AN INNOVATIVE APPROACH TO LOCAL GOVERNMENT ROAD NETWORK MANAGEMENT

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Abstract

The Mornington Peninsula Shire in Victoria has amalgamated routine road maintenance activities and traditional annual reseal/rehabilitation capital works activities into the one long-term integrated road network management contract. The 'Safer Local Roads' (SLR) is a 15 year outcome based maintenance contract incorporating annual performance reviews. This is an innovative approach to Road Network Management for Local Government, the scale of which has not been previously undertaken in Australia.

The activities are being provided as part of a Quality Relationship (partnership) between the Shire and Downer EDI Works, with a smooth monthly service charge. The aim of the 'Safer Local Roads' contract is to fully integrate all road network management services into one service provision to obtain greater value for money, improve services, obtain a greater certainty in service delivery, and implement a sustainable accelerated program of capital works deliveries.

Various specific performance measures exist to enable contract performance to be assessed, and this paper details the development of methodologies, processes and calculations for measurement of one of the key indicators, being road pavement performance for sealed roads. These were jointly developed between the Shire and Axim a Downer EDI Works business specialising in infrastructure asset management.

Introduction

The Mornington Peninsula Shire until recently ran a fairly traditional model of local road network management. This was achieved by internally determining and supervising their annual reseal/rehabilitation works program which was undertaken by external contractors annually, and also having routine road maintenance services provided by an external service provider over a 10 year contract term.

Whilst being relatively successful in terms of reducing existing rates of deterioration of the sealed network condition over a period of time, the Shire decided to expand their outlook to seek an alternative innovative method of achieving greater efficiencies and value for money for their community from their road network management services. In an effort to gain funding for a sustainable accelerated program of capital works projects, greater certainty in service delivery from having long term financial planning capabilities and to integrate all road network management services into the one service provision and hence achieve greater cost savings, a 15 year contract for total road network management was entered into with Downer EDI Works.

The resultant 'Safer Local Roads' (SLR) contract is an outcome based contract relying upon several performance indicators used to measure contract performance. This approach has previously been undertaken for road network management at State level, but not at this scale at the Local Government level in Australia.

One of the challenges confronted was to determine a process to enable the Shire to monitor sealed pavement performance throughout the contract term and to develop a repeatable methodology of condition measurement so that regular reviews of sealed network pavement performance could be undertaken to ensure desired outcomes were being achieved. Pavement condition is more easily monitored, measured and captured utilising high speed automated data capture vehicles on State networks as these roads are more stable and consistent in nature than at local government level, where several variables and impediments exist within the network that provide greater challenges.

The relationship between the Shire and Downer EDI Works includes Axim a Downer EDI Works business specialising in infrastructure asset management. From the outset a close relationship formed between the Shire and Axim to jointly develop and review the pavement performance measurement processes to achieve the desired outcomes.

Existing Network Attribute Data

Prior to the development of pavement performance indicators, the Shire in keeping with the partnership principals of the SLR, provided Downer EDI Works access to all historical council records of road condition data and pavement and road surface performance data during the tender period. The existing data included recently acquired ARRB surveys where a 10% sample of the Shire sealed local road network had been surveyed and analysed to produce indicative distributions of AADT figures, network age, roughness, rutting, texture depth and pavement deflection. Also an indicative distribution of remaining pavement structural lives based upon FWD data and predicted future traffic loadings was undertaken and made available. Based upon this collection of recent and historical data, a very clear insight into existing network attributes and predicted future behaviour could be determined to ensure that an achievable expectation and provision of services could be proposed.

Routine Road Maintenance Performance Indicators

Contract provisions that already existed prior to the SLR in the Shire's Sustainable Infrastructure Maintenance Services (SIMS) contract for routine road maintenance services were developed in consultation with the community through nearly 30 workshops held throughout the Shire prior to the tendering and start of the SIMS contract in April 2003.

These service levels were reviewed at the time of the introduction into Victorian law of the Road Management Act in 2004.

(The purpose of the Road Management Act is to establish a management system for the road management functions of a road authority which is based upon policy, operational objectives and available resources and also establishes decision making processes in relation to standards of construction, inspection, maintenance and repair).

As a result of the Road Management Act requirements, the existing Shire local road network hierarchy was reviewed and updated accurately reflect a functional road hierarchy concept, and service levels (inspection frequencies, intervention levels, and response times) were reviewed and adopted according to each new individual hierarchy.

These existing routine maintenance service level provisions within the existing SIMS contract were absorbed directly into the SLR contract.

Objectives of Pavement Performance Indicators

It was determined that the SLR contractual requirement regarding sealed network pavement performance was for the existing pavement condition as at the commencement of the contract to be maintained for each pre-defined road hierarchy classification for the15 year term of the contract. In short, the network was to be handed back to the Shire at the end of the contract period in the same condition as when the contract commenced.

This required a benchmark assessment of the network to be undertaken in order to determine the agreed existing service level of the road pavement and to enable Downer EDI Works to have a better understanding of current network conditions. This also enabled Downer EDI Works to determine an appropriate financial model necessary to meet contract requirements, subject to council approval.

A methodology of calculating a sealed pavement performance indicator based upon surveys of network pavement conditions was required. This would be auditable and repeatable to enable future reviews of contract performance, and appropriately rewarded the efforts of Downer EDI Works.

The resultant performance indicator also needed to accurately reflect the existing pavement condition, whilst enabling the possibility of raising service level requirements in the future (subject to increased funding negotiations) should council desire.

Pavement Condition Index (PCI)

It was determined that a Pavement Condition Index (PCI) was to be calculated and used as a measurement of sealed pavement performance.

The PCI was to be determined based upon the measurement of several existing road pavement defect types, aggregated together and appropriately weighted to produce one overall condition index figure for each defined road hierarchy.

Maximum repeatability was required from condition surveys to enable accurate future monitoring, and so surveys using multi-laser profilometer technology were undertaken wherever possible. As many local residential roads cannot have profilometer surveys undertaken due to issues of speed, length and other impediments (speed humps, roundabouts, LATM treatments etc.) visual condition assessments using an accredited third party data capture organisation were utilised in these instances. Visual condition defects to be assessed were clearly defined in accordance with defect descriptions indicated in A Guide to the Visual Assessment of Pavement Condition (Austroads, 1987).

Pavement Defect Assessment Surveys

Pavement defect types to be assessed were selected by mutual agreement following detailed consultation between representatives of the Shire and Axim.

By utilising the flexibility of the Deighton 'dTIMS CT' Pavement Management System implemented by Axim, as 'Authorised Deighton Consultants' in Australia, the opportunity was taken to address previous constraints experienced by the Shire by using an "off the shelf" Pavement Management System. By identifying these constraints and incorporating into the PCI the attributes for measurement that better reflected local conditions and concerns, a more meaningful index was able to be achieved.

Table 1 – Condition Parameters for roads able to have automated surveys undertaken.

Survey Type	Defects or Attributes
Automated	Roughness (NAASRA counts)
Automated	Rutting (mean rut depth)
Automated	Surface Texture (texture depth)
Visual	Crocodile Cracking (% area)
Visual	Flushing (% area)
Database	Surface Age (years) Allowances made for surface type.

Table 2 – Condition Parameters for roads not able to have automated surveys undertaken.

Survey Type	Defects or Attributes
Visual	Crocodile Cracking (% area)
Visual	Flushing (% area)
Visual	Stripping (% area)
Visual	Pavement Defects (% area)
Database	Surface Age (years) Allowances made for surface type.

A summary of defects measured and the road hierarchies and applicable network lengths for each road hierarchy can be seen in Table 3 Appendix A.

Defect data assessed using automated means was collected using a Multi Laser Profiler in accordance with ARRB TR Test Methodologies. Data was collected in both prescribed and counter directions on Arterial and Collector Roads, and in one direction only on Local Access Roads, and was aggregated into 100m intervals. The resultant data was supplied in accordance with clearly defined database file reporting formats.

Data required from Visual Condition assessments were collected by way of GPS enabled PDA devices at 25m intervals in urban areas and at 100m intervals in rural areas. The data was downloaded to appropriate project data centres in batch files by means of daily GPRS transmissions direct from the PDA device on site, and transferred over a mobile phone network. Data integrity checking, condition data repeatability information and batch conversion into required field formats for upload into the GIS and other databases was conducted.

PCI Calculation Methodology

To briefly summarise the PCI calculation methodology:

Each defect or attribute had its data converted to a length weighted average per 100m or remainder thereof of each road surveyed.

A score out of 100 for each 100m length was then calculated, 100 being pristine (expected result from a new road construction).

Each defect or attribute score had its contribution towards the total aggregated PCI value weighted according to the extent to which it contributed towards the nine service objectives of the SLR contract.

A sensitivity analysis was conducted to refine the overall contribution of each defect category and weighting to be applied between attributes in order to achieve a meaningful index that reflected the perceived network condition for each hierarchy.

The aggregated PCI for each 100m section of road was then available to be used in the calculation on a length weighted basis of each individual road hierarchy.

Table 4 – Example of roughness indices determination for road hierarchies A, B and C1.

NAASRA Counts	Indices
< 70	100
>= 70 and < 90	100 - 75
>= 90 and < 120	75 – 50
>= 120 and < 150	50 – 25
>= 150 and < 200	25 – 0
>= 200	0

Figure 1 – Example of formula used to calculate PCI for 100m section of hierarchy A road.

PCI = 0.65 x [(0.3 x roughness) + (0.15 x rutting) + (0.3 x (texture + flushing)/2) + (0.25 x cracking)] + 0.35 x [surface age]

A summary of calculated Benchmark PCI for each road hierarchy can be seen in Figure 2 Appendix B.

Pavement Performance Reviews

A full network condition assessment and pavement performance review based upon identical processes and calculation methodologies will be undertaken on every third year of the contract, and again in the final year of the contract and the next scheduled pavement condition survey is planned for the first quarter of 2009.

This will ensure that levels of pavement performance are regularly monitored and that requirements are being achieved. Contractual provisions are in place to address situations where performance levels are not being achieved, and plans of rectification works are to be submitted and implemented to resolve service level deficiencies at Downer EDI Works undertaking should it become necessary.

Network Growth

Several issues impact upon the ability of performance review measured PCI's being able to be directly compared with required target PCI's. The council maintained local road network is subject to a degree of variance as opposed to the more defined state or federal road networks.

One issue is network growth due to newly constructed roads resulting from subdivisional developments.

Also, network growth and shrinkage can result from roads having responsibilities transferred between authorities as a result of demarcation issues or agreements for transfer of responsibilities.

Existing roads also may be unable to be assessed for defects due to road closures or civil works in progress at time of assessment etc.

Reseals or rehabilitation works that are funded externally to the SLR contract will also affect individual road conditions through no effort from Downer EDI Works.

All of these issues combine to either improve or deteriorate the overall PCI figure achieved at time of condition assessment, and prevent an accurate comparison of PCI in order to measure contract pavement performance.

These issues can advantage or disadvantage Downer EDI Works in their effort to meet target PCI levels, and as such need to be isolated from pavement performance calculations.

To allow for these factors, the benchmark PCI calculated at the commencement of the contract (the target PCI for the first pavement performance review year) is valid only until that review year. Only the exact network that formed the initial defect assessments is used for comparison purposes. Once the second three year review period commences, the growth or shrinkage assets are included in calculations and a new target PCI is calculated for comparison in the following review year.

A simplified diagram indicating the process for PCI comparison in pavement performance review years can be seen in Figure 3 Appendix C.

Conclusion

An innovative approach towards total integrated road network management within the Mornington Peninsula Shire has provided the opportunity for considerable gains to be made on the behalf of the community, in terms of more cost effective service delivery, and a sustainable delivered accelerated capital works program.

Essential to the success of the Safer Local Roads road network management contract is the quality relationship that has been developed between the Shire and Downer EDI Works. This 'partnership' approach ensures that both parties are focussed upon achieving the same goals and that any issues identified during the contract term are addressed and solved jointly to the satisfaction of both parties and that potential risks are also shared.

By allowing Downer EDI Works access to all historical council records of road condition data and pavement and road surface performance data prior to tender, a very clear insight of network attributes and expected behaviour could be determined to ensure that an achievable expectation and provision of services could be proposed.

This same quality relationship model has ensured that pavement performance measurement methodologies and resultant Pavement Condition Index calculations have been developed, documented and undertaken in total agreement and in a transparent manner.

With clearly defined expectations and pavement performance measures, the service level of the sealed road network can now be monitored and assured for the term of the contract at an overall cost saving to the community. Downer EDI also now has, subject to meeting well defined performance reviews, a long term commitment from the Shire for undertaking their road network management services.

Due to the implementation of Safer Local Roads, the Mornington Peninsula Shire, Downer EDI Works and the Mornington Peninsula community look forward to a successful and productive long term relationship.

References

Austroads (1987). *A Guide to the Visual Assessment of Pavement Condition*, AP-8/87, Austroads, Sydney.

Road Management Act (2004), Act No. 12/2004, Version No. 017.

Appendix A

Table 3

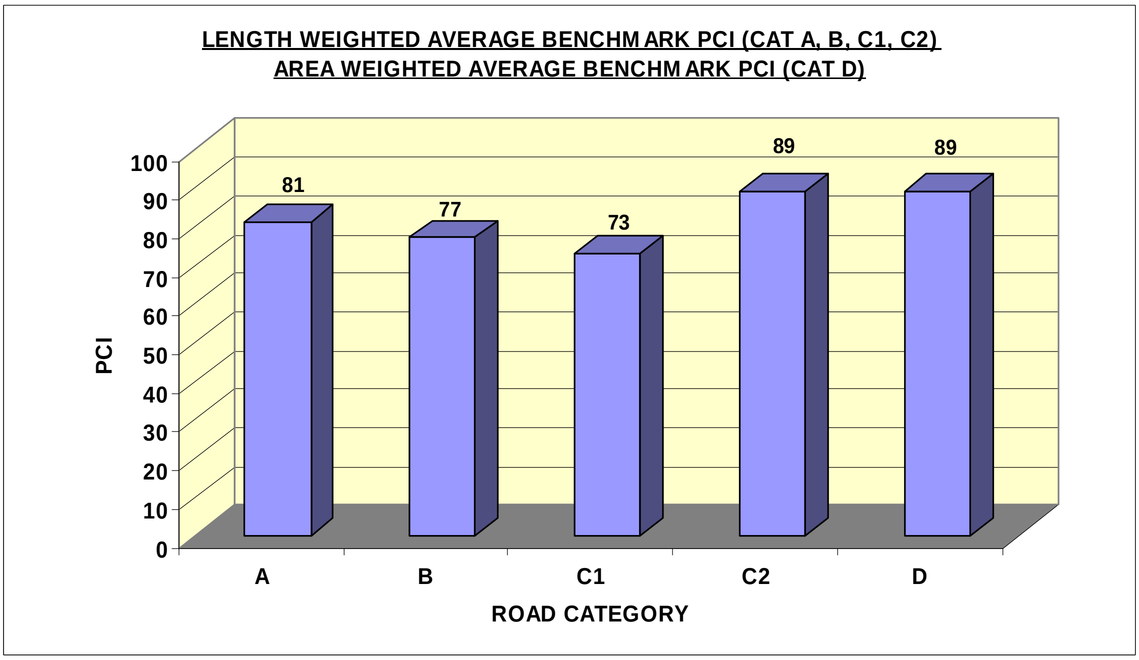
Summary of Defect Assessments

Road Condition Survey Category	Description	Survey Type	Defects Measured	Hierarchy Length
A	Arterial	Automated & Visual (Automated data collected in both directions)	Roughness Rutting Texture Depth Flushing Crocodile Cracking	203km
B	Collector	Automated & Visual (Automated data collected in both directions)	Roughness Rutting Texture Depth Flushing Crocodile Cracking	141km
C1	Local Access (able to undergo Automated Testing)	Automated & Visual (Automated data collected in one direction only)	Roughness Rutting Texture Depth Flushing Crocodile Cracking	248km
C2	Local Access (Not able to undergo Automated Testing)	Visual	Stripping Flushing Pavement Defects Crocodile Cracking	651km
D	Car Parks & Limited Access	Visual	Stripping Flushing Pavement Defects Crocodile Cracking	24km

Appendix B

Figure 2

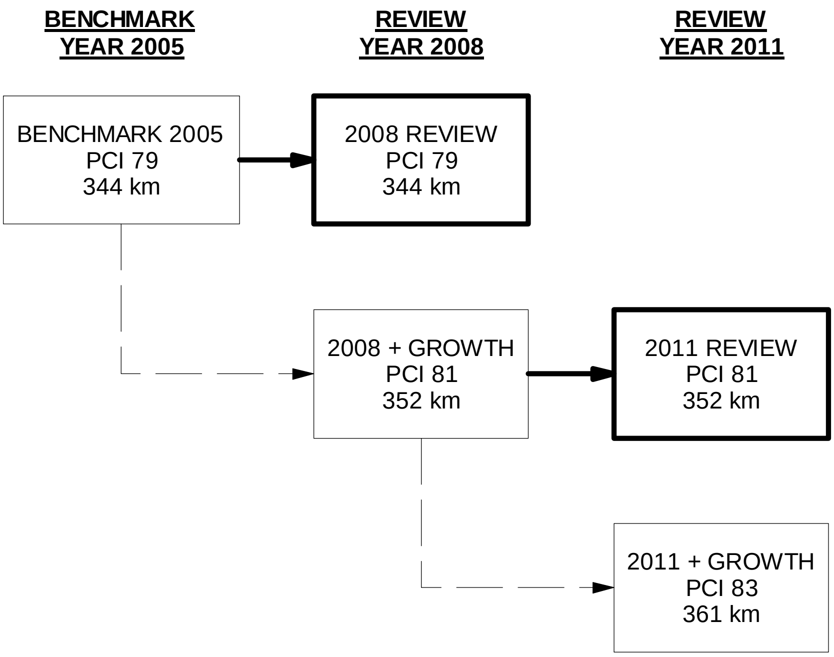
Road Category Benchmark PCI's



Appendix C

Figure 3

Review Years – PCI Comparison Process



Author Biography

Peter Clewer

Asset Management Officer (Roads) – Mornington Peninsula Shire

Peter is the Asset Management Officer (Roads) for the Mornington Peninsula Shire in Victoria. Peter has been involved in the survey and engineering fields for many years with experience in State Government, Local Government and Water Authorities. He has also been employed in a short term overseas assignment as part of an Australian Government Overseas Aid Project, assisting with the implementation of a Land Information System.

More recently Peter has been responsible for the Road Asset Management functions within the Mornington Peninsula Shire, with particular emphasis in customising the Deighton 'dTIMS' Pavement Management System in conjunction with Axim to achieve optimal capital renewal outcomes on locally maintained roads.

Peter is currently assisting in the implementation of processes and calculation of methodologies to enable sealed road pavement condition monitoring to be undertaken to enable regular reviews of pavement performance requirements within the 'Safer Local Roads' road network management contract.

Amy Wade

Manager Axim - A Downer EDI Works business

Amy is passionate about Infrastructure Asset Management and is utilising her skills and knowledge to assist asset owners develop sustainable processes for the effective long term management of their assets.

Amy is an experienced road asset management practitioner having worked for several years with the RTA NSW following the completion of her Civil Engineering degree from the University of Newcastle and has also completed a Master of Engineering Management from the University of Technology, Sydney.

In her role in Axim, Amy is responsible for managing a diverse team of professionals consisting of Assets, Pavement and Software Engineers to deliver Asset and Pavement solutions to Local Councils and Infrastructure Service Providers by combining her practical skills and knowledge with her interests in Asset & Pavement Management Systems.

On this project, Amy has been actively involved with providing support at Mornington Peninsula Shire since December 2002 and has thoroughly enjoyed her experience working closely with Peter Clewer. Amy has many years experience dealing with a varied client base in the asset management field, with particular emphasis in the pavement management area.