MONETARY PERFORMANCE APPLIED TO PAVEMENT OPTIMIZATION DECISION MANAGEMENT

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Abstract

The traditional pavement management system approach optimizes treatment scheduling based on physical condition performance. The recent initiatives of the Public Sector Accounting Board (PSAB) are consistent with the concept of using monetary performance in the decision management process. The Municipal Infrastructure Management System (MIMS) optimization model was developed in the mid-1990s as a research and development initiative. Part of the unique functionality of this model is a detailed modeling approach, which improves modeling reliability and incorporates monetary performance in the optimization process. In this model, the optimal solution integrates the combined monetary impact of minimizing operations expenditures and maximizing the value of the asset. The result provides a dollar to dollar comparison of financial expenditures to monetary performance. This approach is consistent with new PSAB PS-3150 legislation for valuing tangible capital assets. This approach takes the current PS-3150 legislative requirements of accounting to the next level of sustainable asset management. This paper discusses the MIMS key decision management components including asset valuation as a monetary measure of performance. The application is applied to a pavement asset management case study within a Canadian urban municipality. The case study illustrates that appropriate increases in spending can improve the net financial bottom line.

Note * - This paper is based on a paper entitled "Asset Valuation Decision Management Applied to Pavement Optimization" presented in June 2008 in Calgary, Alberta at the International Conference on Managing Pavement Assets (ICMPA).

1 Introduction

Statistics Canada [SC 07] compiled a report on Government spending on infrastructure in Canada. In that report, they determined that roadways constitute 39.9 percent of Canada's public infrastructure capital worth. Due to the relative value of these assets, pavement engineering and pavement management systems have evolved to play an important role in the management and sustainability of these assets.

Pavement management systems (PMS) are the pioneers of civil engineering asset management systems and practices. Pavement and asset management systems are used to apply life-cycle analysis to numerous and variable asset types to plan infrastructure programs and budgets. There exists various degrees of mathematical and information technology sophistication among the various pavement management and asset management systems models. Therefore, significant variation exists in the modeling accuracy and spectrum in which the model can be applied. This is an important consideration in the infrastructure decision management process.

A common element of the Canadian public sector infrastructure assets is the potential criticality of the state of infrastructure. In recognition of capital renewal needs at the national level, the Canadian federal government introduced some major initiatives to address this potential crisis. One of the initiatives was development of the Canadian Infraguide, which is a library of best practices for sustainable infrastructure management. Included in this guide are operational practices and decision management practices that can enhance the preservation of infrastructure assets.

The Infraguide [Inf 05] developed seven fundamental questions for effective asset management. These concepts, in relationship to Public Sector Accounting Board (PSAB) principals are illustrated in Figure 1.

The first three questions (what do we have, what condition is it in, and what is it worth) are consistent with the accounting requirements of the Public Sector Accounting Board (PSAB) and the adoption of the PS-3150 legislation on tangible capital assets. PS-3150 legislation requires that "governments need to present information about the complete stock of their tangible capital assets and amortization in the summary financial statements to demonstrate stewardship and the cost of using those assets to deliver programs and provide services [PSAB 2006]." The timeline is January 1, 2009 for municipal governments to account for and report assets on their statement of financial position.

This study discusses an asset management model and process developed in the mid-1990's that is consistent with the use of asset valuation PSAB practices. The application of this model takes PSAB to the next level of asset management. In an applied case study, this model uses asset valuation in the decision management process to optimize pavement management programming for a Canadian urban municipality in development of the 2005-2009 five-year capital maintenance and renewal program. The name of this model is the "Municipal Infrastructure Management System (MIMS)".

2 Fundamentals of PS-3150

The purpose of financial reporting is to communicate financial information to external stakeholders, demonstrate accountability for management of resources and financial affairs, and evaluate the governments' financial performance. As noted above, the accounting functions of PS-3150 (inventory, valuation, and depreciation) are not the management of these assets. The current mandate of PSAB is **not** for **management** of tangible capital assets, but the **accounting** of tangible capital assets. However, it is expected that future evolution of PSAB legislation may dictate asset management as the next step.

The accounting process will quantify the financial liability of these assets in terms of the net difference of depreciation or betterment. The accounting process will not do financial planning, set appropriate rates and fees, provide information on the physical condition or performance, determine the capital maintenance and renewal backlog, or determine the optimal program strategy to sustain and maintain these assets [PSAB 07].

The accumulation of assets in a critical condition state can have catastrophic effects to the government's financial management and ability to provide services. The asset accounting process will however bring information about tangible capital assets to the forefront of decision makers. Currently many critical assets are out of site and therefore out of mind. In the minds of many decision makers, until the assets reach a critical state, capital renewal is not a priority. The accounting process adds to the better understanding of the obligation to maintain, renew, and replace assets. It can be the beginning to good asset management practices.

One fundamental difference between accounting requirements and the asset management requirements is the asset valuation process. Since accounting is transaction based, it requires an estimate of the **historic cost** at the time of acquisition. The asset is amortized over the asset's theoretical life-cycle, for which the annual depreciation is a liability to the government, unless the asset receives betterment. A betterment will increase the asset's estimated service life, therefore reducing the amortization. This shows the financial benefit of investing in the assets [CICA 07]. In comparison, asset management works with the present and the future. Therefore, the **replacement cost,** at the current or modeled year, is of importance for analysis. Replacement cost provides a realistic and understandable value for decision management. Many public assets are long-lived for which the amortization charge would be more indicative to the current cost of replacement [CICA 07]. However, the official position by PSAB is that "Historical cost has been generally accepted by standard setter around the world and its application is well understood and it is still the preferred method of accounting for tangible capital assets [CICA 07]."

There is however a relationship between historic cost and replacement cost. One can compute the other with information on the asset's theoretical service life, age, and historic inflation/escalation rates. Pavement or asset management systems that incorporate asset valuation in the decision management process will be most suited to the potential evolution of PSAB which may include an asset management approach to enhancing public sector accountability and infrastructure sustainability.

Through a Statement of Principles [PSAB2 07] prepared by the PSAB, it recognizes that a framework is in the making for expanding on the accounting functionality of PS-3150 to include asset management. One important element within the Statement of Principles is the potential of including asset condition performance. Within this framework, they would encourage government agencies to conduct a condition performance assessment of major asset categories. Within each category, PSAB recommends to set target levels for establishing minimum levels of performance. This will be a key factor when establishing the appropriate level of service. Should level of service be based on condition performance or monetary performance? Level of service criteria based on monetary performance will provide a direct relationship of benefit to cost in decision management. This would be consistent with the asset valuation process of PSAB.

3 Optimization Technology

Optimization algorithms are more typically applied to pavement management systems than asset management systems. Asset management systems will often test maintenance and renewal scenarios to determine the cost impact and performance impact of varying alternatives. Optimization modeling is more comprehensive as it will work through numerous permutations and combinations of maintenance and renewal events that will minimize cost and maximize performance over the asset's life-cycle. In compatibility with PSAB initiatives, the ideal optimization model uses asset valuation as a measure of performance so a dollar to dollar comparison can be made between capital renewal expenditures and its impact on the state of the infrastructure.

3.1 Introduction of the Municipal Infrastructure Management System

The Municipal Infrastructure Management System (MIMS) is a computer model for optimizing public sector infrastructure more effectively. MIMS was derived from concepts used in pavement management theory. MIMS advances pavement optimization theory through the inclusion of four critical decision management components:

i. Detailed Optimization and Life-Cycle Modeling – A fundamental component of the model uses the lowest common denominator of condition assessment to minimize modeling error and improve reliability and confidence.

ii. Risk Management and Variable Level of Service (LOS) – To permit roadways of varying functional classifications (i.e. arterial, collector, local) to operate according to thresholds and target levels to establish LOS. That the risk of consequence be considered in the variable LOS criteria.

iii. Generic and Integrated Asset Analysis – That all infrastructure types (roadways, sidewalks, bridges, pipes, etc.) be recognized for their unique characteristics and LOS requirements and be modeled simultaneously; so all infrastructures compete for funding on an equitable basis.

iv. Monetary Performance – Included in the decision process to ensure that benefit received from improved asset valuation exceeds the incremental program expenditures.

3.2 Detailed Optimization and Life-Cycle Modeling

The optimization modeling process is comprehensive involving several interacting and iterative components.

The foundation of condition assessment is based on SEVERITY and EXTENT. Modeling to this lowest common denominator minimizes error and improves reliability between modeling years.

Deterioration or performance prediction using the condition SEVERITY AND EXTENT format can be achieved through the use of Markovian probabilistic modeling techniques. Figure 2 [Mol 99] illustrates the framework of a deterioration probability matrix. This matrix is applied to each infrastructure condition and is based on the probability of natural deterioration from one severity level to another in a one-year period. Figure 3 [Mol 99] illustrates the Markovian modeling process for simulating the resulting condition in a one year period.

A condition index is determined throughout the simulation period. However, it is **not** used for performance prediction or infrastructure renewal. This would provide an abstract element to the modeling process and subsequently increase modeling error. The condition index is only used for treatment selection. Figure 4 [Bal 91] illustrates the condition index calculation.

Using the SEVERITY and EXTENT condition format for treatment renewal and costing, the treatment strategy process becomes very realistic and can be tailored to the specific operations practices. Figure 5 [Mol 99] illustrates a treatment strategy form within the MIMS computer model. In this example, the full seal treatment for cracking is expected to have various level of renewal impact within the severity levels. This treatment is most effective at the minor severity level and is expected to mitigate 100 percent of the cracking at this level. Costing is applied across the entire pavement surface area. However, the ‘major’ and ‘sever’ severity levels are expected to require additional treatments (possible deep patching) that will consume additional expenditures in these areas only. Working at the SEVERITY and EXTENT level permits this detailed level of modeling.

Indices are grouped into five condition state ranges. Condition state 5 is the most severe. In this example, the full seal treatment is applied only if the modeled road segment is in the condition state 3 or 4 levels. Routine maintenance activities would be expected in all levels as a program alternative; while full rehabilitation would be expected as an alternative in condition states 4 and 5. At the network level, overall program constraints for budget and performance will incrementally trade off segment level effectiveness until the program constraints are met. The optimization is based first on an iterative process at the segment level and then network or program level. Figure 6 [Mol 99] and Figure 7 [Mol 99] illustrates the process flow for the segment level analysis and the network level analysis respectively.

3.3 Risk Management and Variable Level of Service

Infrastructures operating at different functional classifications (i.e. arterial, collector, local) are not expected to operate under the same level of service. The modeled condition extents are equated against established thresholds to derive indices for treatment selection. Higher classification roadways (i.e. arterials), requiring a higher level of service, will generate higher indices. Higher indices generate stronger treatments, resulting in a higher level of service. Figure 8 illustrates how level of service is built in treatment selection.

Risk management is addressed concurrently in the decision process. To address risk, thresholds are set to desired levels needed to mitigate risk. It should be noted that the higher the level of service requirements the higher the cost. As such, this is the cost of managing that risk.

3.4 Generic and Integrated Asset Analysis

Infrastructures of various classifications and types (i.e. pipes, sidewalks, pavements, etc.) can be modeled in a simultaneous integrated analysis resulting in:

- <u>Reduced Constraints</u> – The more constraints, the less optimal the final solution
- <u>Improved Rationalization for Budget Programming</u> – An integrated analysis will provide better funding distribution between infrastructure programs as all infrastructures compete for funding on an equitable level.

In the modeling process, alternative treatment paths are generated for each infrastructure segment over its life cycle. Figure 9 [Mol 99] illustrates three alternative treatment paths generated over a four year period. Each path has an associated cost. Over this life-cycle, the marginal effectiveness value is determined based on minimizing the uniform annual cost (UAC). The marginal effectiveness calculation is unit-less and therefore generic to all infrastructures.

Marginal Effectiveness = <u>UAC of treatment path with lowest UAC</u>

UAC of considered treatment path

Figure 10 [Mol 99] illustrates marginal effectiveness with in the MIMS computer model. In the segment level analysis, the most effective (marginal effectiveness = 1.0) treatment paths for each segment are selected. During the network analysis, to bring the resulting program into desired budget and performance ranges, the marginal effectiveness is incrementally traded off to balance the program as a whole. As the process is generic and integrated among all infrastructures, the infrastructure segment tested is based entirely on its ability to minimize the loss of effectiveness to balance the program needs. As such, the loss of effectiveness to meet the desired program objectives is minimized. **As the process is indiscriminate over infrastructure type of any particular program**, **program development is optimal and fair across all funding programs**.

3.5 Monetary Performance

Monetary performance is a direct measure of asset performance in relation to its asset value.

MIMS uses the write down value (WDV) in its modeling algorithms. This is the measure of monetary performance. The write down value is the asset depreciation and is derived from condition performance. It measures the treatment cost to restore the segment to a near new condition. Figure 11 [Cla 93] illustrates the write down value description within the asset valuation process.

The value of any infrastructure asset in its near new condition state is the replacement cost. In a lesser condition state, the infrastructure value is the written down replacement cost. The depreciated value between an assets replacement cost and the written down replacement cost is its write down value.

Monetary performance is paramount in decision management for program optimization. It provides the direct comparison between change in program expenditures to the incremental gain or loss in asset value. The optimal program occurs when the incremental improvement to the asset value (benefit) exceeds the incremental program expenditures (cost); and that the benefit/cost (B/C) ratio is maximized.

From a financial accounting perspective, continued decline in asset valuation (monetary performance) is equivalent to deficit budgeting. Many agencies currently do this to balance their programs. Conversely, **an improvement in the monetary performance can improve the financial bottom line if the increase in asset value is greater than the increase in program expenditures**.

4 Pavement Management Case Study

The Municipal Infrastructure Management System (MIMS) was used in an urban Canadian municipality to develop the pavement component of the five-year capital maintenance and renewal program. The given case study used 2004 condition data to develop the 2005-2009 five-year capital planning program.

The overall pavement network was 2,041,214 m2, which is approximately the equivalent of 200 km of two-lane roadways. The model was run over a fifteen-year simulation period, which is typically the design life for pavements in this region.

The condition types modeled in the analysis are rutting, fatigue cracking, surface condition (i.e. open surface texture), roughness, and lineal cracking. The severity (minor, moderate, major, severe) and extent (percent) raw condition data format is modeled though the analysis. However, the condition data is indexed for model decision management and general reporting. The higher index represents more deterioration.

The treatment types considered in the model are:

- Routine Maintenance – General repair of major deficiencies
- Crack Filling – Includes three types of crack filling depending on severity
- Micro-Sealing – Preservation enhancing
- Thin Lift Overlay – Conventional rehabilitation
- Resurfacing – Conventional rehabilitation including milling of existing surface

Historically, the municipality had no pavement sustainability program. Capital renewal expenditures were declining to balance the overall fiscal program. There was significant pavement deterioration, in particular to the fatigue cracking distress.

The objectives of the analysis were to:

- Determine the optimal preservation enhancing treatment that will stabilize and sustain the condition and value of the pavement assets
- Deploy preservation enhancing treatments in the optimization process for doing the right things to the right assets and the right time
- Provide a stable annual program with limited variability
- Demonstrate through accounting of tangible capital assets that potentially increasing spending can improve the financial bottom line.

Table 1 [PA 04] summarizes the network level program constraints. Included are budget limits, which include overall program upper and lower limits. Included also are the program limits for each treatment type. Relative annual program stability is important for balancing with the revenue stream, managing internal operations, as well as working within the capacity of the construction industry. The monetary performance constraints are used to deliver a stable annual program that will not result in a loss of service in any program year.

Table 2 [PA 04] summarizes the modeling program including capital maintenance and renewal treatment costs, resulting monetary performance (write down value), and resulting condition performance (condition index).

Over the five-year program period, the optimal modeling solution recommends program expenditures of $6,877,188. The modeling results show that pavement performance adjusts with the level of spending. This would be an expected observation as more spending will correct more roadway deficiencies. This is noted in both the monetary performance and the condition performance. In the five-year program period, the monetary performance improved by

$4,232,665 (11%) and the condition performance improved from 65 to 49 (25%). It is important to note both scales show an improvement. However, the monetary performance measure is the more indicative when validating the performance in comparison to the program expenditures.

To maintain a zero net difference in performance from one year to the next would require $1,145,179 per year. The optimal program strategy determined a five-year program funding level 20 percent higher.   The incremental five-year expenditures of $1,151,293 resulted in a monetary performance improvement of $4,232,665. Therefore the **net benefit** to the program is **$3,081,372** ($4,232,665 - $1,151,293) over the five-year period. In this case the indication is that the City's pavement network has been historically under funded. The **benefit/cost ratio** is **3.68** ($4,232,665 / $1,151,293), thereby concluding evidence validating the additional expenditures.

In reference to PSAB, the $4,232,665 asset valuation improvements could be accounted for as betterment. The incremental cost of providing this betterment is $1,151,293. Therefore, the financial bottom-line is a net gain of $3,081,372. Historically, without accounting for tangible capital assets in the financial accounting process, the result of the increased spending would have shown only as a deficit.

5 Conclusions

i. Public Sector Accounting Board

The PS-3150 legislation is an accounting function to value tangible capital assets. The evolution of PSAB will require asset management plans to deliver sustainable infrastructure programming.

ii. Optimization Modeling

The detailed modeling process provides the framework for a realistic life-cycle strategy using preservation enhancing treatments at the appropriate times

Key elements of the optimization process include:

- **Detailed optimization** using the Markov Chain at the segment level analysis, which provides improved reliability in comparison to conventional deterioration prediction practices
- **Variable level of service** to the roadway functional classifications (arterial, collector, local) so the treatment strategy is appropriate for the usage
- The provision for **risk management** is included in the threshold levels used to set level of service
- **Integrated asset analysis** which removes barriers that inhibit the optimal solution
- **Monetary performance** in the decision management process to validate that the appropriate level of spending has been determined.

iii. Monetary Performance

In comparing condition performance and monetary performance, a direct relationship exists, but the magnitude will vary. The variation in magnitude will depend on the set-up of each model. Condition performance can be an abstract indicator for financial decision management. Monetary performance is a more comprehensive measure which uses asset valuation derived from condition performance. Using monetary performance in the decision management process, the asset valuation optimization process will quantify the economic benefit for establishing the appropriate level of service. Condition performance alone may set target levels that are not the most cost effective.

The monetary measure of performance is the write down value, which provides an appropriate measure for deterioration in relationship to the replacement cost. **Pavement optimization technologies that use the write down value as a monetary measure of performance can directly optimize the benefits of infrastructure performance versus the cost of capital renewal programming expenditures**. Accepting replacement cost within the PSAB measure of asset valuation will provide the framework for PS-3150 legislation to go from the accounting process of inventory, valuation, and depreciation, to the next level of asset management.

iv. Case Study

The application of monetary performance in the pavement optimization and decision management process realized a true **benefit multiplier of 3.68**. **If the asset valuation benefits were brought forward in the financial statements, the increased spending would improve the financial bottom line**. Further case study trials would determine the variability of the benefit multiplier. If the benefit multiplier was repeatable on other infrastructures, the impact to the state of the infrastructure at a national level could be significant.

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6 References

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7 Tables

Table 1 – Five-Year Budget and Monetary Performance Constraints

Program Constraint	2005	2006	2007	2008	2009
Total Budget – Upper Limit	$2,500,000	$2,500,000	$2,200,000	$2,200,000	$2,200,000
Total Budget – Lower Limit	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000
Routine Maintenance – Upper Limit	$500,000	$500,000	$500,000	$500,000	$500,000
Routine Maintenance – Lower Limit	$100,000	$100,000	$100,000	$100,000	$100,000
Crack Filling – Upper Limit	$100,000	$100,000	$100,000	$100,000	$100,000
Crack Filling – Lower Limit	$10,000	$10,000	$10,000	$10,000	$10,000
Micro-Sealing – Upper Limit	$800,000	$800,000	$800,000	$800,000	$800,000
Micro-Sealing – Lower Limit	$150,000	$150,000	$150,000	$150,000	$150,000
Thin Lift Overlay – Upper Limit	No Limit	No Limit	No Limit	No Limit	No Limit
Thin Lift Overlay – Lower Limit	No Limit	No Limit	No Limit	No Limit	No Limit
Resurfacing – Upper Limit	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000
Resurfacing – Lower Limit	$200,000	$200,000	$200,000	$200,000	$200,000
Monetary Performance (write down value) – Upper Limit	$38,000,000	$38,000,000	$38,000,000	$38,000,000	$38,000,000
Monetary Performance (write down value) – Lower Limit	No Limit	No Limit	No Limit	No Limit	No Limit

Table 2 – Five-Year Pavement Program Summary

Program Year	Capital Maintenance and Renewal Treatment Cost	Monetary Performance (Write Down Value)			Program Sustainability Level	Treatment Cost Vs Sustainability Difference	Condition Performance Index	
		Initial	Final	Change			Initial	Final
2005	$1,992,651	$37,585,558	$30,337,126	$7,248,432	$1,145,179	($847,472)	65	51
2006	$1,008,831	$30,337,126	$31,089,334	($752,208)	$1,145,179	$136,348	51	51
2007	$1,185,830	$31,089,334	$30,865,071	$224,263	$1,145,179	($40,651)	51	51
2008	$1,191,878	$30,865,071	$32,344,155	($1,479,084)	$1,145,179	($46,699)	51	51
2009	$1,497,998	$32,344,155	$33,352,893	($1,008,738)	$1,145,179	($352,819)	51	49
Total	**$6,877,188**			**$4,232,665**		**($1,151,293)**		

8 Figures

Figure 1 – Seven Questions for Effective Asset Management

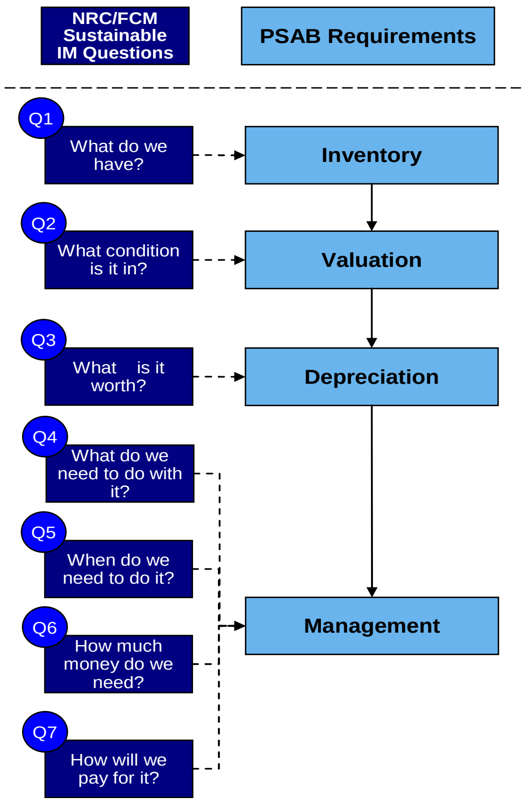


Figure 2 – Deterioration Probability Matrix

		To:					
		None	Minor	Mod.	Major	Severe	**Total**
	None	P_{11}	P_{12}	P_{13}	P_{14}	P_{15}	1.0
From:	Minor	P_{21}	P_{22}	P_{23}	P_{24}	P_{25}	1.0
	Mod.	P_{31}	P_{32}	P_{33}	P_{34}	P_{35}	1.0
	Major	P_{41}	P_{42}	P_{43}	P_{44}	P_{45}	1.0
	Severe	P_{51}	P_{52}	P_{53}	P_{54}	P_{55}	1.0

Figure 3 – Markovian Simulated Condition Extent Calculation

		Extent Levels within each Severity Rating				
Year	None	Minor	Moderate	Major	Severe	Index
Y_0	E_{01}	E_{02}	E_{03}	E_{04}	E_{05}	I_0
Y_1	$E_{01}*P_{11}$ + $E_{02}*P_{21}$ + $E_{03}*P_{31}$ + $E_{04}*P_{41}$ + $E_{05}*P_{51}$	$E_{01}*P_{12}$ + $E_{02}*P_{22}$ + $E_{03}*P_{32}$ + $E_{04}*P_{42}$ + $E_{05}*P_{52}$	$E_{01}*P_{13}$ + $E_{02}*P_{23}$ + $E_{03}*P_{33}$ + $E_{04}*P_{43}$ + $E_{05}*P_{53}$	$E_{01}*P_{14}$ + $E_{02}*P_{24}$ + $E_{03}*P_{34}$ + $E_{04}*P_{44}$ + $E_{05}*P_{54}$	$E_{01}*P_{15}$ + $E_{02}*P_{25}$ + $E_{03}*P_{35}$ + $E_{04}*P_{45}$ + $E_{05}*P_{55}$	I_1

Figure 4 – Condition Index Calculation

$$INDEX = CWF* \left(\frac{\%severe}{SeTH} + \frac{\%major}{MaTH} + \frac{\%moderate}{MoTH} + \frac{\%minor}{MiTH}\right)$$

Where:

%severe =	severe condition extent
%major =	major condition extent
%moderate =	moderate condition extent
%minor =	minor condition extent
SeTH =	severe threshold level of extent
MaTH =	major threshold level of extent
MoTH =	moderate threshold level of extent
MiTH =	minor threshold level of extent
CWF =	condition weighting factor

Figure 5 - Treatment Strategy – Condition Type Cracking

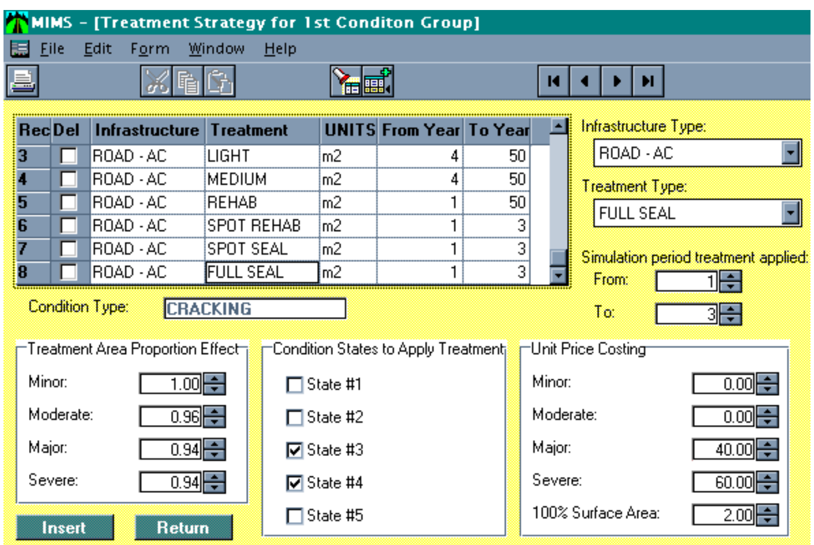
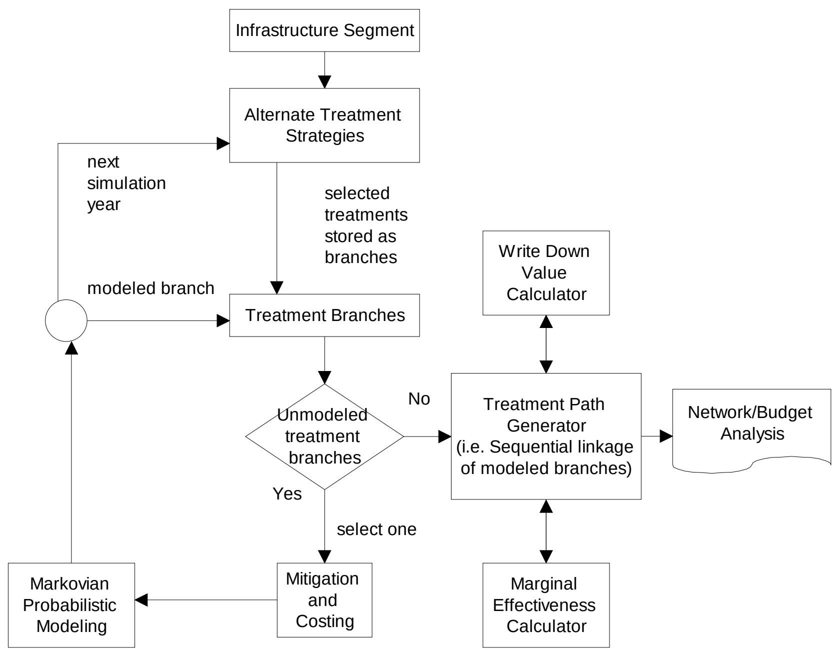


Figure 6 - Segment Analysis



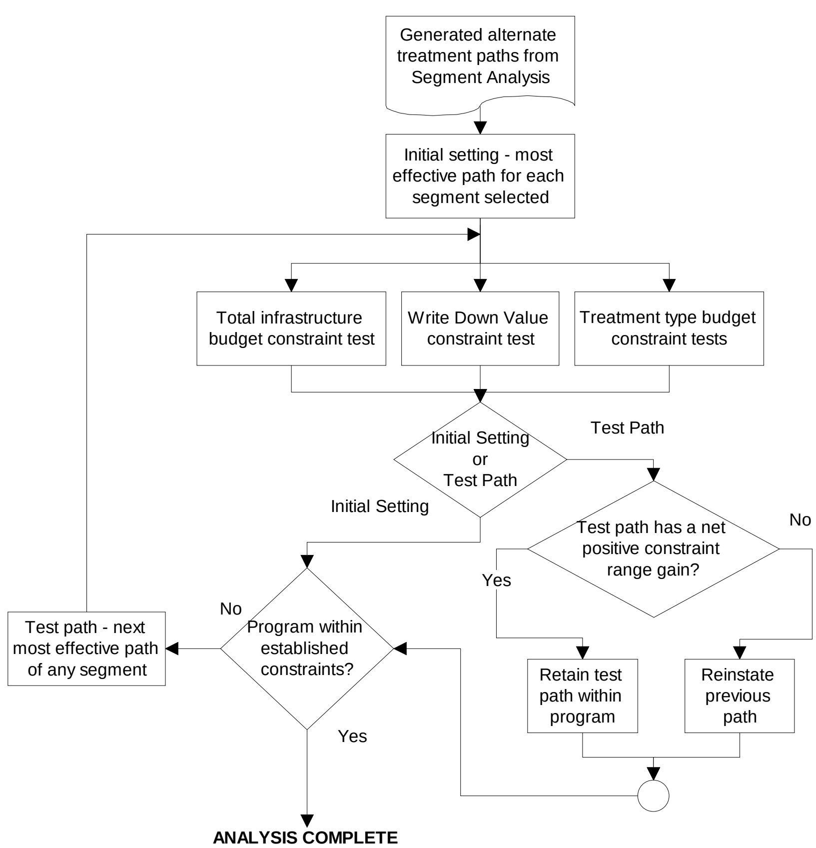


Figure 7 - Network Analysis

Figure 8 – Level of Service in Treatment Selection

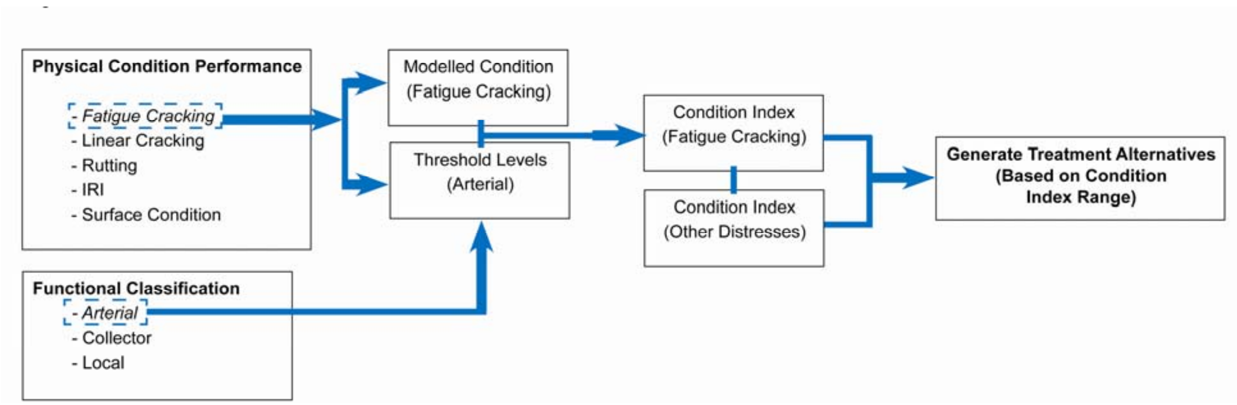


Figure 9 Alternative Life-Cycle Treatment Paths

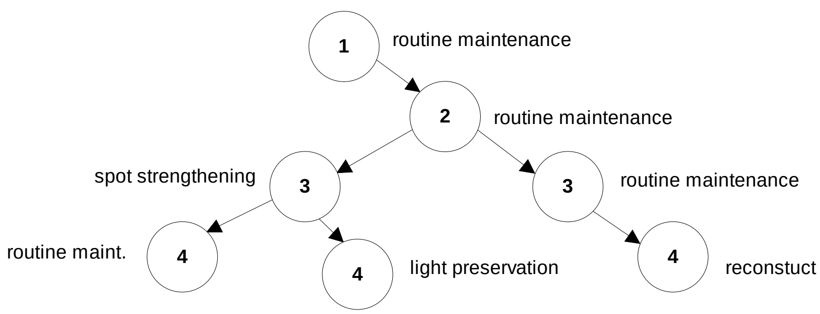


Figure 10 – Marginal Effectiveness

MIMS - [Optimization Analyzer]

File Edit Form Window Help

Rec	Segment	Path	Tagged	Area	Uniform Ave. Annual Cost	Marg. Effectiveness
384	0100200MUANN002	1	N	36852	$65380	1.000
385	0100200MUANN002	2	N	36852	$79253	0.825
386	0100200MUANN002	3	Y	36852	$74384	0.879
387	0100200MUANN002	4	N	36852	$72483	0.902
388	0100200MUANN002	5	N	36852	$82610	0.791
389	0100200MUANN002	6	N	36852	$79415	0.823
390	0100200MUANN002	7	N	36852	$71890	0.909
391	0100200MUANN002	8	N	36852	$73248	0.893
392	0100200MUANN002	9	N	36852	$72968	0.896
393	0100200MUANN002	10	N	36852	$69188	0.945
394	0100200MUANN002	11	N	36852	$69689	0.938
395	0100200MUANN002	12	N	36852	$66041	0.990
396	0100200MUANN002	13	N	36852	$82246	0.795
397	0100200MUANN002	14	N	36852	$76889	0.850
398	0100200MUANN003	1	Y	96450	$198268	1.000
399	0100200MUANN003	2	N	96450	$429143	0.462
400	0100200MUANN003	3	N	96450	[illegible]	[illegible]

Figure 11 - Asset Valuation