a council’s road asset register. It is the basis of council’s decision-making platform for all of the following:

- Annual proactive works programming – reseals, overlays,

footpath repair, heavy patching, and rehabilitation.

- Capital upgrade and expansion works planning.
- Forecasting capital renewal and identifying renewal tactics.
- Spending strategies for the mid-term (say five years).
- Periodic proactive maintenance planning and scheduling
- Road pavement performance analysis.
- Asset valuation.

In addition, availability of accurate and objective condition and inventory data enables council staff to answer those tough questions that management or ratepayers may ask from time to time.

In spite of the absolute importance of this data, in particular its accuracy, currency and integrity, it is often not thought through properly and very few tend to ensure that their data is relevant to their specific needs, i.e. that the data is ***fit for purpose***.

Whilst a lot of time and effort is spent on determining cost-effective ways and efficient practices of data collection, in the past very little thought has gone into determining the nature, type and fitness for purpose of this data.

So, what is fit for purpose data and why is it so important?

Fit for purpose data, as the name suggests, is data that is needs based and relevant to its end use. For example, with road pavements, if the data is relevant to asset preservation needs, then the data should be able to drive the required decision making, be it routine maintenance, periodic maintenance (renewal) or capital upgrade / expansion works. As shown in Table 1, the type of data that drives routine maintenance may be different to the type of data that drives periodic maintenance or capital works. This example shows how important it is to know “what type of data to collect” based on its end use.

| End use                               | Data attribute   |
|---------------------------------------|--|
| Routine Maintenance                   | Pot-holes<br>Edge breaks<br>Corrugations<br>Minor deformations (<2m <sup>2</sup> )<br>Edge drop off<br>Drain blockage  |
| Periodic Maintenance (Renewal)        | Cracking<br>Surface texture<br>Bleeding<br>Stripping<br>Oxidisation (Ravelling)<br>Roughness<br>Minor Rutting<br>Major deformations (>2m <sup>2</sup> )<br>Surface Defects<br>Shape Loss |
| Capital Works (Upgrade and Expansion) | Roughness<br>Major Rutting<br>Pavement strength<br>Pavement Defects<br>Geometry and Safety factors<br>Alignment<br>Capacity<br>Functionality   |

**TABLE 1**

The type of data needed to drive decisions may vary for the same asset, based on its end use – this is the fundamental characteristic of fitness for purpose. As a simple example, if the end use of collecting data related to road pavements is for OHS and legislation reasons, then the data should reflect the type of defect in a pavement that causes OHS problems, such

as ride quality, undulations, deformations, skid resistance or smoothness. This data is clearly different to the data required purely to drive routine maintenance activities.

Table 2 provides an example of a simple checklist that could be used to determine if data is fit for its intended purpose.

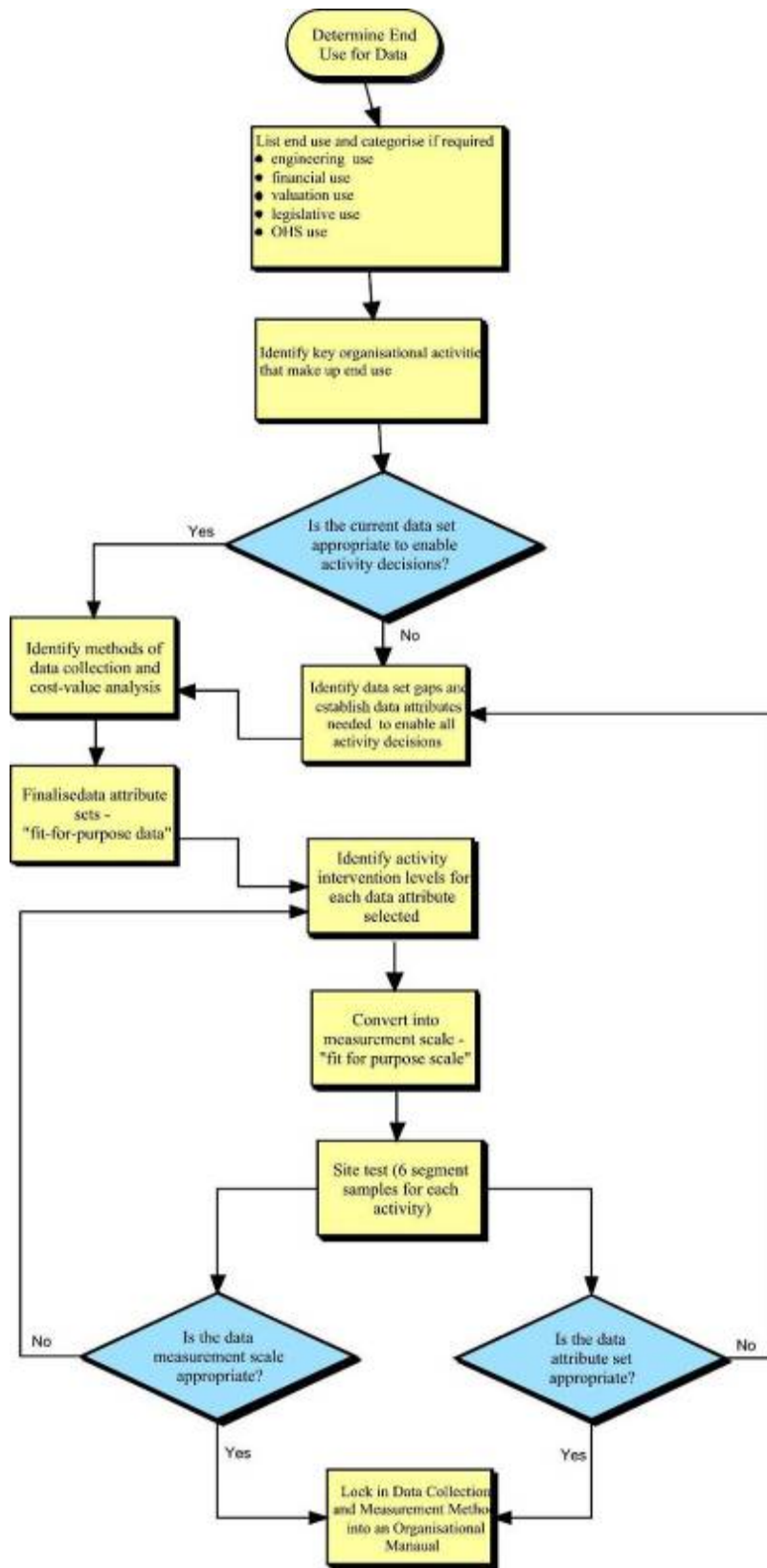
| <i>Treatment Activity</i> | <b>Condition Criteria (data set) driving decisions</b> |           |           |        |         |            |                  |           |
|---------------------------|--|-----------|-----------|--------|---------|------------|------------------|-----------|
|                           | Surface Texture  | Oxidation | Cracking  |        | Rutting | Shape Loss | Pavement Defects | Roughness |
|                           |  |           | Crocodile | Linear |         |            |                  |           |
| Surface Enrichment        | Yes  | Yes       | No        | No     | No      | No         | No               | No        |
| Spray seals               | Yes  | Yes       | Yes       | No     | No      | No         | No               | No        |
| Spray seals with fabric   | Yes  | Yes       | Yes       | No     | No      | No         | Yes              | No        |
| AC overlay                | N/A  | N/A       | Yes       | No     | No      | Yes        | No               | No        |
| Ac overlay with fabric    | N/A  | N/A       | Yes       | Yes    | No      | Yes        | Yes              | No        |
| Defect Patching           | N/A  | N/A       | No        | No     | No      | No         | Yes              | No        |
| Rut Regulation            | N/A  | N/A       | No        | No     | Yes     | No         | No               | No        |
| Rehabilitation            | N/A  | N/A       | Yes       | Yes    | Yes     | Yes        | Yes              | Yes       |
| Crack Sealing             | N/A  | N/A       | N/A       | Yes    | N/A     | N/A        | N/A              | N/A       |

**TABLE 2**

Fit for purpose data requires an **appropriate measurement scale**. Once the data attribute set (defects) to be measured has been identified, the rating scale that is used should reflect council specific intervention levels. In some instances, the scales of measurements for the same defect characteristic may vary within the council network depending on

road class, hierarchy, traffic or other criteria. After all, the data must be able to provide trigger points that justify decisions and these trigger points may be different in different parts of the network.

Flowchart 1 maps a simple logic process that can be easily applied when determining if data is fit for purpose:



**FLOWCHART 1**

Table 3 provides an example of a simple ***Fit For Purpose Data Analysis*** for this case study. It is important to note that this is only a sample and the outcome will certainly

differ between Councils and even within Councils depending on the intended purpose as explained above.

| <b>Data</b>        | <b>Method</b>                    | <b>Cost</b>  | <b>Value</b>   | <b>Decision</b>                                       |
|--------------------|----------------------------------|--|--|---|
| Surface Texture    | Visual                           | Low  | High – unique trigger for surface enrichment, currently considered a good, holding treatment.                      | Yes – collect this data                               |
| Oxidation          | Visual                           | Low  | High – council's specific trigger for reseals  | Yes – collect this data                               |
| Crocodile Cracking | Visual or Electronic (automated) | Medium if visual and high if automated.<br><br>No evidence available to suggest that automated methods may be more accurate. | High – specifically drives spray seals with fabric treatment in council's works program.                           | Yes – collect this data using visual methods          |
| Linear Cracking    | Visual or Electronic (automated) | Medium if visual and high if automated.  | Low – does not drive council's major treatments.   | No – do not collect this data                         |
| Rutting            | Visual or Electronic (automated) | Medium if visual and high if automated.<br><br>Testing has shown that visual methods are not reliable.                       | Very high – specific distress that currently is of concern and is a key driver of rut patches and reconstructions. | Yes – collect this data using automated means.        |
| Shape Loss         | Visual                           | Low  | Very high – specifically used to determine regulation and overlay  | Yes – collect this data                               |
| Pavement Defects   | Visual                           | Low  | Medium – typically used to refine treatment selection at project level   | To be determined after further analysis               |
| Roughness          | Automated                        | Very high  | Medium – typically used for higher speed roads   | No – do not collect this data (for local urban roads) |

**TABLE 3**

**Is Condition the single model simulation criteria?**

Pavement Management has been enhanced significantly over the last ten years, thanks to the passionate practitioners who have silently contributed to the industry. Local Government scores a high rank in the practitioner category as local government has been forced to do more with less.

As our infrastructure ages and as demand and utilisation characteristics change, practitioners have realised correctly that condition may not be the sole modelling criteria. Decisions to upgrade and expand an asset often have very little to do with the condition of the road and much more to do with its functional adequacy, capacity and core user based deficiencies (although in line with “doing more with less”, an identified

capacity driven road upgrade may well be aligned, where possible, with a need for condition based renewal). Pavement depths, widths and bridge capacities are a classic issue with increased mass limits, traffic volumes and user needs and preferences.

Some of the very recent, world class case studies in local government are using capacity and functional adequacy as key criteria in their models. These models are not only predicting future renewal needs, but are accurately modelling the strategic needs of expansion and upgrade. In some cases very mature sites have also started modelling the need for new or alternative assets based on connectivity deficiencies. An example of more mature and strategic rating criteria is shown below:

## Strategic Asset Assessment Concept

**Road Asset**

**Condition**

- ◆ Cracking
- ◆ Shape Loss
- ◆ Pavement Defect
- ◆ Surface Texture
- ◆ Risk

**Capacity**

- ◆ Width
- ◆ load capacity
- ◆ connectivity
- ◆ traffic volume
- ◆ LG deficiency criteria

**Functionality**

- ◆ Connectivity
- ◆ Speed limits
- ◆ Mass Limit/Hrs of operation
- ◆ LG deficiency criteria



### Intervention-rule based Rating Scale

Having established the fit for purpose data set, it is still extremely critical to ensure that the measurement scale adopted is also fit for purpose. Council's using software based Pavement Management System will recognise the value of this step, as this also provides the '**treatment decision matrix**', or interventions levels for various treatments across their road deterioration profiles.

Table 4 provides an example of a treatment decision matrix (in this case based on condition criteria only) that uses and further highlights the value in ensuring that data is fit for purpose. In this example, Linear cracking only drives decisions relating to the crack seal program. If Council does not have a proactive crack seal program, is there any need to collect this data?

| Treatment               | Optimal Intervention Levels<br>(The ' <i>Appropriate Measurement Scale</i> ' in this example includes % of segment area affected, roughness counts and predefined 'levels' based on a 1 to 5 scale) |           |                           |        |                          |                          |                          |                          |
|-------------------------|---|-----------|---------------------------|--------|--------------------------|--------------------------|--------------------------|--------------------------|
|                         | Surface Texture   | Oxidation | Cracking                  |        | Rutting                  | Shape Loss               | Pavement Defects         | Roughness                |
|                         |   |           | Crocodile                 | Linear |                          |                          |                          |                          |
| Surface Enrichment      | 20%   | Level 3   | Must not be more than 5%  | N/A    | Must not be more than 2% | Must not be more than 2% | Must not be more than 2% | Must not be more than 60 |
| Spray seals             | 30%   | Level 4/5 | Must not be more than 10% | N/A    | Must not be more than 2% | Must not be more than 5% | Must not be more than 5% | Must not be more than 60 |
| Spray seals with fabric | 30%   | Level 4/5 | 10-20%                    | N/A    | Must not be more than 2% | Must not be more than 5% | Must not be more than 5% | Must not be more than 60 |
| AC overlay              | N/A   | N/A       | 20-40%                    | N/A    | Must not be more than 5% | 5-15%                    | 0-5%                     | 60-110                   |
| Ac overlay with fabric  | N/A   | N/A       | 40-60%                    | N/A    | Must not be more than 5% | 5-15%                    | 5-10%                    | 70-110                   |
| Defect Patching         | N/A   | N/A       | N/A                       | N/A    | N/A                      | N/A                      | 10-25%                   | N/A                      |
| Rut Regulation          | N/A   | N/A       | N/A                       | N/A    | 5-20%                    | N/A                      | N/A                      | N/A                      |

| Treatment      | Optimal Intervention Levels<br>(The 'Appropriate Measurement Scale' in this example includes % of segment area affected, roughness counts and predefined 'levels' based on a 1 to 5 scale) |           |           |        |         |            |                  |           |
|----------------|--|-----------|-----------|--------|---------|------------|------------------|-----------|
|                | Surface Texture  | Oxidation | Cracking  |        | Rutting | Shape Loss | Pavement Defects | Roughness |
|                |  |           | Crocodile | Linear |         |            |                  |           |
| Rehabilitation | N/A  | N/A       | >60%      | N/A    | >20%    | >15%       | >25%             | >110      |
| Crack Sealing  | N/A  | N/A       | N/A       | >30%   | N/A     | N/A        | N/A              | N/A       |

**TABLE 4**

### Outcomes and Benefits from this Process

The council in this case study now has an extremely robust and value adding data collection process. This process has been documented as an organisational pavement data collection manual and the measurement methodology and measurement scales have been clearly documented as an organisational rulebook. Documenting the process allows council to refer to (for auditing and repeatability purposes) and refine the process as it evolves into the future.

*Fit for Purpose Data Analysis* has ensured that council's activity intervention levels are appropriate and that these are accurately reflected in council's PMS. Their outputs are now optimal and there is ownership of these outputs from the end users.

By analysing its data requirements, the Council in this case study is able to make informed decisions on the quantity and methodology of its data collection activities and as a result will see significant savings by only collecting desired data. As the long-term performance models based on this data become more reliable and better defined over time, the ongoing savings through the optimisation of council's pavement management decision making process will run into millions of dollars.

As the data inputs and PMS outputs are reliable and clearly linked to defined intervention levels, the council is now able to determine a *strategic rating cycle*; the regularity of network condition assessment activities. Data accuracy within the limits of the 'appropriate measurement scale' can be easily maintained without undertaking costly or resource hungry network assessments every year, by only rating strategically selected samples of the road network in the second and third year, followed by a complete re-rate in year 4.

An example of a strategically selected segment would be one with a condition score of 3, where a particular treatment is triggered by a score of 4 or 5. A segment with a score of 2 will take longer than 3 years to trigger a treatment (ie transition to a 4), and any 'outliers' will be picked up through maintenance inspections or resident complaints, so why inspect this segment annually? Likewise, if the segment is already a score 4, does it really matter if it slides to a score 5 without you knowing, if it already triggers a treatment? A strategic rating cycle based on this methodology will further reduce data collection costs.

## Quality Assurance and Site Testing - What does Model Site Testing Involve?<sup>1</sup>

Site-testing is the most critical step in ensuring that models will be pragmatic, are objective and that we are able to defend inputs and outputs to stakeholders. Site-testing involves developing model parameters in consultation with the people that have network knowledge – it also creates a sense of ownership and involvement between the ‘field staff’ and the ‘office staff’, who are traditionally sceptical of each others roles. Maintenance Staff undertake repair work for very valid reasons – identifying these reasons, defining them in a measurable and repeatable manner, and documenting the process to ensure repeatability and objectivity are key to the development a robust and reliable performance model.

In very simple terms, the following steps are involved:

1. Identifying the asset treatments from the people that do the work – e.g. footpath grinding, reseals, heavy patch repair, rut repair etc.
2. Identifying a sample of segments within like streets or footpaths for each unique treatment.
3. Involving the works crew in an on-site consultation to determine what the reasons are for choosing that treatment on that road or footpath.
  - a. Why do we think this street is optimal to be resealed?
  - b. Would reseal still be an optimal treatment in 12 months, 2 years, or 5 years if we did nothing to this street this year?
  - c. Would you have resealed this street last year if you had the money?

- d. Why is it too late to simply do some patching on this street?
  - e. Identify the specific defects which define the decision to undertake the treatment (eg stripping triggering reseal, longitudinal cracking triggers crack seal, etc)
4. Physically measure the asset defect condition (extent and severity) with the works crew to determine objective trigger points for each treatment.
  5. Develop an objective decision matrix which then becomes the model parameter input (or the PMS software decision making framework).
  6. Test the model on site by checking if outputs (treatment decisions) at the project level make sense.
  7. During rating, undertake a rigorous site testing and QA process including data quarantining if results are out of acceptable limits.

One method of QA is to have the condition assessment ‘teams’ rate a selection of each others work, or in the instance of a single team, have them re-rate random segments during the course of the assessment process.

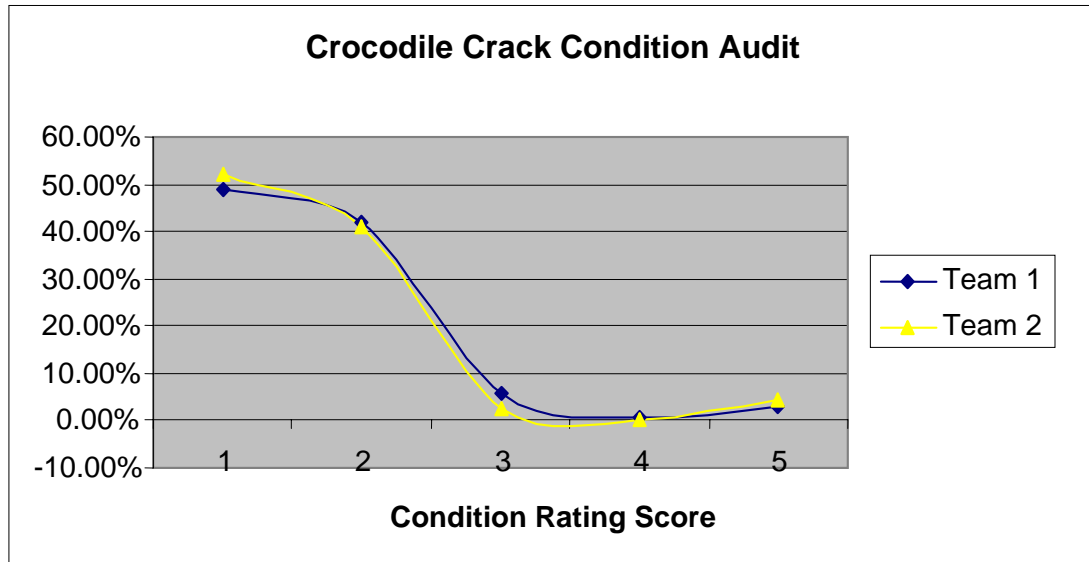
In the real example in Graph 3 below, a large NSW Council compares two in-house assessment teams in terms of their classification of the local road network (by segment) crocodile cracking condition rating on a pre-defined (i.e. workshopped) score of 1 and 5 with excellent results. This was not achieved by chance, but rather it was facilitated by a rigorous, regular and well documented condition assessment and auditing methodology. In addition to good training, each team would assess a proportion of the other teams work on a regular basis. Areas for improvement were identified, such that re-training and/or re-rating could be scheduled as required. Accuracy improved as team experience increased, and the regularity and quantity of

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<sup>1</sup> Reference sites in Victoria, Tasmania and NSW as well as Asia can be provided by the author where site-tested robust models have been proven to add value over time.

auditing could be adjusted. This process is equally relevant and is generally employed

for assessing out-sourced condition assessment.



GRAPH 3

### Why Use a Performance Model?

In essence, performance models are decision-making tools that can operate at both strategic and tactical levels in an organisation.

Performance models are excellent prediction tools; they can model the behaviour of an asset over time for a large number of sub-components (segments). The model can 'predict' the outcome of a network influenced over time by both random and quantified deterioration factors, such as age, traffic, consumption, etc. Improvements to the network, in terms of maintenance and renewal activities, can also be modelled (and optimised) over time.

Where an analysis of life cycle trends for various funding strategies or where renewal gap analysis is required, longer prediction periods are used, often for 20 years or more. In instances where the requirement is to develop an optimised forward capital renewal program, the prediction period will

tend to be much shorter, generally up-to five years.

Models are an incredible means to assess the long-term impacts of short-term decisions, and hence they are very critical tools for long-term strategic planning. Models can be very effective in testing long-term network savings by increasing the quantum of maintenance or prioritising resealing works for the next five years to arrest surface deterioration and avoid more costly rehabilitation down the track.

### Road Surface and Pavement Models

Instead of modelling the surface and pavement of a road as a composite structure, it is more meaningful to model them separately. This is because:

1. The condition data we collect is generally unique in reflecting either surface or pavement condition (eg stripping is a good surface indicator while significant crocodile cracking indicates an underlying pavement defect).

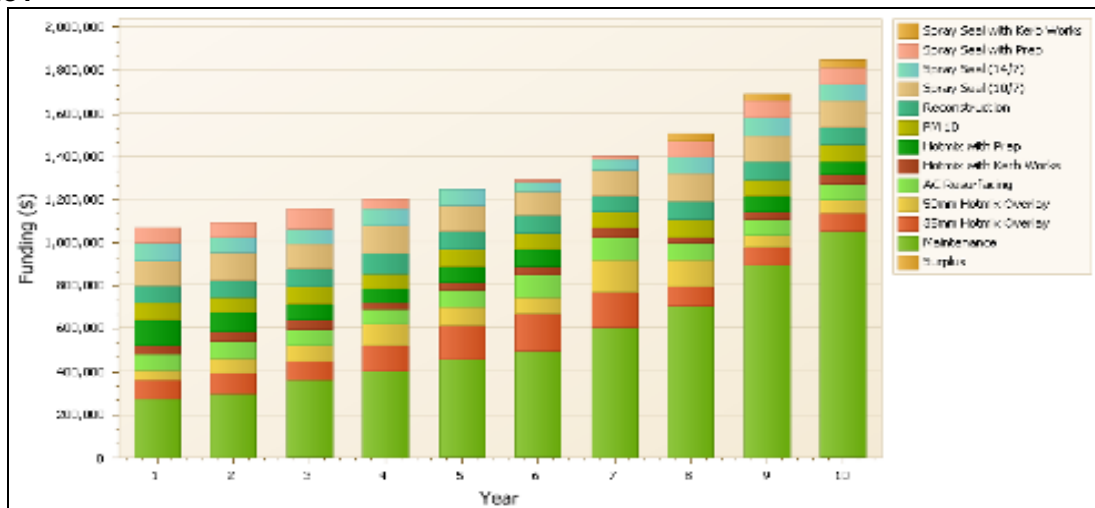
2. Visual surface observation methods that you have employed may only indicate true pavement condition in marginal instances.
3. The rate of wear (life cycle) of surfaces is different to that of the pavement.
4. It may be complex to represent zones of optimal treatment appropriately in a combined model.
5. We may be using condition based modelling to also develop consumption based financial valuation reports, separately for surface and pavement.

This does not mean that a composite model is a bad model - in instances where the condition measurement method supports a composite model, the results will be perfectly valid.

### What can a Good Performance Model Provide?

A good performance model must provide the following as a minimum, in accordance with the International Infrastructure Management Manual and the recent NAMS guidelines for local government planning. Note that each example shown below is a real example of Australian Councils with good, robust, tested performance models:

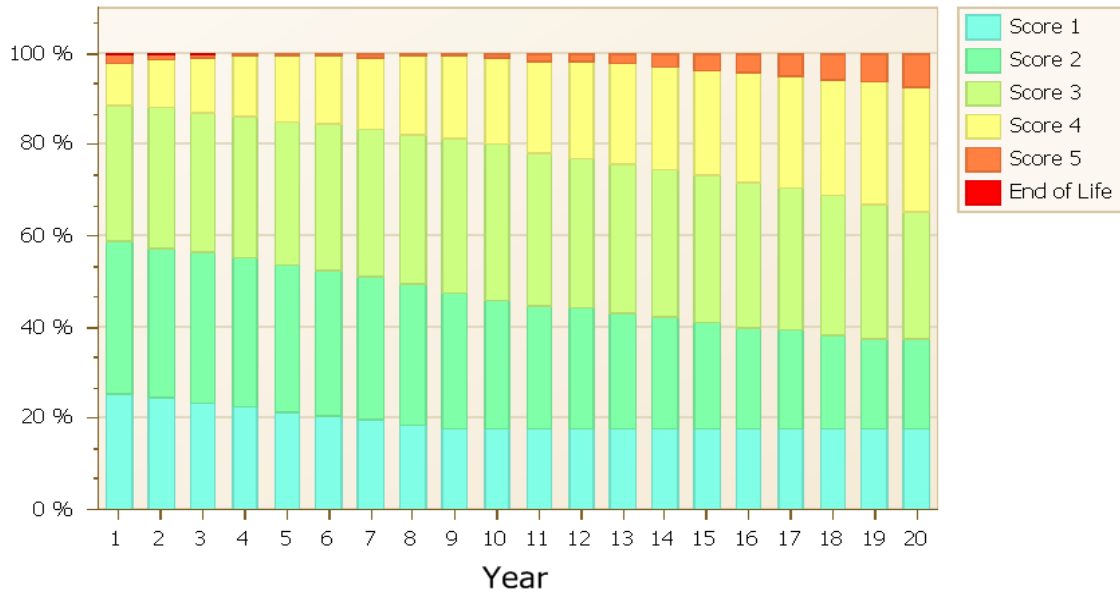
1. Clear picture of the level of funding that a council must allocate to their sealed roads, gravel roads, footpaths, etc for the next five, ten, twenty years, based on a target level of service. Graph 4 below demonstrates the optimisation over time of a fixed renewal budget for various treatments on a sealed road network. The increasing maintenance component is indicative of a deteriorating network – as the network deteriorates, the maintenance costs increase.



GRAPH 4

2. Clear picture of the condition profile of the road network if the funding levels were altered and any risk analysis associated with any deteriorating condition. Graph 5

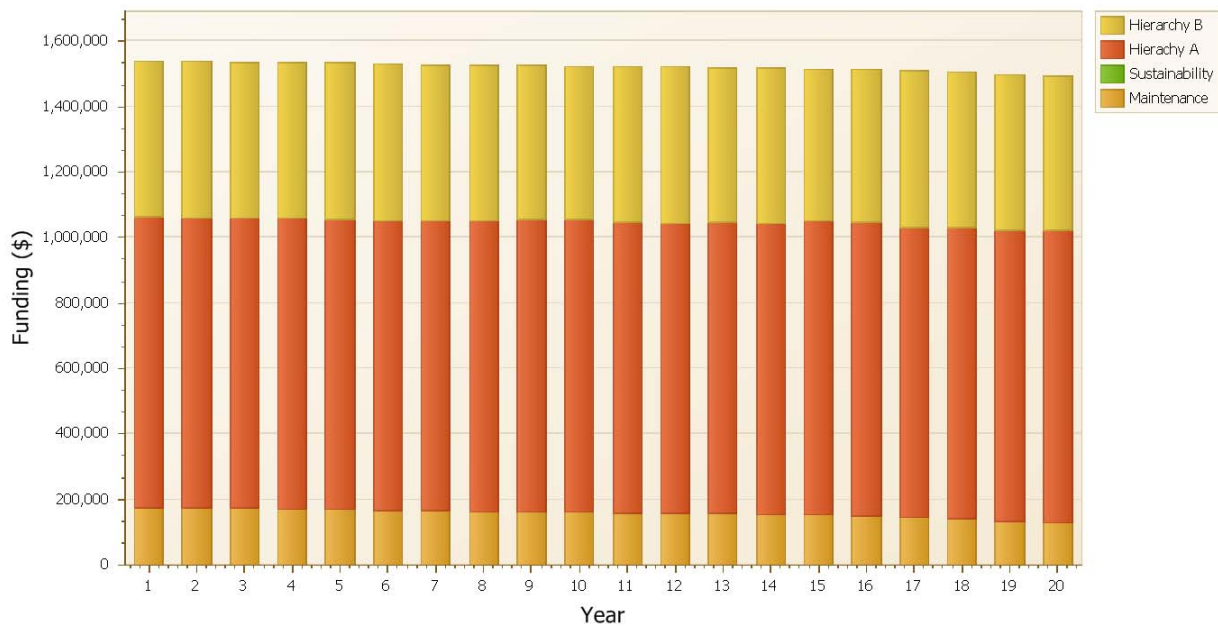
below shows how the quantity of assets beyond a defined level of service (say score 4) increases over time under constrained funding.



**GRAPH 5**

3. A funding allocation strategy by network or hierarchy i.e. optimal distribution of funding by hierarchy. In the Graph 6 example below, a

strategic analysis has indicated that the best long-term outcome can be achieved with a 30/70 funding split between the two road hierarchies.



**GRAPH 6**

4. Maintenance tactics – i.e. the level of minimum maintenance funding,

optimal maintenance funding and the impacts of reduced maintenance funding.

5. Maintenance figure estimate for a range of strategies, e.g. what should be a minimum allocation to maintenance if:
  - a. we increased our reseal surface coverage (or return period) from 7% to 9% over the next five years.
  - b. we did no rehabilitations for next five years.
  - c. we spend 30% of the capital funding on a new stronger seal treatment application.
6. Renewal profiles and future gaps – 10 years, 20 years and 50 years showing peaks and troughs of upcoming renewals including annualised funding levels to match asset consumption.
7. Asset trade-off analysis – e.g. between footpaths and roads.
8. 3 year resurfacing programs by location.
9. 5 year capital works programs.
10. Life Cycle costs of asset network management including Net Present Worth and Equivalent Annualised Cash Flow.

### **Prioritisation – Ranking versus Optimisation**

Asset Management tools that many councils are implementing use either a ranking or an optimisation process for analysis and scenario building.

Ranking is based on a set of rules that essentially determines the best project level allocation of funding, e.g. prioritise the reseal budget by spending on poorly oxidised surfaces first and if money is left over, spend on the aged seals.

Optimisation is based on targets or outcomes, e.g. determine a funding level to achieve a target condition of 2 out of 5, and then produce a list of capital works projects to support this.

Each method has its own place and the fitness for purpose from each council's perspective is the key.

### **Conclusion (An Ideal System)**

As I hope we have outlined above, an ideal system is not about having the best software tool or even the most comprehensive database – it is all about being fit-for-purpose. The most sophisticated tools that use the most complex mathematical algorithms may add little or no value at all if they are data hungry, resource hungry and require thousands of dollars in training. In general, the following characteristics are fundamental to an ideal system:

1. Allows users to design their own rating system and is flexible enough to use council defined data.
2. Allows users to use their network specific performance models.
3. Allows users to define treatment-condition relationship.
4. Total integration between the network level and project level modules. Many systems claim this but in reality don't have real-integration.
5. Allows users to allocate funding by treatment type at the project level. Many systems will only allow users to allocate total funding only i.e. not by treatment type. This makes it impossible to do 'what-if-scenarios' for various treatment allocations and to assess future impacts.
6. Easy to use and most importantly the modelling criteria is objective and not flawed with a range of assumptions.

### **Lessons to consider**

- QA is essential for robust, objective and repeatable data

- Contractor v/s in-house – available resources will determine the option, but auditing is the key
- System has to be flexible – there is always more than one solution.
- Stakeholders must be involved – the model must be fit for purpose
- Models must be tested – one size fits all will not work
- Local Government is different to state highways - even within local government there are variances from cities to rural towns.

### **Author Biography**

**Phil Miles** is a Civil Engineer with a passion for engineering problem solving and process improvement. Phil commenced his engineering career with the Australian Army, graduating from the Australian Defence Force Academy in 1995 and spending the next 10 years in civil construction operations, project management and instructional roles both in Australia and overseas. Phil transitioned to local government in 2005 and held the position of Road Asset Engineer at Gosford Council until 2008, where he introduced optimised decision making and robust pavement management processes from the ground up. He is now the Infrastructure Strategy Manager at Cessnock City Council, responsible for transport and drainage infrastructure Asset Management and Strategic Planning.

**Ashay Prabhu** has 16 years of industry experience in Asset Management and Maintenance. Ashay works primarily with local government councils and has been part of council teams for many years, enhancing internal processes and building fit for purpose frameworks to achieve Good Practice in Asset Management. Ashay's prime focus is in hands-on asset management training, delivering on-site programs in asset inspections, life cycle modelling, performance modelling, strategic planning, asset valuations, operational

management and maintenance planning. His track record in successful and cost-effective asset management implementations has been recognised by many councils in Australia and overseas as he is currently engaged in developing frameworks to comply with accounting and legislative needs, including training of maintenance inspectors for insurance audits. Ashay is a co-founder of the Asia Pacific Institute of Asset Management. He has presented strategic workshops and seminars by invitation to senior bureaucrats and ministerial departments in Asia. He has been recently appointed as an Adjunct Professor at Bond University to teach asset management.