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Original Research Paper

Optimising local council's return on investment from annual pavement rehabilitation budgets through targeting of the average pavement condition index

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ABSTRACT

A high quality transportation system is necessary in a modern economy, and a road network is a common and significant, component of the system. Road systems have two major objectives: to enable the movement of passenger vehicles and the movement of freight vehicles at reasonable speeds. An important part of the transportation system and an expensive investment, a functional road network must meet both objectives to maintain an efficient economy. In Australia, the Department of Infrastructure and Regional Development reported that, in 2011/12, the total road length was approximately 900,000 km, and the total road expenditure was approximately $19 billion. Good policy requires that infrastructure investments provide a return on investment, thus warranting judicious management to ensure that it is maintained in a cost effective manner. Recent studies in Queensland, Australia, have identified differences between financial and engineering professionals in their understanding of infrastructure depreciation, condition deterioration, and future funding needs. Furthermore, the Queensland Asset Sustainability Ratio (ASR) requires clearer definitions to ensure that infrastructure remains meaningful to all users. This study proposes a separate sustainability index for road pavements (SIR) unlike the ASR that combines all type of assets. The justification is our ability to assess road condition, the high value of road assets, relative value to other infrastructure, and advanced knowledge of deterioration relative to other infrastructure. The SIR involves community consultation to target an average pavement condition index (PCI). This study also provides an alternative method to determine the optimal target PCI for a local

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government authority (LGA) that balances community expectations and funding levels, with a particular focus on return on investment (ROI) for the annual road reseal and rehabilitation budget.

1. Introduction

Local, rather than state and national governments are responsible for managing the majority of roads in Australia. A study by Haas et al. (2001) states that “Maximising customer benefits and satisfaction is a goal toward which any service or product provider, including pavement engineers, should strive”. In Australia, the Department of Infrastructure and Regional Development reported that, in 2011/12, the total road length was approximately 900,000 km, and the total road expenditure was approximately $19 billion (DIRDAG, 2013). Local governments must foresee and understand future costs to maintain road networks because they represent a never-ending, multimillion dollar annual expenditure. This particular financial planning is a phenomenon faced by governments all over the world.

1.1. *Local governments in Queensland, Australia*

In Australia, local councils are products of state governments and, as such, have the authority to realign boundaries. This has been accomplished through various means such as appointing administrators, amalgamations and de-amalgamations. In 2013 the Honourable David Crisafulli MP, Minister for Local Government, Community Recovery and Resilience (2013) announced the de-amalgamation of Noosa, Livingstone, Mareeba and Douglas Shire Councils, back to their boundaries prior to the 2008 amalgamation. Gaining support for the recommendations of this study from the Queensland State Government would ensure both the small initial cost and the political will for change would be ensured.

1.2. *Local government financial reporting – depreciation*

The current LGA method of reporting future road maintenance budgets is based on the financial depreciation component of annual financial reports. In Australia, these reports comply with the International Financial Reporting Standard (IFRS). Depreciation is historical in nature and can be calculated by various methods, resulting in a diverse range of acceptable financial calculations. In Queensland, Australia, there is a mandatory reporting requirement for all local governments to report their asset sustainability ratio (ASR), which includes all assets. The ASR also includes the result of one of the financial depreciation methods in the calculation of the ASR.

Under the Local Government Act of 2009, Local Government Regulation of 2012, City of Brisbane Act of 2010, and City of Brisbane Regulation of 2012, all councils are required to prepare General Purpose Financial Statements and Annual Reports within the following timeline (Fig. 1) (DILGPQG, 2015a, b).

1.3. *Alternative financial reporting – sustainability index for roads*

This paper focuses on generating an ROI curve based on pavement management system (engineering) outputs and future budgets of local governments. ROI is defined as the (for any future year) average pavement condition index (PCI), for the annual rehabilitation budget until the future year chosen. An opportunity to include the community exists in choosing the PCI, as local taxes will be required to fund the PCI. Neshkova and Guo (2011) concluded “that public participation is, in fact associated with enhanced organisational performance”. When the PCI is chosen, the sustainability index for roads (SIR) is defined as the chosen PCI relative to the achieved PCI, which is a function of the predicted budget and the allocated budget.

This paper proposes an easier, quicker, and cheaper alternative for the financial reporting of roads. The project proposes a solution to the current annual local government financial reporting burden that is more engineering based. This new method can be used independently or alongside IFRS reporting, as it gives the local government control by enabling

Fig. 1 – Local government financial reporting timeline (DILGPQG, 2015a, b).

consultation with residents before deciding on their target pavement condition index. The proposed practice is unbound by the initial construction cost, design life, or depreciation methodology for the road network. The proposal to rely on local concerns has been considered in the United States of America. Neshkova and Guo (2011) wrote "Since bureaucrats make decisions on the basis of their narrow specialisation, they might not be able to foresee all consequences of public policies". Neshkova and Guo (2011) considered data from state transportation agencies to assess if public participation in administrative decision making is only normatively desirable or if it indeed offers practical value. They concluded in part the evidence presented here indicates that public participation is, in fact, associated with enhanced organizational performance.

2. Literature review

2.1. Sustainability in road management

National Road Administrations (NRAs) across Europe continually improve the performance of their road networks. These improvements have been supported by significant research into the optimisation of road planning, design, construction and maintenance. These studies have also improved the understanding of the social, environmental and economic aspects of managing road networks in European countries. However, while understanding some aspects of sustainability, there is not an overall understanding of sustainability, therefore, how to benchmark and improve overall performance (Sowerby et al., 2014). Thus, the Sustainability National Road Administrations (SUNRA) project aims to generally define sustainability and identify how to measure sustainable developments at a strategic level. The goal also includes integrating sustainable decision-making into key intervention points by selecting indicators, setting appropriate targets and recording results.

NRA responsibilities include achieving financial efficiency and meeting non-transport objectives for community welfare, the environment and sustainability. In some cases, the NRA also oversees vehicle and traffic regulations, as well as multimodal responsibilities. The SUNRA team surveyed 22 European NRAs via a questionnaire to assess current practices in terms of sustainability, and 17 NRAs responded to the majority of questions. These responses reasonably represent European countries in terms of geography, size and road network maturity. The surveys reveal almost all NRAs have specific ambitions concerning sustainability. While each country has their own focus, common sustainability themes include climate change, greenhouse gas emissions, lifecycle assessment and other forms of environmental "footprint", air quality, noise, ecology, life cycle costs and cost effective strategies.

The literature review and survey of European NRAs demonstrate the need to define the scope of sustainability and help categorize suitable strategic targets and metrics. Also necessary is establishing a system for the measurement and rating of sustainable practices that are flexible enough to be applied to any European NRA. The SUNRA project developed three frameworks to address these needs, enabling NRAs to 1) define sustainability within their context of services and the activities of their organisations and extended supply chains; 2) set appropriate performance targets and identify indicators; and 3) measure and record their performance at the project level. Framework 1 provides four recommended steps to define sustainability 1) interpret of sustainability in the context of transportation and road systems; 2) review impacts, influences and responsibilities; 3) Craft a strategic commitment; and 4) implement the commitment. Framework 2 consists of four levels, with level one being the lowest and level four being the highest. Level 1 describes a commitment by the board to sustainability and the NRA measures and monitors performance based on current priority topics. During level 2, the NRA develops a sustainability strategy and relevant policies. For Level 3 the NRA establishes a sustainability strategy and policies, and by Level 4, the NRA has a well embedded strategy. Framework 3 is a spreadsheet-based tool that was developed to provide a rating system framework to assess the sustainability of road projects. It comprises three working steps: 1) review aspects of each sustainability topic included in the framework; 2) identify of indicators and targets for each aspect; and 3) record the performance against the established targets.

In this study, a series of frameworks was developed for NRAs to develop a tailored approach to sustainability based on national priorities, significant issues, stakeholder concerns and individual organisational structures. The SUNRA frameworks provide a practical approach to measure the sustainability of an NRA. Framework 3 enables the NRA to define and record the performance of a road project by drawing on existing processes and records, rather than adding additional administrative burden. Framework 3 is comprehensive enough to fully cover of sustainability aspects yet, flexible enough to be adaptable among different NRAs and their projects.

3. Sustainability in asset management and financial reporting

3.1. Current sustainability reporting

The current Queensland State Government ASR is defined below.

The ASR (expressed as a percentage) is an approximation of the extent to which infrastructure assets managed by a local government are being replaced as they reach the end of their useful life (DILGPQG, 2013).

The current Queensland State Government ASR is calculated in Eq. (1).

$$ASR = \frac{CapERA}{DepExp} \tag{1}$$

where ASR is asset sustainability ratio, CapERA is capital expenditure on replacement asset and DepExp is depreciation expenditure.

Issues with this ratio are that it does not include maintenance expenditures and depreciation can be calculated with different results.

Local governments provide services to their community. An example is "Our purpose is to make a positive difference in

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people's lives through the quality of the services we provide" (Logan City Council, 2013). If LGA's are to continue to provide quality services, including their community in deciding on a target PCI for their road network, it would be a low cost high return innovation.

3.2. *Asset management Queensland*

Asset management by the Queensland Treasury began with the adoption of the Financial Management Standard of 1997. In 2000, the Queensland Treasury issued guidelines to replace the 1997 standard. The Non-Current Asset Accounting Guidelines for the Queensland Public Sector provides guidance on identifying, valuing, and recording non-current assets.

Depreciation, a non-cash item, accounts for approximately 25% of a local government's operating costs (Delaney et al., 2014). Nationally, pavement represents 61% of the non-financial assets of local governments. In the United Kingdom, the Transport Research Laboratory (TRL) reports that "The Current UK Highways Agency asset alone is worth over £60 billion making it the UK Government's largest single asset" (Jones, 2002). Australian Accounting Standards Board (AASB) 116 defines depreciation as "the systematic allocation of the cost of an asset, less the estimated amount an entity would obtain from the disposal of the asset, over its useful life" (AASB, 2004). Therefore, depreciation is not intended to physically measure the deterioration of an asset. Rather, it measures the loss in value based on specific accounting and financial estimates. Depreciation bears no relationship to future funding based on community requirements and expectations. A review of a transport asset management plan in England during 2008 found depreciation to be an issue. FHWA (2008) wrote "Furthermore, when asked what further support they would need to proceed with asset management, they asked for guidance on depreciation, or unit rates".

The Queensland Government has increased the reporting of key performance indicators, specifically the asset sustainability ratio, of which roads comprise a major part. While applying the straight-line method of depreciation may be appropriate for other infrastructure assets, this paper proposes an alternative method for road pavements since the asset's service is consistent over an extended period of time.

3.3. *Financial reporting definitions*

One financial reporting issue revolves around comparing data from both the local and state government level. Fig. 2 presents a case study where different reporting definitions lead to massive reporting differences, questioning the value of the report itself (Delaney et al., 2014). The availability of different financial figures can lead to disputes on significance and credibility which will divert attention to the opportunity to provide better road management.

3.4. *Support for system improvements*

This study proposes improvements that will lead to better road management. Implementing the study's findings will require a small initial investment and the political will to implement change. Improvements from the study will

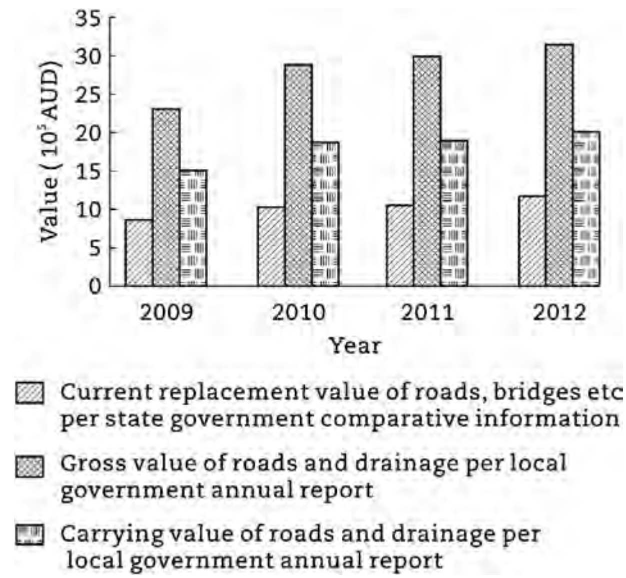

Fig. 2 – Differences in local versus state government financial reporting (Delaney et al., 2014).

increase as the SIR is implemented by LGA's across the state. The Queensland Government has a history of supporting local councils to purchase systems and train staff, where there is potential to improve asset management. This has recently been demonstrated by the 100% subsidy on purchasing bridge management systems software (QDTMR, 2013).

4. Proposed sustainability reporting

4.1. *Roadmap to sustainability*

Understanding the local conditions and costs, local leaders could provide transparent reports on the sustainability of their road network to state governments. Supported by calibrated systems, they are adept at determining road condition treatments and what best suits their community, economy and financial circumstances. This paper provides a tool to help determine what the sustainability index for roads should include.

For roads, important questions are outline below.

1. What condition should the road network be in (balance condition and cost)?
2. What is the best way to calculate this condition (PMS)?
3. What budgets will ensure target conditions (ROI)?
4. How will we measure success (sustainability ratio based on local choice)?

4.2. *Knowledge of pavement deterioration*

Chosen because it is used by fifty-one LGAs in Australia, the Snowy Mountains Engineering Corporation, Pavement Management System (SMEC PMS) operates under local company names in Australia, New Zealand, Africa, the Middle East, Asia Pacific, South Asia and both North and South Americas (SMEC, 2014). SMEC PMS calculates a PCI for each road block and can report an average PCI for a network analysis. PCI trends downwards due to natural deterioration and upwards due to funded treatments by annual works programs (predicted). The PMS allows the user to run scenarios, such as varying future budgets to result in varying PCIs. In this paper, the ROI is defined as the increase in PCI with each increase in annual budget.

As shown in Fig. 3, road pavements undergo a non-linear deterioration process (SMEC, 2003). Unlike other civil assets, above-ground pavements can easily be treated for a site specific condition, through maintenance, rehabilitation or reconstruction treatment.

Historical depreciation (financial accounting) is measured using condition-based information may best match engineering based deterioration (management accounting). This paper proposes the use of a more progressive pavement management system (PMS), which is independently calibrated

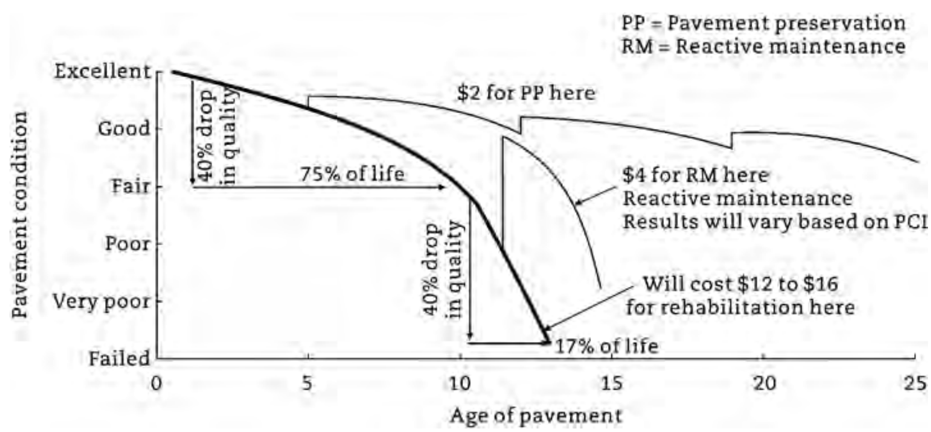

Fig. 3 — Pavement deterioration and rehabilitation funding implication.

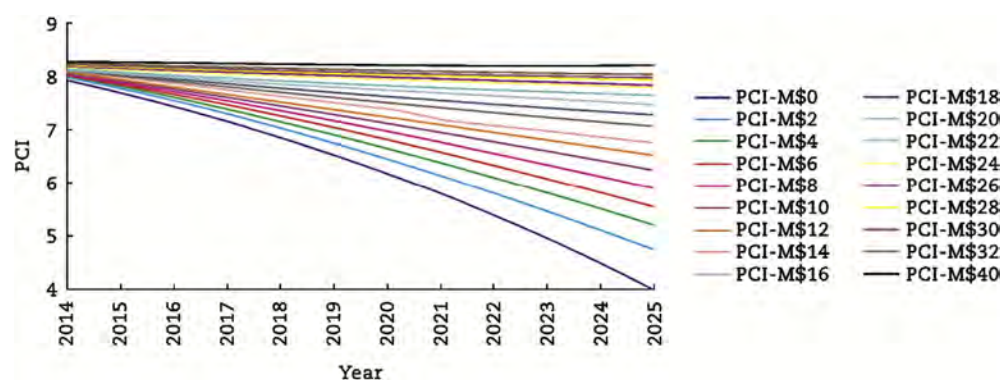

Fig. 4 — Typical pavement deterioration predictions.

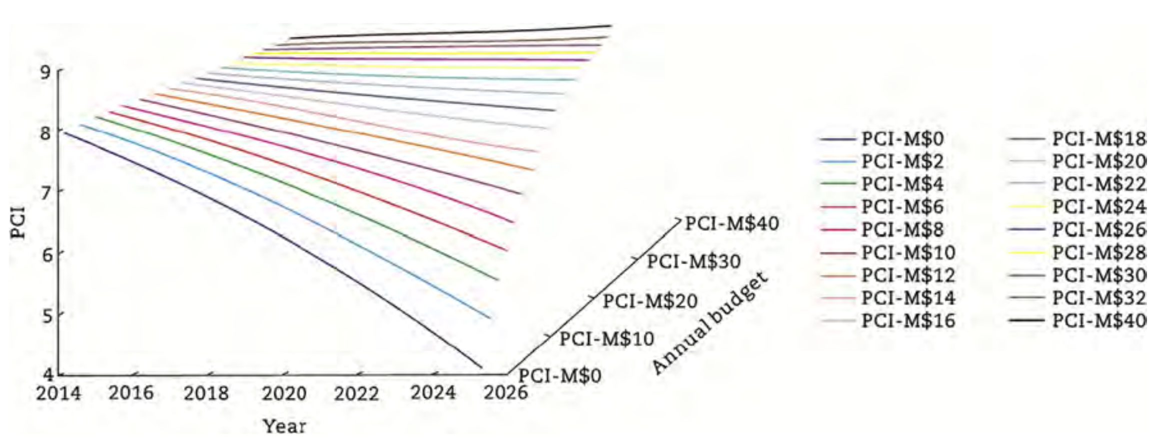

Fig. 5 — 3D presentation of typical pavement deterioration predictions.

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to the local environment. Using locally proven pavement treatments and their corresponding costs, the PMS produces cost effective future works programs by targeting the locally accepted PCI. Predicted program costs through PMS can best determine future budget needs, and they can be used alongside or as an alternative to depreciation calculations.

4.3. Proposed sustainability index for reporting roads

This paper supports a sustainability index for roads SIR defined as Eq. (2).

$$SIR = \frac{\text{BudgetLGA}}{\text{BudgetPMS}} \tag{2}$$

where BudgetLGA is budget provided by LGA, BudgetPMS is budget predicted by the PMS to meet the LGA's chosen PCI.

The SIR uses the most advanced engineering knowledge available to provide a control to the local government.

To maximise the potential of the SIR, only local councils with a calibrated PMS would be initially allowed to use the proposed alternative easier, quicker and cheaper financial reporting format for roads. This can be done in conjunction with the current ASR, and any initial duplication costs can be covered by the state government.

5. Methodology for optimising rehabilitation budgets

This paper proposes that engineers provide the predicted return on investment for various budgets/PCIs while the local government provides the budget for a target PCI. The following method will determine the target PCI, in which a simple average PCI is proposed. This process can be easily altered to determine the PCI by using higher PCIs for higher order roads and lower PCIs for lower order roads.

Progressive local councils in Australia have used pavement management systems since the end of the last century. The justification for using the SMEC PMS is that it is used by over 50 LGAs in Australia and around the world (SMEC, 2014). Like other systems, accuracy depends on data integrity, the applicability of the rule base, the calibration of deterioration factors and most of all "ground proofing" the works programs. Councils in Southeast Queensland are partners in a long term pavement study from 2003 to 2017, during which time they calibrated the deterioration factors of their region (Chai and Kelly, 2001). The SMEC PMS produces future works programs using different scenarios, such as with fixed or varying budgets and a targeted pavement condition index for any future year. The change in average PCI over time with different budget scenarios is presented in Fig. 3. The PMS was run on data from the same local council as in Fig. 4 below.

The reduction in PCI with reducing budgets is expected, providing no new insights for better road management. A three dimensional representation of the same data, when viewed from the added dimension, holds a clue to part this papers proposal. It is presented in Fig. 5.

The curve seen from the right hand side of Fig. 5 is PCI in the vertical axis and annual road rehabilitation budget in the

Table 1 – Multiple runs with the predicted PCI for annual budgets (2014–2025).

End of year	PCI-M$0	PCI-M$2	PCI-M$4	PCI-M$6	PCI-M$8	PCI-M$10	PCI-M$12	PCI-M$14	PCI-M$16	PCI-M$18	PCI-M$20	PCI-M$22
2014	7.92	7.96	7.99	8.02	8.03	8.05	8.07	8.09	8.10	8.12	8.13	8.15
2015	7.69	7.77	7.80	7.85	7.88	7.91	7.95	7.98	8.01	8.04	8.07	8.10
2016	7.44	7.54	7.61	7.66	7.72	7.77	7.82	7.87	7.92	7.96	8.00	8.04
2017	7.16	7.29	7.39	7.47	7.55	7.62	7.69	7.75	7.82	7.88	7.93	7.99
2018	6.86	7.03	7.15	7.26	7.37	7.46	7.55	7.63	7.71	7.79	7.86	7.93
2019	6.53	6.74	6.91	7.04	7.17	7.29	7.40	7.50	7.60	7.70	7.79	7.88
2020	6.18	6.45	6.65	6.82	6.98	7.12	7.26	7.37	7.51	7.63	7.74	7.84
2021	5.82	6.14	6.39	6.59	6.78	6.96	7.13	7.19	7.43	7.56	7.69	7.81
2022	5.41	5.81	6.10	6.34	6.57	6.78	6.98	7.08	7.33	7.48	7.63	7.77
2023	4.98	5.46	5.81	6.08	6.35	6.60	6.84	6.97	7.24	7.42	7.58	7.73
2024	4.52	5.11	5.51	5.83	6.13	6.42	6.69	6.85	7.15	7.35	7.53	7.68
2025	4.03	4.74	5.20	5.56	5.91	6.24	6.55	6.74	7.06	7.29	7.48	7.66

End of year	PCI-M$24	PCI-M$26	PCI-M$28	PCI-M$30	PCI-M$32	PCI-M$40	Keep PCI	AMP PCI8	Creep to AM & SP target
2014	8.16	8.18	8.19	8.21	8.22	8.27	8.289884	8.438393	8.29
2015	8.13	8.15	8.18	8.20	8.23	8.31	8.300127	8.670282	8.35
2016	8.09	8.12	8.16	8.20	8.23	8.29	8.301721	8.701501	8.40
2017	8.04	8.09	8.14	8.18	8.21	8.27	8.301369	8.701755	8.45
2018	8.00	8.06	8.11	8.14	8.17	8.25	8.303479	8.701977	8.50
2019	7.96	8.04	8.08	8.11	8.14	8.22	8.303687	8.702748	8.55
2020	7.94	8.02	8.06	8.09	8.12	8.21	8.302339	8.701548	8.60
2021	7.91	7.98	8.02	8.05	8.09	8.20	8.301817	8.701067	8.65
2022	7.88	7.95	7.99	8.03	8.07	8.19	8.299515	8.700832	8.70
2023	7.84	7.91	7.96	8.01	8.05	8.19	8.300476	8.700153	8.70
2024	7.81	7.89	7.95	8.00	8.04	8.20	8.300166	8.700202	8.70
2025	7.81	7.88	7.94	8.00	8.04	8.22	8.301229	8.699815	8.70

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Table 2 – PCI for chosen future year 2025.

PCI-M$0	PCI-M$6	PCI-M$8	PCI-M$10	PCI-M$12	PCI-M$14	PCI-M$16	PCI-M$18	PCI-M$20	PCI-M$22	PCI-M$24	PCI-M$26	PCI-M$28	PCI-M$30
1.53000	0.35000	0.33000	0.31000	0.20000	0.32000	0.22000	0.19000	0.18000	0.15000	0.07000	0.06000	0.05288	0.04575

horizontal axis. The equation of this curve defines the road network's ROI, in terms of future PCI for annual rehabilitation budget. By referring to this new model, the community can make an informed decision on the level of service (LOS) it is willing to fund. The sustainability of the road network can be measured by the relativity of the chosen PCI and the actual PCI, as Eq. (2).

5.1. *Case study*

The PMS was used to run multiple scenarios, which were used to maximise the PCI in all road blocks in the predictions table. The only change within the scenarios was that the available budget increased by a set amount of $2,000,000. Table 1 shows the change in PCI from 2014 to 2025 for each budget. The three columns on the right-hand side are scenarios that maintain the PCI at the current level, bringing the PCI to the level reported in the LGA's asset management and services plan (AM&SP) and to creep to PCI reported in the AM & SP.

5.2. *Return on investment*

For any future year, ROI in this paper is defined as the increase in PCI with an increase in budget. While the data in Fig. 5 can be used to calculate the change in PCI for any year, only the change in PCI for 2025 is presented in Table 1. For ease of presentation, budgets up to $6,000,000 have been combined. The change in PCI (varying), with set increases ($2,000,000) in the budget, is calculated in Table 1.

The data in Table 2 was graphed to provide a visual display of the increase in PCI with an increase in budget. As defined above, Fig. 6 shows the ROI, in terms of PCI for each budget.

5.3. *Community consultation*

While Fig. 6 provides the ROI (in terms of PCI) for budget allocations, local councillors will still need descriptors of what PCI means. This is provided in Table 3.

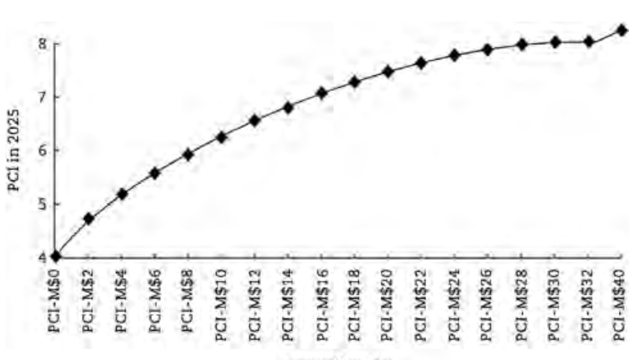

Fig. 6 – PCI in 2025 with varying annual budgets.

State governments (Tan and Artist, 2013) and the International Infrastructure Management Manual (IPWEA, 2011) have requirements for LGAs to develop community consultation plans are commendable. Neshkova and Guo (2011) drawing on practices from the U.S. Departments of Transportation, concluded that “by incorporating citizen participation into the usual business of government, public managers better serve the main objectives of their agencies”.

This paper proposes that the ROI presented in Fig. 6, provides information to the community, that they pay the salaries and fund road maintenance. The best available engineering knowledge has been used to predict the future pavement condition in an open and transparent manner. No attempt has been made to steer towards an increase in future budgets. Fig. 6 shows that the ROI is not linear. Therefore, while it seems intuitive that LGAs would prefer a high quality road network, the question is what level of quality they are prepared to fund.

5.4. *Case study findings*

In this case study, a target PCI was set at 8.5 (Logan City Council, 2014). The PCI descriptors and target PCI in Fig. 6 were overlaid to form Fig. 7. Setting a target PCI of 8.5 for an asset management and services plan, without considering the ROI, can lead to unrealistic targets that may not be funded. This will reduce confidence in the engineers that operate pavement management systems.

From Fig. 7 demonstrates that a target PCI of 8.5 is unrealistic, and a target PCI of 8.0 falls within the upper target range at an annual cost of $25,000,000. Separate scenarios were run for a target PCI of 8.5 and the current PCI of 8.3. These returned budgets of $60,000,000 and $40,000,000, respectively.

6. Statistical analysis

The OriginPro 8 software package was used to calculate the mathematical relationship between PCI and budget, for the 2025 data in the case study. The strong exponential correlation relationship is shown in Fig. 8.

With an R^2 of 0.99, the results confidently show that the relationship between a future PCI and an annual pavement maintenance budget (PMB) can be calculated using Eq. (3).

$$PCI = 4.5408\exp(-PMB/14.8161) + 8.6126 \quad (3)$$

where PCI is future average PCI, PMB is annual pavement maintenance budget for road rehabilitation.

Table 3 – SMEC PCI in terms of both descriptors and numbers (SMEC, 2010).

PCI descriptor	Excellent	Very good	Good	Fair	Poor	Very poor	Failed
PCI number	8.5–10.0	7.0–8.5	5.5–7.0	4.0–5.5	2.5–4.0	1.0–2.5	<1.0

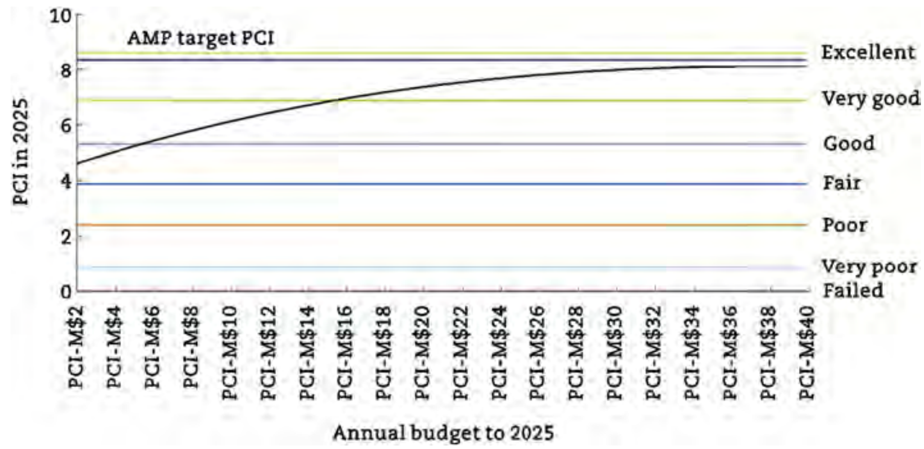

Fig. 7 – Return on investment with PCI numbers and descriptors.

7. Limitations

This paper is based on a single, local government council in Queensland. A second case is being studied, and the results also appear to be exponential. This enhances the generalisability of the results.

This study analysed SMEC PMS data on the SQL Server database. Most LGAs operate on an SQL server. The author does not have access to the old, non-supported Oracle database PMS. LGAs that use the Oracle database PMS would need to have their data analysed on-site.

SMEC PMS using Highways Design Manual III (HDMIII) is restricted to flexible pavements. In Australian local government road networks, the vast majority of pavements are flexible pavements.

The SIR covers two of the three pillars of sustainability, namely financial and social. A plan including the third pillar (environmental) has been developed, and specialized engineering support has been attained with implementation to commence in late 2016.

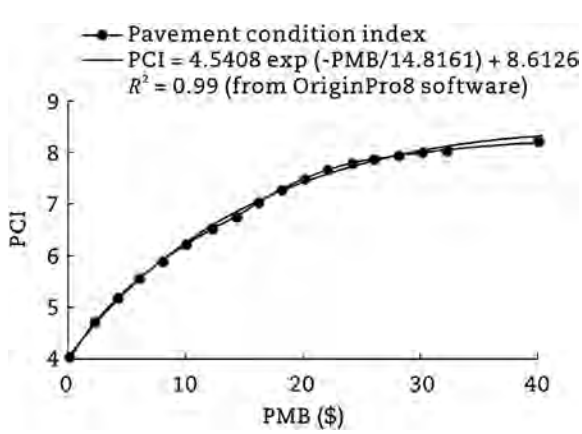

Fig. 8 – Statistical analysis demonstrating exponential ROI curve.

8. Conclusions

Research for this paper is motivated by the desire for "better road management" and as part of a PhD. To promote "better road management", this paper proposes that SIR is an easier, quicker, cheaper and more realistic financial reporting format for roads.

The current ASR in Queensland, Australia, can be improved to be specific to each asset type. Financial depreciation calculations permit variable results. The best engineering knowledge was used in the SIR's calculation and it is forward not backwards looking. These improvements are included in the SIR, along with other advantages over the ASR. SIR does not require the calculation of construction cost, pavement lives or depreciation. It only requires annual updates of the rehabilitation treatment rates. These improvements ensure that the SIR more accurately measures the sustainability of the road network than the ASR.

A case study highlights deficiency in a current AM&SP with a target PCI of 8.5 and annual rehabilitation budget of approximately $26,000,000. The SIR ROI model demonstrates that the required budget for this target PCI is approximately $60,000,000. The SIR ROI model provides an easily interpretable method to balance the competing goals of condition and cost. By having the SIR ROI model, the LGA can make a better decision by targeting a PCI to match the current budget or seeking community support for an alternative target PCI. In that case, a target PCI of around 8.0 would have been more appropriate. A second case study is underway and will be reported when completed. SIR provides an additional way to provide knowledge to local governments, so that they can make more accurate commitments to better road

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management. The outcomes of these decisions should be transparently reported. By reporting the agreed SIR, LGA has the opportunity to seek community support if the sustainability of the road network is in jeopardy.

SIR uses a future view, as opposed to a historical view, of what budgets are required. It takes into account the deterioration of both road surfaces and road pavements, both of which are built into the PMS. SIR also considers the road network's future funding needs. These can be accurately compared because the use of the best engineering knowledge eliminates the current acceptable practice of using different depreciation methods and their resulting different depreciation values in calculating the ASR.

From a local perspective, providing the LGA and the community with the means to better understand the reasons for the budgets they allocate and to have their sustainability index that measures their needs, this paper supports the belief that a SIR built for local government by local government, will have more commitment that any imposed by state government and thus will lead to better road management.

From a state wide perspective, PMS can be calibrated locally to get the best predictive works program possible. By using PMS calibrated to local conditions, SIR is comparable across road networks and, thus, provides the state government with a more accurate way to review future funding needs. This state wide perspective can then influence actions to ensure that poor road network condition do not adversely affect the efficiency of road transportation or the economy.

As part of an implementation program, one restriction could be to permit only LGAs that have independently calibrated PMS to report in this manner. This restriction would improve comparability. Further consideration is the development and use of a regional rule-base to define various combinations of pavement conditions and traffic loadings used to select specific treatments in future works programs. These considerations should overcome the risk of comparing pavement condition indexes with different definitions. Gharraibeh et al. (2010) using United States experience in a study of USA six PCIs from five departments of transport questioned believed that, “Because these indexes appear to be similar (essentially a 0–100 scale, with 100 indicating ideal condition), it can be tempting to use them for comparing the performance of pavement networks in different states or jurisdictions within a state”. The paper concludes “The results of this study show that significant differences exist among seemingly similar pavement condition indexes”. The development of an implementation plan for SIR would enable the advantages of SIR to be demonstrated to LGAs, using examples of their actual LGA data in their own PMS. The SIR would bring sustainability for road pavements within the reach of LGAs, with the support of their community, at minimal cost and provide the state and LGAs comparable assessment of road the road condition and funding needs.

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