Asset Management for the Roads Sector

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FOREWORD

The OECD's Road Transport and Intermodal Linkage (RTR) Research Programme for the 1998-2000 period included a mandate for the establishment of an Asset Management Working Group. The terms of reference set for the Group included:

- Develop a common definition and identify the appropriate components for an asset management system.
- Document the state of implementation of asset management practices and programmes in OECD Member countries, including the identification and measurement of benefits of applying asset management systems.
- Review the data and analysis requirements, including accounting principles and capitalisation methods, used in successful asset management systems. Consider the type of indicators that are used to measure the performance of a road network/transport system in the implementation of an asset management system and suggest options that range from essential measures to those that can provide some benefit.
- Strategies to facilitate the implementation of asset management systems – *i.e.* new skills for personnel, new thinking for all levels of management, public involvement, newly oriented goals, etc.

The Asset Management Working Group was chaired by Mr. Neville Potter (Australia) and also included representatives from Belgium, Canada, Czech Republic, Finland, France, Hungary, Italy, Japan, Mexico, the Netherlands, Poland, Sweden, Switzerland, the United Kingdom, the United States.

ABSTRACT
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In most OECD Member countries, the road network constitutes one of the largest community assets and is predominately government-owned. Road administrations must maintain, operate, improve, replace and preserve this asset while, at the same time, carefully managing the scarce financial and human resources needed to achieve these objectives. All of this is accomplished under the close scrutiny of the public who pay for and are regular users of the road network, and who increasingly demand improved levels of service in terms of safety, reliability, environmental impact and comfort.

Asset management as applied to the roads sector represents "a systematic process of maintaining, upgrading and operating assets, combining engineering principles with sound business practice and economic rationale, and providing tools to facilitate a more organised and flexible approach to making the decisions necessary to achieve the public's expectations".

Governments are placing greater pressures on road administrations to improve the efficiency of, and accountability for, the management of the road network. Indeed, in many countries, local highway authorities face formal accountability and reporting requirements on how they manage their assets. Asset management systems offer the prospect of significantly improving road network management outcomes. This report is a review of asset management systems as applied to the roads sector and an analysis of the responses to a survey conducted among those countries represented on an OECD Working Group on Asset Management Systems.

Subject Classifications: Economics and Administration, Maintenance, Traffic and Transport Planning.

Subject Codes: 10, 60, 72.

Keywords: Administration, Cost, Economics, Efficiency, Level of Service, Maintenance, OECD, Operating Costs, Policy, Road Network, Road User, Safety.

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EXECUTIVE SUMMARY

In most OECD Member countries, the road network constitutes one of the largest community assets and is predominately government-owned. Road administrations must maintain, operate, improve, replace and preserve this asset while, at the same time, carefully managing the scarce financial and human resources needed to achieve these objectives. All of this is accomplished under the close scrutiny of the public who pay for and are regular users of the road network, and who increasingly demand improved levels of service in terms of safety, reliability, environmental impact and comfort.

For their part, governments are placing greater pressures on road administrations to improve the efficiency of, and accountability for, the management of the road network. Indeed, in many countries, national road administrations and some smaller, local highway authorities face formal accountability and reporting requirements on how they manage their assets.

It is for these reasons that many governments are considering how they can introduce the concept of asset management within the roads sector.

"Asset management" as applied to the roads sector can be considered to be "a systematic process of maintaining, upgrading and operating assets, combining engineering principles with sound business practice and economic rationale, and providing tools to facilitate a more organised and flexible approach to making the decisions necessary to achieve the public's expectations".

In practice, an asset management system (AMS) will include all the processes, tools, data and policies necessary for the effective management of all the assets for which the road administration has responsibility, including physical highway infrastructure such as pavements and bridges as well as human resources, equipment and materials and other items of financial and economic value.

This report is a review of asset management systems as applied to the roads sector and the responses to a questionnaire survey carried out among those countries represented on a Working Group on Asset Management Systems (chaired by Mr. Neville Potter).

The report describes how the development of an asset management system for road administrations is a logical evolutionary step from managing individual assets and programmes to managing from a broader perspective, making most effective use of the limited resources. As such, asset management systems are generally integrated systems in which existing management systems for individual assets can be combined to produce new and often more conceptual information. In this regard, many road administrations already have a solid backbone on which to build an asset management system.

In general, the sequence of asset management begins with the identification of goals and policies of a road administration and the available budget. From this starting position, the sequence proceeds through data collection, performance monitoring, analysis of maintenance options and programme optimisation, through to project selection and implementation. Finally, monitoring and review procedures provide feedback, which in turn influences the goals, policies and available budget. The typical components of this sequence are described in the report.

Asset management systems generally make use of data from a wide range of sources, both from within and outside a road administration and also supply information into various parts of an administration where it may be combined with data from other systems. The report describes how asset management systems are involved in all stages from data collection and storage through to data analysis and interpretation; all of which are dependent on effective data administration and management.

Asset management is ultimately about managing a road administration's resources more like a business. In many countries, road administrations are now required to implement standardised asset inventory, valuation and depreciation approaches and enhance the information provided as part of their annual financial statements, in a manner more in line with those used by private sector companies. Typical methods used for accounting for assets are described in the report.

Another important aspect of the use of asset management systems identified by the report is the need to monitor the performance of the asset against defined required outcomes or targets of performance. One approach for this is the use of performance indicators to measure progress towards achieving the road administration objectives, but there are other, simpler approaches. The same measures of performance can be used by all parts of an administration but the importance given to each measure may differ.

The report also describes how the implementation of an asset management system can provide road administrations with a range of benefits including improved communications, improved data about assets and network performance. More effective tools for the management of the asset are also provided which allow better use of available funds and provide opportunities for staff development.

Although most OECD Member countries represented on the Working Group are already working with management systems for individual assets, no country has yet introduced an integrated asset management system. Details of the implementation of asset management systems for the roads sector in OECD Member countries are provided.

The detailed responses from the OECD Member countries represented on the Working Group to the questionnaire are included in the Appendices to the report. They include details of the components of asset management systems, accounting methods, performance indicators and benefits achieved. Some countries provided additional information, such as specific examples of asset management systems.

The experiences of those OECD Member countries that are moving towards asset management in the roads sector have indicated that there are a number of points that should be considered by road administrations before implementing an asset management system:

- An asset management system should integrate existing management systems for individual assets, thus enabling a common approach to be adopted for the management of different assets.
- Improved collection, storage and management procedures for asset information, including inventory, location and condition data, will be required.
- Analysis capabilities should include the ability to prioritise maintenance options on the basis of the life-cycle cost of the assets.
- Asset management will encourage road administrations to adopt a more business-like approach to the management of the assets for which they have responsibility while the concept of asset valuation and depreciation will provide engineers with a common language with budget holders and decision makers. This will enable the implications of different investment strategies to be determined, including, potentially, assets in other sectors. Asset management will further encourage the concept of performance monitoring including, for example, performance indicators.

Although no such asset management system has yet been fully implemented at a national level in any of the OECD Member countries represented in the Working Group, it is considered inevitable that asset management systems will begin to be implemented as a result of either legislative requirements or the desire to realise the incremental benefits of an integrated system over systems for managing individual assets.

Chapter 1

INTRODUCTION

This report has been prepared by the OECD Working Group based on contributions from individual experts, reviewed by members of the Working Group, and their responses to a questionnaire.

The countries represented in the Working Group are: Australia, Belgium, Canada, Finland, France, Hungary, Italy, Japan, Mexico, the Netherlands, Poland, the United Kingdom, and the United States.

The main tasks set by the Steering Committee for the Programme of Research on Road Transport and Intermodal Linkages for the Working Group were to:

- Develop a common definition and identify the appropriate components for an asset management system (AMS).
- Document the state of implementation of asset management practices and programmes in OECD Member countries. Identify the benefits – *i.e.* reduced costs, opportunities for new technologies to improve the efficiency of asset use, better transport planning, improved decision making and information sharing, etc. – in the wake of applying asset management systems. Consider how to measure these benefits.
- Review the data and analysis requirements, including accounting principles and capitalisation methods, used in successful asset management systems. Consider the type of indicators used to measure the performance of a road network/transport system in the implementation of an asset management system and suggest options ranging from essential measures to those that can provide some benefit.
- Examine the challenges that must be faced in the implementation of asset management systems – *i.e.* new skills for personnel, new thinking for all levels of management, public involvement, newly oriented goals, etc. Propose steps to effectively meet these challenges.
- Prepare a marketing plan for the dissemination of the results of the study and assume a key role in the preparation of the final report.

In summary, the Working Group was required to produce a report that emphasises the high economic and policy importance of asset management systems and provides policy recommendations and suggestions to guide OECD Member country organisations that want to implement asset management systems.

The Working Group's report focuses on the increasing interest in Member countries in the use of asset management systems and their possible application to road systems management. The body of the report outlines the technical characteristics of asset management systems and the benefits they can provide as well as addressing a number of important aspects of their implementation. The appendices provide guidance to those contemplating using asset management systems, covering experiences in Member countries with AMS implementation, asset valuation approaches and performance indicators able to assist with performance monitoring of road systems. A well-documented asset management development framework and a model for implementing an asset management system are outlined in Appendix 7.

Chapter 2

ASSET MANAGEMENT: INTRODUCTION AND DEFINITION

In most OECD countries, the road network constitutes one of the largest community assets and is predominately government-owned. The agencies responsible for the transport infrastructure must maintain, operate, improve, replace and preserve this asset. At the same time, the financial and human resources needed to achieve the performance objectives of the road network are scarce and must be managed carefully. All of this is accomplished under the close scrutiny of the public who pay for this part of the transport system, are regular users of the asset and increasingly demand improved levels of quality, in terms of safety, reliability and comfort, from the road network.

For their part, governments are placing greater pressures on road administrations to improve the efficiency of, and accountability for, the management of the community's asset. For example, road administrations in Canada, the United States and the United Kingdom, and local government councils in Australia, face formal accountability and reporting requirements on how they manage their assets.

It is for these reasons that that many governments are considering how they can implement the concept of asset management in the roads sector.

What is asset management?

A definition of "asset management" that is appropriate for the roads sector is:

"A systematic process of maintaining, upgrading and operating assets, combining engineering principles with sound business practice and economic rationale, and providing tools to facilitate a more organised and flexible approach to making the decisions necessary to achieve the public's expectations".

The term "asset management system" (AMS) embraces all the processes, tools, data and policies necessary to achieve the goal of effectively managing assets.

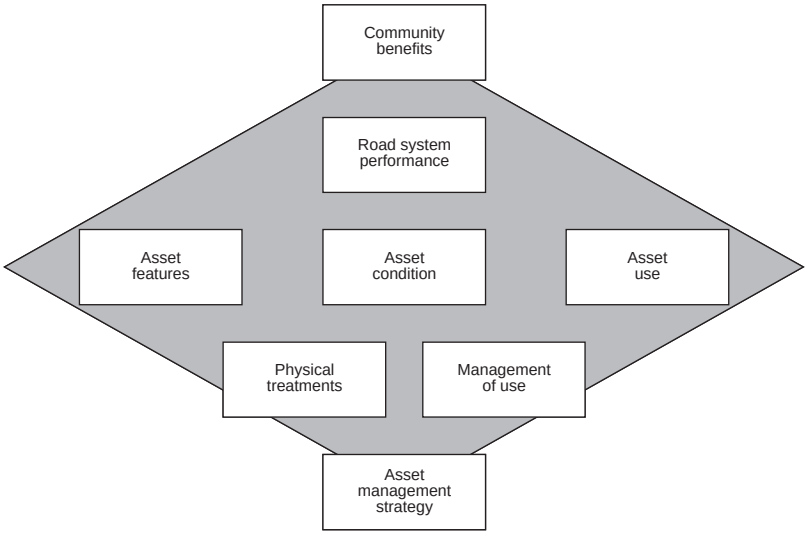
What can be included in an asset management system?

Each road administration is responsible for the management of its own unique set of assets. However, the American Association of State Highway and Transportation Officials and the Federal Highway Administration (1997) broadly summarises the typical assets of a road administration as:

- Physical infrastructure, such as pavements and bridges.
- Human resources (personnel and knowledge).
- Equipment and materials.
- Other items of value such as rights-of-way, data, computer systems, methods, technologies, and partners.

Generally, the types of assets to be included in an AMS are dependent upon the administration. Typically, the system will start with the administration's major assets and over time be expanded to include other assets as data, or system capabilities, become available for them.

Figure 1. **Major elements of an asset management system**



Source: Austroads (1997).

What are the requirements of an asset management system?

Asset management systems generally:

- Include inventory information for the asset and condition measures.
- Include values of condition of the asset.
- Include a performance prediction capability.
- Ensure data integrity, enhance data accessibility and provide data compatibility.
- Include all relevant components in life-cycle cost analyses.
- Enable the removal of outdated systems and unproductive assets.
- Consider both system and project optimisation.
- Report useful information on a periodic basis, ideally in real time.
- Facilitate iterative analysis processes that can be performed on a regular basis.

How do existing systems fit into an asset management system?

One of the key aspects of asset management is integration. AMS provides an integrated approach to all administration costs, be they road user, works, administration, environment or social costs, and the use of existing administration data sources. AMS integrates existing management systems for individual assets. This merger provides road administrations with consistent system-wide data, enabling the allocation of available funds across competing pavement, structure and other infrastructure needs (Transport Association of Canada, 1999).

In addition to the integration of management systems for individual assets, asset management also provides an opportunity for both horizontal and vertical integration within an administration, as it necessarily cuts across finance, planning, engineering, personnel and information management functions. The team approach required in bringing all these different perspectives together is fundamental to achieving effective, integrated asset management practices, and moving beyond the traditional engineering approach of most road administrations. All key parts of the administration need to participate actively in fully supporting the working partnerships inherent in effective asset management.

How does asset management encourage a more business-like approach to managing resources?

Asset management is about managing administration resources more like a business. A key part of this is the need for administration managers to develop a common language with budget holders, thus giving them the critical ability to demonstrate the implications of investment options.

This business-like approach of asset management requires estimation of the value of infrastructure assets, as this value is a significant factor in determining priorities for future investment (New York State Department of Transportation, 1998).

The valuation process, with its emphasis on economics or finance, represents a shift in thinking from the traditional engineering approach to transport programme development. Asset values can be expressed in a variety of ways. For example, each asset could have an intrinsic economic value to the transport network as a whole; that is, the value of the efficient movement of people and goods. Alternatively, again for example, each asset could have a capital value either calculated from the cost of repairing the asset to an "as built" condition or the cost of replacing the asset in kind. The expression of asset value in such accounting terms is a key element in developing the common language between engineers, financial managers and overseeing bodies.

How do asset management systems assist in monitoring performance?

Community consultation is an important aspect of asset management as it provides an understanding of stakeholder requirements and public expectations. It is therefore essential if road administrations are to develop the right policies for road use and environmentally sustainable development. This focus on achieving defined outcomes also encourages performance monitoring. An example of this is the use of performance indicators or other measures to monitor progress towards achieving the administration's objectives.

How should asset management systems be implemented?

As a general principle (US Dept. of Transportation, 1997), an AMS should be:

- Customer-focused.
- Mission-driven.
- Long-term in outlook.
- Accessible and user-friendly.
- Flexible.

An AMS will provide the framework for an administration to make the best-informed decisions about the use of available resources in managing its capital, maintenance and operating programme by considering all the engineering, business and economic factors affecting the asset. It should be recognised that an AMS is only a tool that will be used by decision makers in conjunction with experience and political insight to make final decisions.

This report provides an analysis of asset management systems within the roads sector as well as examples of how they are being implemented in OECD Member countries are given in the Appendices to this report.

Chapter 3

COMPONENTS OF AN ASSET MANAGEMENT SYSTEM

An asset management system embraces all the processes, tools, data and policies necessary to achieve the goal of effectively managing the asset. Although the concept of a "system" does not usually focus on data requirements, an effective approach to managing the asset as an integrated system should encompass the data required to meet asset management objectives. This implies that, in general, an AMS will consist of the following components:

- Goals and policies of the administration.
- Data.
- Resources and budget details.
- Performance models for alternative strategies and programme development.
- Project selection criteria.
- Implementation programme.
- A monitoring and feedback loop.

These components are generally common to all asset management systems, and can be tailored to match the needs of a road administration. In addition, the system should be flexible enough to adjust to the changes in the components, particularly the goals, priorities and assets of an administration. The establishment and operation of the system should follow a systematic procedure that will generally involve the development, or use of existing, performance models and will incorporate accepted economic and business practices. Asset management systems can involve detailed data analysis to facilitate interpretation by administrators for "best" policy determination. This means that there is a need for adequately trained users with the necessary skills to use the system effectively.

Development of an asset management system

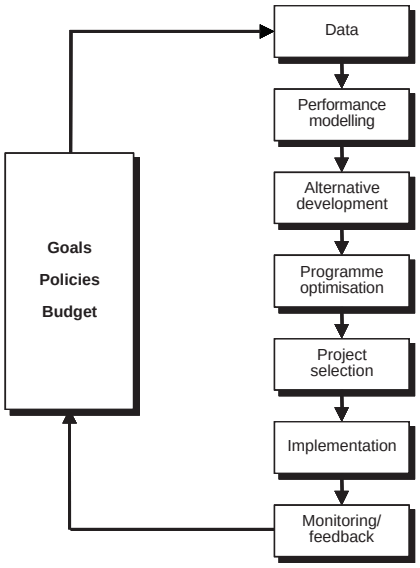
The development of asset management systems for road administrations is a logical evolutionary step from managing individual assets (such as pavements and bridges) and programmes (such as capital and maintenance) to managing from a broader perspective that will use more effectively the combined but limited resources available to an administration. As such, asset management systems are generally integrated systems in which the data from existing management systems for individual assets can be combined to produce new information that, in many cases, it has not been possible to consider easily with separate systems for individual assets. Many road administrations already have a solid backbone on which to build an asset management system, but there are a number of opportunities for improvement:

- Developing common or shared databases.
- Integrating management systems for individual assets.
- Integrating capital, maintenance and operating programmes.
- Linking policies with engineering standards and programme development.
- Applying sound economic and business philosophies to the decision-making process.
- Developing the tools and computer models necessary to evaluate alternative strategies.

Asset management procedures

Figure 2 outlines the major procedures undertaken with an AMS and shows both the interaction between each procedure and the sequence of operation.

Figure 2. **Procedures undertaken with an asset management system**



Each procedure in Figure 2 is made up of a number of elements, tools or activities. Where an element, tool or activity is critical for more than one procedure, it is shown for each procedure. Examples of the typical procedures undertaken with asset management systems used by Member countries are described in Appendix 1.

Goals

- Congestion.
- Intermodal.
- Network.
- Pavement condition.
- Safety.
- Structure condition.

Policies

- Access.
- Administration standards.
- Community benefits/interaction.
- Economic development.
- Engineering standards.
- Environmental standards.
- Heritage management/cultural resources.
- Long-range plans.

- Organisational structure.
- Political issues.
- Research.
- Stakeholder requirements.
- Training.

Budget

- Annual/multi-year.
- Division/breakdown into budget heads.

Asset data

- Collection methods – field, laboratory, automated, multimedia.
- Common database and reporting – including map-based reporting.
- Condition assessment – current status.
- Inventory – type (pavement, structure, sign, etc.) location, features.
- Population – type, composition, growth rate.
- Traffic – type, composition, growth rate.
- Valuation – current financial and economic value, capitalisation methods.

Performance modelling

- Deficiencies/needs – gap analysis, network analysis.
- Future condition – deterioration models, remaining life.
- Levels of service.
- Valuation – financial and economic value, capitalisation methods.
- Volume/use forecast – vehicle operating and user cost models.

Analysis options

- Cost-benefit.
- Environmental.
- Life-cycle cost.
- Multi-criteria.
- Risk.
- Safety.
- Treatments – maintenance.

Programme optimisation

- Alternative levels of detail.
- Environmental analysis.
- Financial/economic analysis.
- Integration of assets.
- Multi-criteria analysis.
- Programme review and approval process.
- Risk analysis.
- Trade-off analysis – decision rules/tools.

Project selection/prioritisation

- Project ranking – economic, environmental, risk, multi-criteria.
- Treatments – project and network level.

Implementation programme

- Construction.
- Maintenance.
- Operating.
- Monitoring/feedback.
- Budget review.
- Condition assessment.
- Data collection.
- Goal review.
- Policy review.

Chapter 4

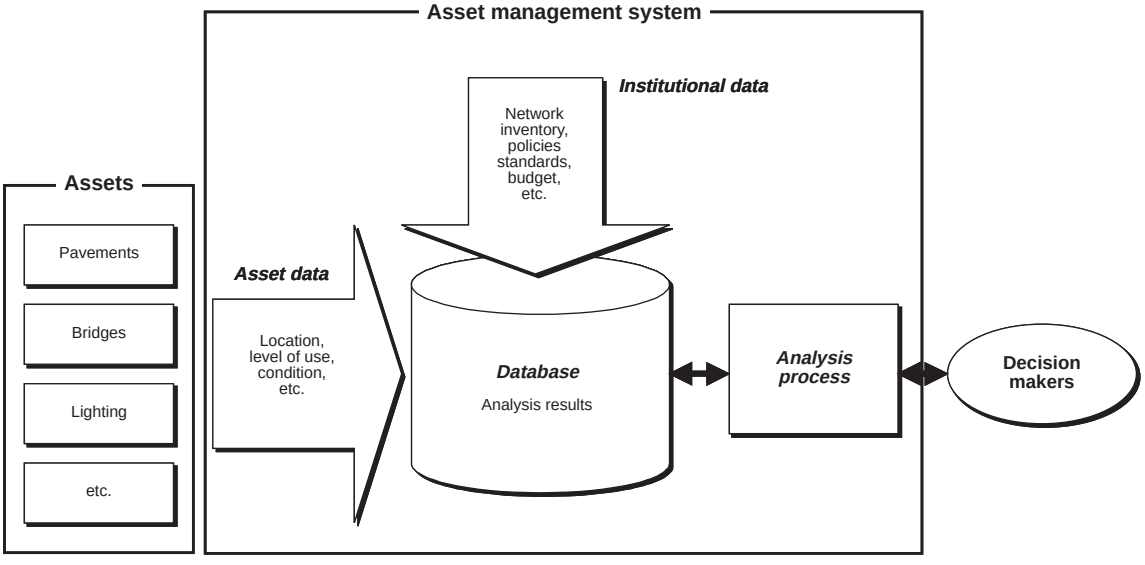
DATA REQUIREMENTS AND ANALYSIS PROCEDURES

Asset management systems generally make use of data from a wide range of sources, both within and outside a road administration. Asset management systems also supply information to various levels and parts of an administration (*e.g.* senior management, decision makers, etc.) where it may be combined with data from other systems. It is therefore vital that every effort is made to ensure that all data, both used by and output from, an AMS is of an appropriate quality. This in turn necessitates that all staff within an organisation are aware of the importance of data quality and that appropriate data checking and validation procedures are put in place.

Typically, an AMS in use by a road administration will utilise of the following data:

- Definition of the network.
- Definition of the assets on the network (*e.g.* bridge, pavement).
- Location of the assets on the network.
- Condition of the assets.
- Levels of use (*e.g.* traffic flows).
- Policies and standards (*e.g.* maintenance standards and treatment designs as well as monitoring information such as performance measures).
- Budget information (*e.g.* broken down by asset type, programme level).

Figure 3. **Typical flow of data into and out of a generic road asset management system**



Asset data are used in various analyses undertaken in conjunction with the AMS (*e.g.* calculation of an asset value). The results from the analyses may be held in the database linked to the AMS.

Data administration

For all asset management systems, the importance of effective data administration cannot be over emphasised. The connection between the data, the ownership of the data and a detailed description of the data must be correctly established and defined at the outset and maintained throughout the life of the system. It is the responsibility of the management within an organisation to promote the importance of effective data administration and to ensure that staff are well-equipped and have an appropriate mandate for the realisation of this task.

Particular attention is required where data comes from sources outside the organisation. Management must make clear what information is required, which organisations are responsible and what data are to be supplied. The adoption of a structured approach will identify any gaps in the data and will highlight any data that are of inadequate quality.

Data collection

Data suppliers must be alert, not only to the accuracy of the data collected, but also to its location and lifetime. Suppliers therefore need a reliable quality control procedure for checking these elements. Typically, a quality control procedure for data collection should include:

- A formal quality management procedure (*e.g.* operating under ISO certification).
- Predefined warning values or historical data that can be used in control procedures.
- A requirement that all equipment must be calibrated regularly.
- Reasonable storage mechanisms for raw data (*i.e.* data used to produce the data in the AMS).

Above all, data suppliers within and outside the road administration must recognise the need for data quality and ensure its delivery.

Data storage

The data used by an AMS has a high financial value to a road administration. Therefore, once the collected data have been supplied, they will generally come under the control of the administration function within the road administration. The administration will have responsibility for controlling the quality of both new and stored data. Typically, data quality control procedures should include:

- Data verification (*i.e.* data should be checked for integrity, location, time, completeness and accuracy).
- Application to both incoming data and existing stored data.

Management systems

Asset management systems combine information from more than one source and generally use this to enable administrators to produce additional interpretations of existing data and/or new information. This requires that both the management of the input data and the processes within an AMS must be carefully controlled in order to ensure its effective operation.

Possible ways of improving the effectiveness of an AMS include:

- Generating calculations within the AMS that are correctly configured and "calibrated" to match the business requirements of the organisation.
- Facilities to ensure that the outputs of the system can be compared with results from earlier years, different assets, regions and management units as well as with users' knowledge and expectations about the condition and durability of the asset.
- Ease of examination of financial results to aid decision making and input into other systems.

- Cross-checks when combining or summarising data from different sources to avoid misinterpretation.
- Use of data mining techniques at any stage of the analysis for investigating trends in the data.
- Facilities to ensure that outputs from the AMS can feed back into the administration to help define policy and standards and performance against targets.

Data analysis

Asset management systems generally carry out the following data analyses:

- Interpretation of the condition data collected on the individual assets.
- Identification of "optimal" treatments.
- Calculation of life-cycle costs.
- Prioritisation of maintenance treatments against budgets.

Asset management generally examines such factors as investment levels, maintenance standards and economic importance. In terms of infrastructure management, these factors may be translated into various measures of performance of the asset, including level of use, safety and environmental impact. Asset management will therefore be influenced by geographical and socio-economic circumstances in the organisation and the business processes adopted.

The value of the assets will be calculated using recognised and accepted accounting practices within the AMS. The calculation of the value of the asset is not generally included in management systems for individual assets.

Data analysis can be of a technical, financial or general nature and not every type of analysis will be used equally in all levels of an organisation. In general, different parts of an organisation will carry out data analyses at different levels of detail. Table 1 shows examples of the types of data analyses carried out by a road administration and which may benefit from the use of an asset management system.

Table 1. **Typical data analyses carried out by a road administration**

Type of analysis	Analysis
Technical	Condition of the asset Causes of maintenance Age and degradation of the asset Use of the network
Economic	Budget required Budget allocations (*e.g.* budget breakdown) Variations in unit prices Deviations between out-turns and estimated costs Maintenance costs of assets Total costs and budget
General	Comparison of prioritisation with political preferences Comparison of detailed and outline technical plans Changes in performance monitoring statistics Comparison of regional performance monitoring statistics

Chapter 5

ACCOUNTING FOR THE CAPITALISATION OF ASSETS

Asset management is about managing a road administration's resources more like a business. This business-like approach requires the estimation of the value of infrastructure assets, as this value is a significant factor in determining priorities for future investment. The valuation process, with its emphasis on economics or finance, represents a shift in thinking from the traditional engineering approach to transport programme development.

Asset values can be expressed in a variety of ways. For example:

- Each asset has an intrinsic economic value to the transport network as a whole, that is, the value of the efficient movement of people and goods.
- Or, each asset has a capital value either calculated from the cost of repairing the asset to an "as built" condition or of replacing the asset in kind.

The expression of asset value in such accounting terms is a key element in developing the common language between financial managers and overseeing bodies.

In many countries, government agencies, including road administrations, are now required to implement standardised asset inventory, valuation and depreciation approaches and enhance the information provided as part of their annual financial statements, in a manner more in line with those used by private sector companies. Details of the experiences of a number of OECD Member countries in implementing capital asset reporting standards are given in Appendix 2.

Valuing the road infrastructure assets

Valuation plays an important role in asset management because one of the main purposes of valuation is to enable reporting in monetary terms to reflect the physical conditions of the road network, and to assist asset managers in informing asset owners of the effects of different financing strategies.

There are a number of approaches prescribed to value infrastructure assets, and no single approach is universally accepted by the international community. Commonly used approaches to value transportation infrastructure assets include:

- E*conomic value*: derived from the value of the asset to the whole community in terms of the value of the efficient movement of people and goods.
- H*istorical cost*: the base acquisition accounting cost, or the initial cost to build the facility in the year it was constructed (usually taken from the original construction cost records).
- C*urrent replacement cost*: the engineering cost estimate to replace the facility under current market conditions with one of equivalent capacity, taking into account cost efficiencies arising from improvements in technology.

The two methods of cost estimates fall within the broader valuation method known as "capital" or "wealth value" assessment that uses a cost-based approach to assessing the value of an asset.

Depreciating the road infrastructure assets

As with the approaches to the valuation of assets, there are a number of established depreciation methods in use among Member countries. The two most common methods are:

- S*traight-line depreciation*: the value of an asset depreciates at a constant rate over time.
- C*ondition-based depreciation*: where the value of an asset depreciates according to its condition.

Many road administrations use a combination of these two methods, the choice of depreciation method generally depending on the type of asset. For example, it may be appropriate to apply straight-line depreciation to assets that are not subject to vehicle loading, such as traffic signal systems and highway lighting, whereas condition-based depreciation may be more appropriate for assets such as pavements and bridges.

Implementation

Although a number of Member countries are moving towards the adoption of standard accounting and capitalisation methods for highway infrastructure assets, the majority of these efforts are still in the implementation phase. However, there are similarities in the approaches being adopted which suggest that any countries wishing to implement standard accounting and capitalisation methods for highway infrastructure in the future should consider:

- Maintaining accurate and up-to-date information about assets (including inventory and condition).
- Adopting an appropriate and consistent method for valuing assets.
- Adopting an appropriate and consistent method for depreciating assets.
- Reporting the value of the road infrastructure in financial statements.

Chapter 6

PERFORMANCE MONITORING

An important aspect of the use of asset management systems is the need to monitor the performance of the asset against defined required outcomes or targets of performance. One approach for this is the use of performance indicators to measure progress towards achieving the road administration objectives. Other simpler approaches include the straightforward recording of condition of the asset with time. Some of the different ways that performance can be represented are percentile of level of condition, effects on users, levels of safety, effects on the environment and economic aspects of the network. Each of these represents different measures of performance of the asset and may be defined by more than factor (*e.g.* various aspects of condition may represent the overall condition or noise and pollution may combine to represent overall environmental performance).

The use of performance indicators as a means of performance monitoring and target setting has been examined by the OECD (1997) in its report *Performance Indicators for the Road Sector*. This identified 15 performance indicators used by OECD Member countries to monitor the performance of the road agencies and includes the results of a field test of their use. The following performance indicators (PIs) were identified in the report:

- Average road user costs.
- Level of satisfaction regarding travel time and its reliability and quality of road user information.
- Protected road user risk.
- Unprotected road user risk.
- Environmental policy/programmes.
- Processes in place for market research and customer feedback.
- Long-term programmes.
- Allocation of resources to road infrastructure.
- Quality management/audit programmes.
- Forecast values of road costs vs. actual costs.
- Overhead costs (percentage).
- Value of assets.
- Roughness.
- State of road bridges.
- Satisfaction with the road system.

The same measures of performance can be used by all stakeholders of the asset but the importance given to each measure may differ for the different stakeholders. To consider the performance of the asset, the stakeholders can be divided into three categories; owners (*e.g.* government), road administration and users, with each category equal in importance. The OECD report on performance indicators uses these three categories of stakeholders and allocates the performance indicators, in terms of each aspect of performance. Table 2 shows the classification of performance indicators for each category of stakeholder used in the field test.

Table 2. **Classification of performance indicators**

Aspect of performance \ Stakeholder	Goverment	Road administration	Road user
Accessibility/mobility	Average road user costs		Level of satisfaction regarding travel time
Safety	Protected road user risk		Unprotected road user risk
Environment		Environmental policy/programme*	
Equity			
Community		Market research and customer feedback*	
Programme development	Long-term programmes*	Allocation of resources to road infrastructure* Quality management/audit programme*	
Programme delivery		Forecast value of road costs vs. actual costs Overhead percentage	
Programme performance	Value of assets	Roughness State of engineering structures	Satisfaction with road system

Of these 15 indicators, ten are defined as exact measures with associated quantitative values. The other five are qualitative indicators, measured initially by the presence or absence of some feature, to which additional data need to be supplied for further evaluation. These five qualitative indicators are shown with asterisks in Table 2.

For the OECD study, participating countries were asked to describe the type of indicators used by the road administration to measure the performance of the road network/transport system in the implementation of an AMS. Details were also sought of how this information is presented or used, particularly to convey information to decision makers who influence the level of road funding.

Indicators were found to vary across different Member countries and sometimes even across jurisdictions within the same country. However, all Member countries use traditional performance measures related to pavement management (such as condition indicators) and most countries use safety indicators.

While all Member countries use those indicators related to the physical management of roads (*i.e.* pavements), fewer countries use additional indicators such as community satisfaction and environmental performance and fewer still have linked these indicators to a definition of asset management. Details of the various performance indicators currently used by Member countries are given in Appendix 3.

Chapter 7

BENEFITS OF ASSET MANAGEMENT SYSTEMS

Individual management systems, such as pavement management systems and bridge management systems are commonly in use in Member countries, while other management systems such as traffic, roadway features or safety systems are also in widespread use or undergoing development. The decision to implement an AMS or to integrate the existing commonly used separate systems is now being considered by many road administrations. A major consideration in this decision is the potential benefits that are available over those provided by the separate systems.

Clearly there is a need for efficient management systems given the common background of ageing infrastructure, reduced budgets, reduced staff resources and increased public expectations.

There is also a need for engineers to be able to clearly communicate with financial managers in understandable accounting terms rather than with just engineering condition indices. While asset management encourages road administrations to be more business-like, and uses recognised accounting principles and practices, it also assists in budget justification within the framework and the recognition of various competing government programmes. In some countries (*e.g.* Australia and the United Kingdom), the introduction of asset management principles is a legislative requirement for the road administration. To achieve this efficiently, an AMS is required.

Asset management has the potential to provide road administrations with a systematic approach to the management of transportation networks. Practical decision processes and tools are currently being developed to support best management practices given the economic background of fiscal restraint. In addition to information on inventory, condition and level of use, administrations require tools and skills to analyse administration and community needs and to present the needs and benefits to decision makers and to government.

Potential benefits from implementing an asset management system

The many benefits and expected outcomes available to a road administration upon implementation of an asset management system can be placed into the following categories:

- Communications (both internal and external to the administration).
- Asset inventory, condition and level of use.
- Road network performance.
- Asset management tools.
- Budget process.
- Staff development.

A detailed description of the potential benefits available and examples of the benefits identified by participating Member countries are given in Appendix 4. Summaries of the potential benefits available in each of the above six categories are given in Tables 3 to 8 inclusive.

Table 3. **Summary of potential benefits relating to communications**

Description of benefits		Expected outcomes
Common benchmarks	• Enable comparisons of funding levels to be made between individual assets (*e.g.* pavements and bridges).	• Better budget analysis and decision making provides an improved service to the community.
Improved internal and external communications	• Provide better communication of strategies and promotion of more effective management within an administration.	
	• Enable more effective communication to stakeholders and improved understanding of stakeholder needs.	
	• Implement benchmarks between administrations to allow the identification and adoption of best practice.	
Adoption of accounting practices	• Leads to improved communication with budget holders and other decision makers.	
	• Provides the value of assets to support the allocation of budgets.	

Table 4. **Summary of potential benefits relating to asset inventory, condition and level of use**

Description of benefits		Expected outcomes
Integrated, harmonised database	• Improves data quality and consistency, due to use of minimum quality standards.	• Provides operational efficiencies due to easier interpretation of data and better analysis tools.
	• Allows comparison of information and standardised evaluation of condition.	
	• Improves data display and reporting facilities.	
	• Increases in access and use of new technologies for data collection and management provide a major benefit to the management of road administration assets.	
	• Consistent data of a higher quality and more convenient analysis and reporting tools will result in better management decisions.	
Upgrade skills and technology	• Provides opportunities to upgrade existing technologies improving the efficiency of data collection, storage, management, analysis and reporting.	
	• Provides opportunities to upgrade staff skills and ensure staff acceptance of a new business framework.	
	• Improves dissemination of information using new technologies.	

Table 5. **Summary of potential benefits relating to road network performance**

	Description of benefits	Expected outcomes
Performance monitoring reports	• Enables asset inventory and performance to be related to the needs and priorities of the whole community. • Enables the improved use of inventory and condition data in planning, maintenance and budgeting. • Provides an increased focus on community benefits. • Provides information that can be understood by non-engineers to focus multi-programme strategies. • Allows the impact of policy decisions on the infrastructure and on transport costs to be assessed.	• Enables the development of strategies that provide an appropriate level of service appropriate to specific budgets.

Table 6. **Summary of potential benefits relating to asset management tools**

	Description of benefits	Expected outcomes
Management systems for individual assets	• Provides up-to-date, accurate information on the condition of the individual assets. • Contains the tools to assist in the determination of appropriate rehabilitation and maintenance programmes and strategies for a given budget.	• Enables more effective use to be made of available resources. • Facilitates improved programming for asset rehabilitation and maintenance.
Common definitions and standards for rehabilitation and maintenance	• Permits benchmarking with other road administrations, both nationally and internationally. • Enables the determination of design standards and levels of service together with the required budget to maintain these levels.	• Enables asset management to perform as a planning and investment strategy tool and not just a traditional, engineering-based management system.
Economic modelling	• Provides an estimate of the economic effect of spending scenarios. • Enables the management of the asset on an economic basis. • Allows prioritisation of maintenance needs on the basis of future costs rather than current condition.	

Benefits realisation

Benefits realisation requires the measurement of improvements in the asset including, but not limited to, level of service, road user cost, crash rates or asset value. The benefits listed in Tables 3 to 8 will only accrue to an administration if the asset management strategy is implemented fully and evaluated regularly for fine-tuning and continuous improvement. To achieve the expected outcomes, an administration cannot ignore the business management or engineering practices and performance measurement associated with the management of the asset.

One difficulty in analysing benefits is that only some can be easily measured and quantified. To compare benefits and costs in an analytical way, it will be necessary to select a subset of benefits that are measured on a common basis.

Table 7. **Summary of potential benefits relating to the budget process**

	Description of benefits	Expected outcomes
Assessment of investment choices	• Improves the process of allocation within a programme area (such as pavements). • Enables the use of standard accounting concepts and terms to provide understandable information to decision makers. • Enables an enhanced analysis of budgetary need. • Allows the identification of the potential impact on assets if budgets are reduced or performance standards are lowered. • Improves the process of allocation of the management of maintenance and rehabilitation budgets. • Provides enhanced budget reporting information for financial managers and decision makers. • Provides a negotiation tool to justify budgets to government and decision makers based on sound technical and economic criteria. • Enhances the credibility of the decision-making process. • Enables the assessment of the implications of using specific network level performance measures.	• Enables the determination of the funding levels required to maintain an asset at a specified level of service. • Enables the prioritisation of work requirements and funding allocations to achieve the goals and objectives of the administration. • Enables the allocation of expenditure between individual assets to give the best value for the overall asset.

Table 8. **Summary of the potential benefits relating to staff development**

	Description of benefits	Expected outcomes
Staff development opportunities	• Broadens the multi-disciplinary knowledge base. • Indirect benefits can be realised by an administration's staff, resulting from implementation of an asset management system. • Provides access to accurate data and state-of-the-art information technology. • Provides access to the analysis tools needed for cost effective management. • Provides the opportunity to make the right decisions on programme spending at the right time. • Improves the credibility of the decision-making process. • Improves the ability to defer lobbying pressures from special interest groups. • Provides the ability to query databases to a wide range of staff. • Enables front line staff to become more involved in the decision making process. • Provides opportunities to improve the technical and business knowledge of staff.	• Increases productivity due to reduced information fragmentation and increased ease of access.

Chapter 8

IMPLEMENTATION OF ASSET MANAGEMENT SYSTEMS IN OECD MEMBER COUNTRIES

Although most OECD Member countries represented on the OECD Working Group are already working with management systems for individual assets (*e.g.* pavements and bridges), no country has yet introduced an integrated asset management system for the whole national road network.

Table 9 summarises the responses from the participating OECD Member countries. More detailed responses are given in Appendix 5.

Table 9. **Current implementation of management systems for the roads sector**

System / Country	Pavement management system	Bridge management system	Other management system	Integrated asset management system
Australia	✓	✓	No	Implemented in Western Australia
Belgium	*No information*	*No information*	*No information*	*No information*
Canada	✓	Being studied	Maintenance; road features	Being implemented
Finland	✓	✓	Gravel road maintenance management system Short-term strategy and project management system Contract management system	Being studied Financial accounting system for the state including accounting of road assets
France	*No information*	*No information*	*No information*	*No information*
Hungary	✓	✓	Maintenance	Being studied
Japan	✓	Being studied	Tunnel management system (being studied) Disaster prevention management system (being studied)	Being studied Database for all national highway inventory information is in use
Italy	*No information*	*No information*	*No information*	*No information*
Mexico	✓	✓	Road network maintenance strategy Being studied	No
Netherlands	✓	✓	Environmental management system	Being studied
Poland	✓	✓	Winter management system	No
United Kingdom	✓	✓	Routine maintenance (all assets) Environment Electrical Winter	Resource accounting and budgeting (pilot)
United States	✓	✓	Various types of information systems	Being studied

The responses to the questionnaire indicated that the major benefit of the management systems already in place is proper budget allocation for the maintenance and repair of roads and bridges. Other benefits of the management systems that are already in place were reported to be:

- Uniformity in definitions.
- Ability to compare costs between different assets and administrations.
- Initiating cost effectiveness.
- Explaining the effects of decisions.
- Supporting decision making.
- Contributing to performance monitoring.
- More consistent work programming.

Although many management tools are already available, it is generally recognised that a broader, higher-level approach is needed. More effective investment can be achieved by using methods that go beyond the traditional management practice using systems for the management of individual assets within the road network (*e.g.* pavements and bridges) by focusing on the entire network.

An example of the use of asset management systems in another sector is provided in Appendix 6.

A means of getting started, guiding the development of an AMS and of measuring progress in the implementation of such a system is given in Appendix 7.

Chapter 9

CONCLUSIONS AND RECOMMENDATIONS

Based on this review of asset management systems for the roads sector and the responses to the questionnaire sent to countries represented on the OECD Working Group, the following conclusions can be drawn:

- An AMS for the roads sector can be defined as: "a systematic process of maintaining, upgrading and operating assets, combining engineering principles with sound business practice and economic rationale, and providing tools to facilitate a more organised and flexible approach to making the decisions necessary to achieve the public's expectations."
- An AMS, as defined in this report, has not yet been implemented for all the national roads in any of the OECD Member countries represented on the OECD Working Group.
- It is inevitable that asset management systems, as defined in this report, will be implemented in some countries as a legislative requirement and in other countries to reflect the incremental benefits of an integrated system over the systems for managing individual assets.

For improved *road sector management policy*, it is recommended that road administrations consider the development and implementation of an integrated AMS. The expected outcomes to follow from such an approach were identified by the Working Group as:

- Improved budget analysis and decision making which provides a higher level of service to the community.
- Increased operational efficiencies arising from easier interpretation of data and better analysis tools.
- Increased strategic planning within budget constraints.
- Increased productivity of the road administration due to reduced information fragmentation and better access to higher quality and more consistent data.
- Determination of funding levels required to maintain assets at specified levels of service.
- Improved allocation of expenditure between individual assets to give the best value for the overall asset.
- Improved prioritisation of work requirements and funding allocations to achieve the goals and objectives of the road administration.

It is recommended that the following points be considered by road administrations when implementing an asset management system:

- The implementation of an AMS generally begins with the integration of previously separate systems for managing the principal individual assets of the road administration.
- The AMS should be designed to encompass the location and condition data for the asset, relationships describing the performance of each part of the asset, methods for selecting the maintenance work giving best value for money based on the policies of the administration and a means of monitoring the performance of the asset following the introduction of the new system.
- Analysis capabilities developed for the AMS should include techniques to enable maintenance options to be selected on the basis of the life-cycle cost of the assets.
- An important capability to be included in an AMS is the evaluation of the value of the asset and the depreciation of that value with time or use.
- One of the valuable benefits of an AMS is the ability it provides to monitor the performance of the assets. Performance indicators can help with such monitoring.

Appendix 1

COMPONENTS OF ASSET MANAGEMENT SYSTEMS IN OECD MEMBER COUNTRIES

Listed below are components of an AMS as identified by the respective road administration or country. This information was used as the basis for producing this report.

Although Member countries seem to use different terminology when describing asset management systems, there appears to be a consensus on what components should be included in an AMS:

- Asset inventory – including data on asset condition, asset use and asset features.
- Maintenance methods.
- Prediction models – future conditions including forecasts, growth rates, etc.
- Life-cycle cost analysis.
- Decision-aid tools – including risk analysis, trade-off analysis procedures for ranking projects, etc.
- Asset management strategy.

OECD Working Group

- Asset inventory – condition, use, features.
- Maintenance methods.
- Pavement deterioration and road-user cost models.
- Prediction models – future conditions, including traffic forecasts, growth rates, etc.
- Life-cycle cost analysis.
- Remaining life determination.
- Decision-aid tools – multi-criteria analysis, risk analysis, trade-off analysis, ranking projects, strategy.
- Heritage management.
- Accounting principles.
- Capitalisation of road infrastructure.

Australia

Community benefits	• Road system performance • Asset features • Asset condition • Asset use • Physical treatments • Management of use • Asset management strategy
Stakeholder requirements	• Levels of service • Standards • Current condition • Deterioration models • Future condition • Decision rules • Growth rates • Future configuration requirements • Gap analysis • Treatments/costs • Project generation • Prioritisation model • Prioritised project list • Funding level • Investment options • Programme development

Source: Austroads, 1997.

Canada

Asset inventory		• Type and location • Condition • Use • Value
Performance prediction models		
Project-specific analytical tools		
Decision-aid tools		
Common database	Programme/network/system-wide level	• Data – location, inventory, properties, performance, evaluation, etc. (financing) • Deficiencies/needs – current and future (budget) • Alternative strategies and life-cycle analysis • Priorities
	Project/section level	• Data materials, properties, traffic/flows/loads, unit costs, etc. • Detailed design (standards and specifications) • Construction (budget limits) • Maintenance (environmental constraints)
	Ongoing, in-service monitoring and evaluation	

Finland

Communication	• Common definitions • Informed organisation • Informed related organisations • Education of partners • Informed users – monitor needs
Tools	• Uniform definitions and parameters • Minimum requirements and quality specifications • Standard output formats • Easy to use • Appropriate for all levels • Budget based on common and acceptable principles
Performance	• Harmonise • Performance measurements • Planning systems • Quality indices – pavement, safety, environment, etc. • Performance progress
Organisation	• Begin with pilot area • Widen use in organisation • Promote benefits to other organisations • Well trained support • Training facilities

Hungary – Included in the Hungarian Pavement Management and Bridge Management System

Data block – inventory
Condition data
Prognosis block
Maintenance cost block
User cost block
Risk analysis

Mexico

Base system	• Graphic Information System (GIS) – road inventory • Structural condition data base – embankments, drainage, pavement • Field and laboratory assessment procedures • Pavement deterioration models – life-cycle cost analysis • Vehicle operating costs • Cost-benefit analysis – maintenance projects • Optimisation system – to determine allocations under different resource scenarios for priority road corridors
In addition (and where possible)	• Similar components for bridges and signs • Related national satellite-accounts for national road transport assets • Appropriate institutional organisation with trained and experienced field personnel and laboratories • Multi-annual budget possibilities tied to previous year's results (resources allocation, road performance, estimated users – freight and passengers, administration/government and economic benefits)

Netherlands

Communication	• Make a uniform definition of terms in use • Inform the organisation • Inform related organisations • Discuss the approach of the AMS with partners in seminars • Inform road users and monitor their needs closely
Tools	• Create uniform definitions and parameters • Develop minimum requirements and quality specifications • Develop standard output formats • Easily usable systems *e.g.* data maintenance, access etc. • Make tools appropriate for all levels of government • Budgeting based on common and accepted principles
Performance	• Harmonise performance measurements • Stimulate the use of planning systems • Find quality indices for different fields of application (pavement, safety, environment, etc.) • Demonstrate progress made in performance
Organisation	• Begin in a pilot area • Widen the use in that organisation • Promote the benefits to other organisations • Create a well-trained supporting division • Ensure good training facilities

United Kingdom

Referenced features – type, extent	
Condition data and collection procedures	
Maintenance selection methods	
Condition indices	
Construction and maintenance prioritisation methods	
User information	• Level of use • Impact on nearby residents • Safety records • User benefits
Financial management system	
Feature valuation	
Reporting facilities – Graphic Information System (GIS)	

United States

Computerisation and other enabling techniques (*i.e.* electronic sensors, robotics, GPS, satellites, etc.) are used to generate and provide ready access to both quantitative and qualitative data about an organisation's assets. General purpose and specialised resource allocation and optimisation tools are available and can be used to conduct "what-if" analysis of current and future facility performance and needs. These analyses can be based on inventory, condition and performance data; administration policies and long-term plans; statutory guidance; available rules of thumb, and principles drawn from engineering, economics accounting, risk management, customer service, and other sound business practices.

American Association of State Highway and Transportation Officials/Federal Highway Administration Model

Data collection
Performance modelling
Development of alternatives
Decision making and programme development
Implementation
Monitoring
Feedback loop (to data collection)

Input to alternative development and decision making/Programme development	• Policies • Budgets • Goals

New York State Department of Transportation

Asset inventory
Condition assessment
Strategy evaluation (asset valuation and performance models)
Trade-off analysis/programme integration
Programme review
Programme approval
Programme intervention
Performance modelling (feedback)

Input	• Long-range plans • Goals and policies • Budget/allocation

Appendix 2

ACCOUNTING AND CAPITALISATION METHODS USED BY OECD MEMBER COUNTRIES

The following appendix is a synthesis of recent international developments in accounting and capitalisation methods for transportation infrastructure assets. Particular emphasis is placed on recent Australian and US standardised reporting and valuation efforts, since fairly complete information was available on these two countries' efforts. References are made to Canadian and Belgian standardised accounting and capitalisation efforts where appropriate, since partial information on their efforts is also relevant.

Overall efforts to standardise reporting requirements

Australia

In Australia, implementation of asset management principles by all levels of government has been well underway for many years, and it is in conjunction with this broader effort that standardised accounting and capitalisation methods appear to have been developed for road infrastructure assets (Austroads, 1999). In particular, material provided by Australia states that "valuation plays an important role in asset management because one of the main purposes of valuation is to enable reporting in monetary terms to reflect the physical conditions of the road network, and assisting asset managers to inform asset owners of the effects of current levels of financing strategies". Road authorities began reporting the value of road infrastructure in 1989-90. In 1994, all local councils were required to value their road and other infrastructure assets, and by 1996-97, all road authorities in Australia valued their road infrastructure. These requirements instruct the governments to prepare their financial statements using accrual accounting procedures (like in the United States).

The Australian Accounting Standards Board (AASB) and the Public Sector Accounting Standards Board (PSASB) of the Australian Accounting Research Foundation (AARF) jointly manage the Australian reporting compliance effort. The AASB was established by Section 224 of the Australian Securities and Investments Commission Act 1989 and is provided statutory authority to oversee standards compliance through Subsection 334(1) of the Corporations Law. Much like the Government Accounting Standards Board (GASB) requirement for US state and local governments, the principal objective of the AASB effort is to enhance the credibility and efficiency of Australia's capital markets by improving the quality of financial reporting by entities that report under the Corporations Law. The objective of the AARF is to ensure that suppliers of capital are provided with relevant and reliable information. Both organisations believe that if entities seeking capital present high quality financial reports which are attested to by an independent auditor, providers of capital will be well placed to allocate resources in the most efficient manner (again, much like the GASB objectives within the United States). The close relationship between the AASB and the PSASB helps to ensure that the standards developed by both Boards contain (to the extent possible) identical requirements and that financial reports prepared by all entities in Australia are prepared on a consistent and comparable basis (see the AARF Web site at *www.aarf.asn.au*).

This arrangement presumably provides the AASB with full authority to enforce compliance with capital asset reporting standards. As such, it differs from the US approach to ensuring compliance of the GASB requirements. As discussed, GASB has no legal authority to enforce its standards, but the US arrangement provides implicit enforcement power to the private market, in particular the municipal bond rating organisations, which can effect the interest state and local governments are required to pay investors to finance infrastructure improvements.

The effort to work with the agencies to become compliant with the AASB capital asset reporting standards is led by Austroads, an association of Australian and New Zealand road transport authorities, including the Commonwealth and all the State and Territory governments. Austroads' mission is to "provide strategic direction for the integrated development, management, and operation of the Australian and New Zealand road systems, through the promotion of national uniformity and harmony, elimination of unnecessary duplication, and the identification and application of world best practices, including within the area of asset management".

Belgium

In Belgium, the Commission for Standardisation of Public Service Accounting (CSPSA) was established in 1991 to oversee the development of a State's General Account (including the Federal Authority, Regions, the Communities and their administrative bodies). The State's General Account is to be established on an annual basis and is to be comprised of a balance sheet, a profit and loss account, and a progress report for the budget. Consequently, national accounting will include the annual flows of property assets and liabilities. Information provided by the Belgian Government indicates that these changes were expected to become effective (and enforceable) in mid-2001 (Dechef, 1997).

Given these uncertainties, the current asset value of the public road network has been estimated at BEF 80 000-100 000 million. In order to improve this estimate, another approach has been adopted. This approach originates from the successful history of utilising pavement and other management systems implemented in Finland by Finnra. Firstly, the annual need for road infrastructure maintenance and reparation is estimated using the management systems. Systems used have been the network-level Highway Investment Programming System (HIPS), the regional-level Pavement Management System (PMS91), network-level Bridge Management System (BMS) and the Gravel Road Management System.

Yearly investments are calculated directly through the accounting system as actual expenses and are then added to the road assets. Then using depreciation parameters provides value of the road assets and the annual change of the value.

Canada

In Canada, the Canadian Institute of Chartered Accountants (CICA), which sets accounting and auditing standards for business, not-for-profit organisations and government agencies, is leading an effort to develop a standard reporting format for capital assets owned and managed by government agencies. Recently, CICA produced an exposure draft on the reporting of asset capitalisation procedures that recommends a standard approach to asset valuation and depreciation. These recommendations were recently adopted in the current standards for financial statement preparation and tangible capital asset accounting (Transport Association of Canada, 1998). Available information did not specify whether these standards were to become mandatory and what the required implementation date may be for the Canadian government agencies.

United Kingdom

In the United Kingdom, the government launched Resource Accounting and Budgeting (RAB) in 1993 with a commitment to introduce resource accounting across all government departments. Resource accounting is defined as "the application of accruals accounting for reporting on the expenditure of central government and a framework for analysing expenditure by departmental objectives, relating these to outputs where possible" (Her Majesty's Treasury, 1999*a*). The current timetable is that, subject to Parliament's approval, RAB will be fully implemented in 2001-02.

In terms of reporting, RAB will require all government departments to report systematically on how their resources are allocated to their objectives, and on what is achieved as a result. Reporting will principally comprise the publication of commercial style accounts, including profit and loss balance statements and cash-flow statements and notes. These statements will be produced in accordance with the *Resource Accounting Manual* (Her Majesty's Treasury, 1999*b*) which is based on United Kingdom GAAP (Generally Accepted Accounting Practice) as modified for the public sector.

United States

Attempts within the United States to standardise the accounting and capitalisation reporting methods of state and local government agencies have recently reached an important crossroads. This effort effectively requires all state and local governments (*e.g.* county and city governments, public power authorities, municipal hospitals, and state universities) to begin implementing standardised asset inventory, valuation and depreciation approaches. The organisation overseeing this effort, the Government Accounting Standards Board (GASB), is an independent board comprised of accounting and finance professionals within the United States which sets financial reporting standards for state and local governments.

In June 1999, GASB issued Statement No. 34, "Basic Financial Statements for State and Local Governments", which requires state and local agencies to enhance the types of information provided as part of their annual financial statements, in a manner more similar to that used by private sector companies in the United States (US Government Accounting Standards Board, 1999). Specifically, in developing their annual reports, state and local governments are required to use accrual accounting procedures, or to measure and report on their long-term assets and liabilities, including capital assets (*e.g.* highway infrastructure) and general obligation debt. Currently, these agencies typically only report on the revenues received or expenditures paid in the current year, without specific identification of long-term capital spending. Additionally, when these agencies report on revenues and expenditures, they typically do so only for general fund categories, making it difficult for information users to assess the administration's present

financial condition, and whether it has improved or deteriorated as a result of the year's operations. According to GASB, the rules will add important new information to the "current fund" accounting approach used by state and local governments and will provide new financial information from a total government perspective. This information will be useful to those interested in better understanding the financial condition of state and local governments. Interestingly, most private sector companies and utilities in the United States have used accrual accounting as part of their standard reporting procedures for years.

In terms of reporting highway infrastructure assets, *prospective* reporting (*e.g.* all newly acquired infrastructure) becomes effective in three phases, and is based on a government's total annual revenues in the first fiscal year ending after 15 June 1999. For instance:

- Phase I governments (those with total annual revenues of USD 100 million or more) should report all major general infrastructure assets for fiscal years beginning after 15 June 2001.
- Phase II governments (those with total annual revenues of between USD 10 million and USD 100 million) should report all major general infrastructure assets for fiscal years beginning after 15 June 2002.
- Phase III governments (those with total annual revenues of less than USD 10 million) should report all major general infrastructure assets for fiscal years beginning after 15 June 2003.

R*etroactive* reporting (*e.g.* infrastructure assets acquired, reconstructed or significantly improved before the effective date, but in fiscal years ending after 30 June 1980) is encouraged by the above dates but will be required as follows:

- Phase I governments should retroactively report all major general infrastructure assets for fiscal years beginning after 15 June 2005.
- Phase II governments should retroactively report all major general infrastructure assets for fiscal years beginning after 15 June 2006.
- Phase III governments are encouraged but not required to retroactively report major general infrastructure assets.

Highlighting these specific compliance dates reveals a phased approach to infrastructure asset reporting, with prospective reporting implemented first, and required retroactive reporting to follow four years later. This information also reveals that the US effort to standardise reporting requirements for highway infrastructure assets is just getting started, but should be fully implemented by the year 2006.

Current discussion among state, city and county government officials revolves around how to meet the seemingly large requirements given the ambitious time frame, and the cost-effectiveness of obtaining such information for external users. Some agencies have indicated that the requirements cannot be met without substantial expenses incurred in data collection. However, most agencies are expected to comply with the new rules, particularly since any state or local government agency that wishes to issue municipal bonds to finance transportation improvements must have its bonds rated by independent, third-party financial rating organisations. And GASB rules are required to be followed when a state or local government's audit report says it follows generally accepted accounting principles. If a government agency's accounting practices are deemed "out of line" with the new reporting standards as a result of an independent audit, concerns may be raised about the agency's financial condition, thereby increasing the risk of a lower bond rating and the likelihood of higher interest rates in order to attract the necessary level of investment dollars.

Asset valuation approaches: what highway assets are to be reported on?

Australia

The AASB requirements regarding what constitutes "infrastructure assets" appear quite similar to the US GASB requirements, although more detailed in nature. The AASB requirements indicate that within the "roads" category, earthworks, drainage systems, pavement and seals should be included, as well as bridges, buildings in service and "road furniture" (*e.g.* traffic signal control networks and lighting). Most State and Territorial governments include the land under which the roadway resides in their valuations, although some have questioned the necessity to include land. Reasons for this line of argument include the assertion that the value of land underneath roads is unlikely to be useful in assessing the efficiency of an administration in providing road services, and the recognition that land under roads may influence road pricing but would have no real impact on day-to-day asset management decisions.

Finland

The whole asset of the road network of Finnra is determined to contain, in addition to the road structures, land and water areas for construction and advance payments and acquisitions of assets in progress. The assets in total include, however, items such as capital assets, other tangible assets, capital stock and current and liquid assets and cash and bank receivables and other finances.

United Kingdom

UK requirements regarding what constitutes "infrastructure assets" in the roads sector are essentially the same as in Australia, *i.e.* roads, structures, communications and land are included.

United States

In terms of meeting the GASB reporting requirements, infrastructure assets are defined as "long-lived capital assets that normally are stationary in nature and normally can be preserved for a significantly greater number of years than most capital assets". Examples, for the purpose of highway infrastructure reporting requirements, include roads, bridges, tunnels, drainage systems and lighting systems. In addition, GASB Statement No. 34 indicates that the land under which the roadway resides should be included, as well as any easements, traffic signal equipment and buildings (*e.g.* presumably toll structures).

Approaches for valuing highway infrastructure assets

There are a number of approaches prescribed to value infrastructure assets, and it is probably fair to say that no single approach is universally accepted by the international community. However, those OECD Member countries establishing standard infrastructure asset reporting procedures are recommending or requiring one of two commonly used approaches to value transportation infrastructure assets. These include:

- H*istorical cost*: the base acquisition accounting cost or the initial cost to build the facility in the year it was constructed (usually taken from the original construction cost records).
- C*urrent replacement cost*: the engineering cost estimate to replace the facility under current market conditions with one of equivalent capacity, taking into account cost efficiencies arising from improvements in technology.

These two approaches fall within the broader valuation method known as "capital" or "wealth value" assessment. Capital or wealth value assessment uses a cost-based approach to determine the market value of an asset.

Australia

Road assets are initially recorded at their cost, as required by the AASB, and a replacement cost approach is generally applied when road infrastructure assets must be revalued. Replacement cost is most often used for valuing timber bridges, and is based on the cost of an equivalent concrete structure with the same capacity.

Belgium

In Belgium, a replacement cost approach is recommended for valuing infrastructure assets.

Canada

In Canada, the CICA recommends the use of historical cost, where possible, for road infrastructure asset valuation. To date, many Canadian road administrations have limited experience with capital asset valuation using historical cost.* Interestingly, many road administrations expressed a desire to use measures that determine how well they are managing their roadway assets. As such, several Canadian jurisdictions have indicated that valuation of highway assets using replacement cost is one alternative measure that can provide useful information for asset management purposes.

Finland

The road infrastructure asset value is an important factor at the national level. The Ministry of Transport and Communications (MTC) takes care of all modes of traffic (road, railway, air, water and telecommunications), and is responsible for the allocation of the budget between these traffic modes. The asset value of the entire infrastructure is monitored by the MTC, although different administrations are responsible for data collection and the estimation of the asset value. The asset value is currently used in political discussions at the ministerial level and on the balance sheets of the road administration.

External accounting systems have been modified and standardised in the whole state from the beginning of 1998, since when all the state agencies and ministries have had similar accounting systems providing balancing of the accounts. The country-wide accounting system is rather similar to business accounting and there are statement of revenues and expenditures and balance sheets in use in all the agencies.

A simple spreadsheet program (POKLA) has been developed for asset value calculations and valuation. Road network or engineering structures were categorised into four groups (roads structures, pavements, bridges, and other

* Canadian Response to the OECD IM1 Questionnaire, June 1999.

structures) due to the different nature of investments and depreciation parameters. Moreover, the road management of Finnra has been distributed as follows:

- Routine maintenance.
- Periodic maintenance.
- Planning.
- Road investments.
- Traffic information and services.
- Land acquisition.
- Administration.

Road investments have been further categorised into rehabilitation, improvement and new investments. Routine maintenance and other similar costs that do not preserve or increase the asset value are excluded. Data for asset value calculations has been collected since 1950, and the method of calculation is similar to that used in standard investment calculations (Virtala *et al.*, 1996).

United Kingdom

In the United Kingdom, it is recommended that the road network should be valued on the basis of the current replacement cost depreciated to reflect the overall condition of the network (Her Majesty's Treasury, 1999*b*). This is deemed to be a more appropriate valuation approach for basing decisions on resource allocation.

On the introduction of resource accounting, an initial valuation and condition assessment will be made for the network. Thereafter, a variant of renewals accounting supplemented by annual condition surveys may be used as a method of approximate depreciation.

United States

The GASB recommends that state, city and county government agencies, in reporting capital assets as part of their modified financial statements, use a historical cost approach (*e.g.* the construction cost in the year the asset was built) in establishing transportation infrastructure values. If historical cost information is not available, GASB provides guidance for a proxy estimate using the current replacement cost. The current replacement costs should then be deflated to the year of the asset's original year of construction using a number of general price-level indices available from the US Government or other generally accepted and available price indices. If historical cost information was not available, such a procedure would need to be performed for any major infrastructure asset acquired, significantly reconstructed, or significantly improved, in fiscal years ending after 30 June 1980. It must be noted that the aforementioned procedures are merely suggestions, and GASB allows governments to use any valuation approach that complies with the intent of the statement.

Approaches for depreciating highway infrastructure assets

Australia

In Australia's experience, there would appear to be some lessons to be learned by other OECD Member countries developing approaches for asset depreciation, since Australia appears to be furthest along with implementation. For instance, the State and Territory governments are already using one of two approaches to depreciate their highway infrastructure assets: straight-line depreciation or condition-based depreciation. The governments of New South Wales, Western Australia and Tasmania use condition assessments to depreciate their roads and bridges, although each uses a straight-line approach to depreciate their traffic signal systems and highway lighting. Conversely, the governments of Victoria, South Australia, the Northern Territory and Queensland use a straight-line depreciation method for all their highway asset categories (roads, bridges, traffic signals and lighting.) Additionally, the useful lives established for each asset category vary substantially among the States and Territories.

Belgium

In Belgium, the CSPSA recommends the use of a condition-based method to depreciate infrastructure assets and highlights the many advantages of condition-based depreciation. However, straight-line depreciation appears to be permitted under the guidelines.

Canada

Although Canada's effort appears to be just getting underway, information provided in the OECD questionnaire indicates that a condition-based depreciation method is recommended.

Finland

In Finland, the most important parameters in asset value calculations are the depreciation parameters. The main depreciation parameters are the holding times of different structures, type of depreciation function (linear, degressive or progressive), and the salvage value. It is very difficult to define the exact holding times, because: *i*) there are numerous different structures in the road infrastructure; and *ii*) the changes in technologies, work methods, traffic volumes and loadings have been vast during the past 50 years. In addition, the reliability of old investment statistics is poor.

The depreciation parameters have been determined in such a way that deprecations are equal to the reparation needs. This results in a more accurate estimate of the road infrastructure asset value. The holding times and depreciation values finally used are as follows:

Road structures	50 years	2.00%
Pavements	10 years	10.00%
Bridges	85 years	1.18%
Other structures	10 years	10.00%

United Kingdom

The UK Government recommends that a variant of renewals accounting is used to calculate the depreciation charge. Under this approach, a consistent annual condition survey must be undertaken of a significant and representative proportion of the road network in order to assess whether the condition of the network has improved or deteriorated in the year. The financial impact of the improvement/deterioration can then be evaluated.

If the survey reveals that the network has maintained a steady state during the year then the renewals expenditure is an acceptable proxy for the depreciation charge. However, if the condition of the network has deteriorated/improved between surveys, the value of the impairment/improvement, if material, should be charged/credited to the operating cost statement. If the road network is not expanding or contracting, the total charge to the operating cost statement should be broadly similar from year to year.

United States

The GASB indicates that governments may use any established depreciation method, and identifies both straight-line depreciation and condition-based depreciation as acceptable. The GASB requirements also provide maximum flexibility to agencies in establishing the "useful life" of each asset group. No specific guidelines on this are included in the Statement. The Statement does indicate that a single depreciation rate may be applied to *a*) a class of assets; *b*) a network of assets; *c*) a sub-system of a network; or *d*) an individual asset.

The GASB requirements indicate that infrastructure assets which are part of a network or sub-system of a network do not have to be depreciated if two distinct criteria are met. First, the government manages the infrastructure assets using an asset management system that has the characteristics set forth below. Second, the government documents that the infrastructure assets are being preserved at, or above, a condition level originally established for the assets. To meet the first requirement, the AMS should:

- Have an up-to-date inventory of the assets.
- Perform condition assessments of the infrastructure assets at least once every three years, and summarise the results using a measurement scale.
- Estimate each year the annual amount required to maintain and preserve the infrastructure assets at the condition level originally established for those assets.

Such an exemption to the required depreciation exercise may spur state and local governments to implement comprehensive asset management systems, although it is too early to determine the potential effect of such an incentive.

Conclusions

In developing this synthesis report on the accounting and capitalisation methods for highway infrastructure assets among OECD countries, it appears that while significant progress is being made to implement standard accounting and capitalisation methods for highway infrastructure assets, the efforts are still in an initial implementation phase. The recent release of major requirements in the United States by the GASB provides a major catalyst for developing standard accounting and capitalisation methods for transportation infrastructure assets by state and local agencies. These requirements, if implemented by state and local governments within the allowable time frame, should be fully functional by 2006.

Based on information provided for this synthesis report, Australia appears to be farthest along this path and the United States also appears to be a leader in this area. Information made available for Canada, Belgium, Finland and the United Kingdom indicates that these countries are actively moving forward to implement standard reporting, inventory, valuation and depreciation procedures for government agencies. Even with this progress, much work remains to be done. For instance, within Australia, which has already implemented standardised accounting and capitalisation methods for highway infrastructure assets, the systems are not yet fully standardised from region to region. There remain unique differences in the systems among the territorial, state and local governments in Australia, which limit the data from being directly comparable and transparent across jurisdictional boundaries.

With that said, there is much similarity in the recommended methods among the countries highlighted here for establishing highway infrastructure asset valuations and depreciating those assets. As such, those OECD Member countries just beginning to establish standard procedures may well be able to use the Australian, Belgian, Canadian, Finnish, UK and US systems as a guide in developing their own standard accounting and capitalisation methods.

Appendix 3

PERFORMANCE INDICATORS USED BY OECD MEMBER COUNTRIES

Australia

Performance indicators (PIs) are used in Australia for road network asset management purposes at a number of levels:

High-level performance indicators

Each year, Austroads publishes national performance indicators covering road safety, registration and licensing, road construction and maintenance, environment, programme and project assessment, travel time, lane occupancy rates and user costs. Since 1994, these indicators have been progressively developed and, in 1999, a total of 34 indicators were reported (Austroads, 2000).

Other high-level performance indicators are also published annually, such as:

- The federal government has begun publishing data on the condition and performance of the National Highway, for which it has funding responsibility (Commonwealth of Australia, 2000).
- The Roads and Traffic Authority of New South Wales publishes indicators on community satisfaction, pavement ride quality (as indicated by roughness), pavement durability (as indicated by surface cracking), and bridge deficiency.
- The Main Roads Department of Western Australia (MRWA) publishes data on community perceptions of ride quality, road safety, environmental performance and planning effectiveness; programme efficiency; heavy vehicle access (length rated for high-productivity freight vehicles); and road standards (see Table 10).
- The Department of Transport in South Australia publishes trends in rural and metropolitan road usage and trends in road freight tonnages to and from Adelaide.

Performance indicators used for internal management

Australia road authorities use a variety of performance indicators for internal management purposes. Table 11 shows indicators for road network management under an asset management approach proposed by the Queensland Department of Main Roads. The approach covers:

- Programme efficiency.
- User satisfaction.
- Road-user costs.
- Freight movement and heavy vehicle access (length rated for high-productivity freight vehicles).
- Route reliability with respect to flooding.
- Levels of private investment from developers and on toll-ways.
- Environmental performance.
- Contracting performance.
- Administrative overheads.
- Stakeholder acceptance of the road implementation programme.

Lower-level performance indicators

These are used within organisations on a local or *ad hoc* basis, such as cumulative distributions, stacked bar charts and other statistical representations of trends in road pavement or bridge condition, as measured by any of the relevant parameters, within a route, sub-network, road category or region. Relevant condition parameters for rural roads used by the Department of Transport and Works in the Northern Territory are set out in Table 12.

Table 10. **Performance indicators used by MRWA**

Perspective	Government/Ministry	Road administration	Road user
Road preservation programme performance indicators	Preservation expenditure Long-term programmes for road preservation	Pavement condition: roughness, rutting, skid resistance, texture and strength by road category. Road preservation programme efficiency: routine, periodic maintenance and reconstruction, costs/lane km	Rural and metropolitan road roughness: travel on roads not meeting roughness standard. Rutting, skid resistance and texture: percentage of length not meeting condition standard. Number of bridges not meeting T44. Community perception survey: ride quality.
Road use programme performance indicators	Road use expenditure Long-term programmes for road use	Road standards: roads rated for high-productivity freight vehicles (heavy vehicle access percentage of state and national roads by vehicle class). Peak-hour travel. Road use programme efficiency: AUD million expenditure per 1 000 million vehicle-kilometres travelled.	Travel on roads not meeting operational standards: seal width, shoulder width and design speed. Road fatality and serious injury rates. Road safety: community perception survey.
Road expansion programme performance indicators	Road expansion expenditure Long-term programmes for construction	Benefit cost ratios for metropolitan and rural projects over AUD 500 000. Road expansion programme efficiency (unit construction costs, roads and bridges, per lane km)	Community perception survey: planning and provision of roads.
Programme performance indicators	Assets employed: asset values and vehicle travel, asset values and freight.		Environmental performance: community perception survey.
Financial statements	Value of assets.		

Table 11. **Queensland Department of Main Roads: proposed performance indicators**

Type of indicator	Features measured	Typical indicators
Pavement management	Physical condition of the road subgrade, pavement and surfacing.	*Network level analysis*: roughness, rutting (80th percentile rut depth), surface age (a proxy for cracking, surface texture, skid resistance, binder condition) and routine maintenance costs. *Project level analysis*: all of the above, plus pavement deflection, cracking, surface texture and skid resistance.
Network performance	Use of the network and level of service that the network provides.	Currently a mix of physical and user satisfaction indicators are reported only, and not used for asset management: • Smooth travel exposure • Level of service (a measure of seal width vs. AADT) • User satisfaction index (from qualitative user survey) • Road-user costs • Travel times (urban and rural) • Freight movement • Heavy-vehicle access (length rated for high-productivity freight vehicles) • Route reliability with respect to flooding
Programme delivery	Performance of the organisation in the preparation and delivery of its works programme.	• Productivity index • Return on construction expenditure

Table 12. **Northern Territory Department of Transport and Works for Rural Roads: pavement condition parameters**

Surface type	Condition parameter	Needed for managing system?	Needed for customer satisfaction?
Sealed	Roughness	✓	✓
	Rutting	✓	✓
	Flushing	✓	✓
	Stripping	✓	✓
	Texture	✓	
	Edge break	✓	✓
	Cracking	✓	
	Patching/potholing	✓	✓
	Local defects	✓	✓
	Edge drop off width	✓	
	Edge drop off slope	✓	
	Age of seal	✓	
Unsealed	Gravel depth	✓	
	Crown height	✓	
	Carriageway width	✓	✓
	Loose material		✓
	Roughness		✓
	Corrugation	✓	✓
	Potholing	✓	✓
	Loss of shape	✓	✓

Canada

The Canadian experience had been that traditional performance measures such as condition ride comfort index (RCI), capacity (level of service) and safety (accident rate) had served well in the past and would continue to be useful. However, as road administrations move towards asset management, they will need additional performance measures such as economic rate of return, current capital value, environmental measures (*e.g.* the amount of toxic de-icers used) and public perception indicators through user surveys. The key requirement for these performance indicators is to match them with the strategic objectives of the decision makers.

Table 13 below makes it clear that each provincial administration measures the physical condition of their road assets and that most road administrations have set target values for this measure.

Most road administrations use a range of indicators to measure the condition of their highways and bridge structures, such as RCI, international roughness index (IRI), visual distress indicators for pavements and visual condition ratings for bridge structures. However, few administrations have developed means of evaluating the

Table 13. **Performance indicators used in Canada by province**

Province	Physical Condition		Level of Service/Congestion		Safety		Other	
	Measure	Target	Measure	Target	Measure	Target	Measure	Target
NF	–	–	–	–	–	–	–	–
NS	✓	–	✓	✓	✓	✓	–	–
PEI	✓	✓	–	–	–	–	–	–
NB	✓	✓	✓	✓	✓	–	–	–
PQ	✓	✓	✓	–	✓	✓	–	–
ON	✓	✓	✓	✓	✓	✓	✓	✓
MB	✓	✓	✓	✓	✓	✓	–	–
SK	✓	✓	✓	✓	✓	✓	–	–
AB	✓	✓	✓	✓	✓	✓	✓	✓
BC	✓	–	✓	–	–	–	✓	–

performance of the overall system or highway network. It is therefore difficult to determine whether the overall network is improving, declining or remains stable. Furthermore, the condition indicators vary from jurisdiction to jurisdiction, making it difficult to benchmark, or compare network performance among administrations. In addition, results from existing performance measures are not always analysed and presented in a manner understandable or useful to senior management and technical personnel.

Needs exists to compile and evaluate the range of performance indicators for road networks, and provide guidance and recommended best practices for their appropriate application and communication.

Better methods are required to set priorities across competing transportation modes and between transportation and other government priorities.

Typically, technical staff within each administration collect and analyse the asset management information, making preliminary decisions, and initiating and assisting in the preparation of a programme. This programme is then presented to the administration executive, who will review and amend the programme based on administration experience and on political requirements. The database is not reviewed by the executive to a rigorous level of detail, but the programme outcome is subject to amendments.

Canada reports that some road administrations have been successful in achieving a political commitment to asset management. This is, of course, political commitment for some of the component parts of asset management systems, such as the pavement management systems. This is shown by the success in their initial development and their pervasive use within administrations.

In Alberta, the administration has obtained political commitment to develop and initiate an integrated AMS, called an "infrastructure management system". Funds to develop this system have been provided and political commitment has been maintained during its development. The Alberta Infrastructure Management System has been fully documented in the Province's Business Plan and has been approved by the administration's executive and by the government Treasury Board. Alberta has also encouraged the development of formalised asset management systems by other agencies, such as the Ministry of Environment and the Ministry of Public Works, the agencies responsible for buildings and dams.

A partnership effort between Manitoba, Saskatchewan and Saskatoon has also shown that political commitment has been obtained to develop the required systems to initiate an integrated maintenance management system.

In Canada, since there are no fully operational integrated systems in place at present, it is not possible to be definite on how asset management can impact on funding decisions.

Provincial/territorial governments are making strong efforts to reduce deficits, which results in constraints to securing adequate levels of funding. The main ways to address this constraint are for better ways of stating needs and benefits of highway expenditures, and information systems to better articulate proper funding levels. An asset management methodology that provides realistic data and models to predict future performance of the infrastructure and more input to the budgeting process would be of benefit.

Asset management component systems such as pavement management and bridge management systems have been used to prioritise expenditures on specific parts of the infrastructure and, in general, Canada has been successful in improving the efficiencies of funding allocations for pavement rehabilitation programmes.

For the most part, funding is largely based on historical funding levels adjusted for inflation and special projects. Eleven of the 12 provincial/territorial administrations felt that their present level of funding was not adequate.

Budget priorities are typically set by considering first the maintenance and rehabilitation budgets, and then reconstruction. There does not appear to be any objective capability of determining the optimal allocation between these budgets. Economic models and highway asset management systems are the most often mentioned items for improving abilities to set priorities. These same items are mentioned as being required to measure the impacts of budget increases or decreases on system performance.

Hungary

The situation in Hungary is set out in Table 14. No direct satisfaction rate is measured – either on pavements or on bridges.

The above information is made available as follows:

- Main data related to roads in Hungary is published annually (and has been for more than 15 years), as is road management and accounting data (for the last 10 years). The latter report forms part of the Annual Budget for the Parliament.
- Details of the road asset value are published every five years (and have been for 20 years). Apart from the publicly available information, various reports are produced for different levels of decision makers.

Table 14. **Performance indicators in use in Hungary**

Indicators	Applied to:
Surface defects (cracks, potholes, etc)	Pavement on national roads
Unevenness	
Rut depth	
Bearing capacity	
Condition classes of bridges	Bridges on national roads
Widths evaluation (sufficient/insufficient)	
Load bearing capacity of bridges (restricted or not and for what kind of vehicles)	
Restriction due to dimension of vehicles on bridges	
Road-rail road level crossing (safety)	National road network
Safety of junction (need to be rebuilt)	
Inspection of pavement condition (inspection level depends on category)	Municipal roads
Drainage system (whether satisfactory or not)	
General bridge condition (17 different items measured)	Municipal bridges
Highest elevation	Municipal roads
Average travel speed	Absolute indicators on municipal roads
Average waiting time at junctions	
Environmental impacts	
Public transport possibility	
Cyclist	
Safety risk level	
Parking possibility	
Traffic engineering	
Annual travel kilometre per vehicle	Relative indicators on municipal roads
Annual tax income from road traffic	
Annual expenditure for roads	
Actual transport policy (is there any?)	
Number of staff for road transport	
Numbers of successful tenders for transport, environment and regional development	

Japan

Performance indicators are used in Japan at a network and project level. The main performance indicators used by the Ministry of Construction are set out in Table 15.

In Japan, technical and detailed discussion on defining assets and asset management has only just begun, and there are at present no general objective indicators available to quantify the performance of the road network and transportation system. Indicators are produced for pavement performance, for both road administrators and road users. A maintenance control index (MCI) is produced for the former, and a riding comfort index (RCI) for the latter.

MCI is calculated based on cracking, rutting and roughness of pavement surfaces. RCI is calculated based on roughness. In addition to these indices, there is a need for a quantitative indicator to represent structural soundness.

Data on pavement condition is collected by the Regional Construction Bureaux of the Ministry of Construction and the Hokkaido Development Bureau, who process them by mainframe computers. Each bureau provides the pavement condition data to work offices in the form of CD-ROMs, where road engineers use the data as one of their tools in making technical decisions.

While most OECD countries emphasise pavement performance, geographical conditions in Japan mean that tunnels, bridges and slope-protecting facilities are more important than in other OECD Member countries.

Table 15. **Performance indicators in use in Japan**

Type of indicator	Network level indicator	Project level indicator
Network performance	• Peak hour travel speed. • Road fatality rate. • Road accident rate. • Etc.	• Traffic volume vs. traffic capacity. • Waiting time at junctions. • Etc.
Environmental performance	• Percentage of length not meeting condition standard. • Etc.	• Noise. • Vibration. • Air pollution. • Etc.
Pavement management	• MCI. • Percentage of length not meeting condition standard. • Etc.	• Rutting. • Roughness. • Cracking. • Skid resistance. • Permeability of surface. • Noise generated at surface. • MCI. • RCI. • Etc.
Bridge management	• Load-bearing capacity of bridges (based on their design loads). • Etc.	• Load-bearing capacity of bridges (based on their damage condition). • Etc.
Tunnel management		• Condition classes of tunnels (based on their damage condition). • Etc.
Disaster prevention	• Number of slopes not meeting condition standard. • Etc.	• Condition classes of slopes. • Etc.

Mexico

Mexico uses two series of performance indicators:

- For the physical management of roads, the international roughness index (or equivalent present serviceability index); and Benkelman Deflection (or equivalent dynamic/impact measurements of pavement deflection) are used.
- Other performance indicators used are net present value (NPV) for life-cycle, internal return rate, reduced user costs (vehicle operating costs), and the value of cargo that flows through the road transport corridor (road segment).

The Netherlands

Performance indicators have been set for and used by the Public Works Department and its regional maintenance management bureaux for trunk roads, bridges and tunnels as shown in Table 16.

The provincial authorities and the main cities use a comparable system for road maintenance. In some regions, developments are their way to integrate public works and provincial works plans. In the near future, the administrative system in use in the Public Works Department will be changed from a single bookkeeping to a double bookkeeping system (Pacioli) or a multiple accounting system. These developments will encourage management to operate in a more economic, rather than purely technical, way.

Table 16. **Performance indicators in use in the Netherlands**

Physical condition		Level of service/congestion		Safety		Environment (noise, etc.)	
Measure	Target	Measure	Target	Measure	Target	Measure	Target
✓	✓	✓	✓	✓	✓	✓	✓

Poland

In Poland, the following performance indicators are used in the pavement condition evaluation system (SOSN):

Table 17. **Pavement condition performance indicators used in planning at the project and network level**

Skid resistance – Class	Condition	Skid number
A	Good	> 35
B	Satisfactory	26-35
C	Rehabilitation planned	21-25
D	Immediate rehabilitation required	< 20
Roughness – Class	**Condition**	**IRI**
A	Good	< 2.81
B	Satisfactory	2.81-4.37
C	Rehabilitation planned	4.38-5.74
D	Immediate rehabilitation required	> 5.74
Rutting – Class	**Condition**	**Depth (mm)**
A	Good	< 10
B	Satisfactory	11-20
C	Rehabilitation planned	21-30
D	Immediate rehabilitation required	> 30
Surface Condition – Class	**Condition**	**Evaluation of damage types**
A	Good	Loss of grains, local repairs etc.
B	Satisfactory	
C	Rehabilitation planned	
D	Immediate rehabilitation required	
Loss of bearing capacity – Class	**Condition**	**Evaluation of damage types**
A	Good	Separate cracks, patches and potholes Alligator cracks
B	Satisfactory	
C	Rehabilitation planned	
D	Immediate rehabilitation required	

Table 18. **Combined performance indicators used in the planning process at project and network levels**

Pavement condition – Class	Condition	Status
A and B	Good	Required
C	Unsatisfactory	Warning – maintenance activities to be planned
D	Bad	Immediate intervention necessary

General indicator of pavement work requirements

This is a combined indicator of bearing capacity, evenness, ruts, skid resistance and surface condition resulting in condition classes:

- Strengthening (low bearing capacity).
- Pavement rehabilitation (unevenness or rutting).
- Surface treatment (poor skid resistance or surface condition).

This indicator is used for strategic planning of the road budget at the network level and for budget allocation among regional road administrations.

Technical condition of engineering structure performance indicator

A technical condition of engineering structure performance indicator is issued in the bridge management system (SGM). Each structural element is evaluated against a scale of 0–5 points, and the technical condition of the total structure is determined against a minimum of mean values of element groups.

Class	Scale	Condition
A	< 3	Dangerous
B	3-4	Safe
C	> 4	Excellent

This indicator is used to determine the range and type of maintenance activities.

Other important performance indicators used by the General Directorate of Public Roads (GDDP)

- Percentage of traffic-overloaded network used for taking decisions on construction of additional traffic lane or carriageway.
- Traffic accidents rate (number of accidents per 1 million lane-km) used for analysis of road safety.

The information/indicators from the pavement condition evaluation system are presented to decision makers in Parliament and the Ministry of Finance in an annual report which summarises the results of measurement of particular pavement characteristics. These characteristics describe pavement conditions for different categories of roads both for the country as a whole and for the individual regional road administrations. In 1998, the *Annual Report on Pavement Conditions of National Roads* was presented to the Prime Minister, who decided to submit it for discussion by the Economic Committee of Ministers' Council. As a result of the discussions, a new Act on Financing of Roads was voted by the Parliament, guaranteeing growth of the road budget in line with growth in fuel consumption.

The information/indicators from the bridge management system are presented to decision makers in Parliament and the Ministry of Finance in an annual report which summarises the results of the bridge inspection performed each year.

Appendix 4

EXAMPLES OF SPECIFIC BENEFITS ACHIEVED BY OECD MEMBER COUNTRIES

Australia

- Consistent approach to rehabilitation and maintenance planning is based on pavement condition data and life-cycle costing methods. Quality inventory data and condition data are available.
- Consistent approach to rehabilitation and maintenance planning is based on pavement condition data and life-cycle costing methods. Quality inventory data and condition data are available.
- The life of existing assets has been extended by using maintenance management systems.
- There is community involvement and acceptance of designed levels of service. A strategy employed in road management is that roads are now maintained in acceptable condition at the lowest cost to the community.
- Funding allocation methods are now based more on engineering indexes and engineering needs. Programmes are put together using data such as pavement condition and age.
- A consistent and systematic approach has been adopted to develop policies for pavement condition data collection and pavement condition indicators.

Finland*

- Management procedures have resulted in better productivity.
- Better project-level programming.
- Ability to communicate with other organisations and to benchmark.
- The use of road asset values will assist in budget allocation.
- The use of the same database is of benefit.

* The road condition is now considered to be at the optimal level, even though funding has been decreased by 50%.

Netherlands

- An analysis was conducted regarding the costs of maintenance for two similar road sections in different regions. It became apparent that local prices varied for similar work. The analysis led to the conclusion that this situation resulted from different standards were applied to maintenance activities and different initial costs. Life-cycle analysis provided information to regional staff in support of using similar standards.
- Specific goals have been set for maintenance; safety, access and environment and information needs are to be investigated with the goal of obtaining consistency. Regional maintenance plans have been produced and national plans for highway network are contemplated.

United Kingdom

- Asset valuation has been accomplished and a balance sheet approach has been constructed for road assets.
- A value for depreciation for a given time period, based on condition has been calculated.
- It is considered that the output would be an optimum budget. The budget would be based on the "vision" of what the optimum value of the asset should be and would take into account an amount for depreciation.
- Total asset management systems benefits are difficult to identify and quantify. Sub- system benefits can be identified.

New York State Department of Transport (United States)

- Benefits that can be linked to road users include time-saving, wear and tear on vehicles and productivity increases gained by local industry.
- The benefits obtained along with the better framework for business practices, include better inventory, evaluation, planned economic theory, integration of component systems, optimisation of the return on investment, project decisions and long-range planning.
- Technical tools were used for an analysis to determine the potential savings in capital construction costs by increasing preventative maintenance funding for pavements and bridges. The analysis period was set at 20 years. Data from pavement and bridge management systems were used. Performance modelling tools and needs assessment tools were used to test various budget options. It was shown that significant quantifiable savings were achievable by increasing preventative maintenance funding.

Appendix 5

IMPLEMENTATION OF ASSET MANAGEMENT SYSTEMS IN OECD MEMBER COUNTRIES

Australia

- The larger Australian road authorities use a structured set of procedures. These procedures involve generation of work programmes from inputs including asset inventory, asset condition, safety performance, rate of deterioration in asset condition, current and likely traffic volume and type, stakeholder expectations of asset capacity and condition, availability of funding, available treatments and their costs and benefits. Analytical procedures are increasingly being based on discounted life-cycle analysis.
- Pavement and bridge management systems are widely used.
- The Main Roads Department of Western Australia (MRWA) has implemented an integrated asset management (IAM) model.

The main topics of current Australian research in road asset management are:

- Development of national specifications for pavement and bridge condition parameters (definition, measurement and reporting) and bridge condition indices.
- Deterioration rates for road pavements, particularly the effect of maintenance: accelerated testing is in progress using the Australian Accelerated Testing Facility (ALF).
- Development of a national framework (process flow chart) for asset management.
- The use of valuation in asset management.
- The feasibility of truck ride indices as tools for asset management to complement IRI which is based on car riding comfort.
- Community expectations in relation to road condition and road system performance.
- Suitability of HDM 4 for Australian circumstances, and support for HDM 4 development.
- Risk parameters of low-cost pavements.
- Road-user costs in urban and non-urban travel conditions, including freight travel time-savings, prediction models for road crash savings, and harmonisation and validation of models being used by various road authorities.
- The effect of road features and condition on road-user costs.

Canada

- Pavement management system (in most provincial administrations).
- Bridge management systems (under development in most administrations).
- Road features (are being considered).
- Integrated asset management system (being implemented/studied).

Finland

Pavement management system	• Consists of road condition measurement procedures, road condition data bank, network level highway investment programming system (HIPS) and project level PMSPro. • Utilisation in resource allocation and strategic planning at the network level, project management and planning of actions at the regional level.
Bridge management system	• Consists of bridge condition measurement procedures, network-level bridge management system (BMS) and project level system (SIHA). • Utilisation of resource allocation and strategic planning at the network level, project management and planning of actions at the regional level.
Gravel road maintenance management system	• Consists of condition measurement procedures and project-level management system.
Short-term strategy and project management system	• Consists of databases of road investments and GIS application. • Utilisation of short-term planning and budgeting.
Contract management system	
Financial accounting system	• Real-time accounting and calculating of investments. • Provides information on costs and generates balance sheets and income statements.

Hungary

- Pavement management system at network level (calculation of budget needs).
- Pavement management system at local network (HDM III).
- Pavement management system on motorways.
- Highway design and maintenance standard model (economic evaluation module used at project level).
- Bridge management system (on all bridge assets).
- Road asset evaluation system for municipality roads.
- Resource allocation system.
- Road asset value evaluation.
- Global management system on the road and bridge network (research).

Japan

- Pavement maintenance management system.
- Bridge management system (being studied).
- Tunnel management system and disaster prevention management system (being studied).
- Whole of life-cost models for road network (research being undertaken).
- Database for all national highway inventory information, MICHI (Ministry of Construction Highway Information Database System) with 61 categories/facilities and 4 000 items, is in use.

Mexico

- Pavement management system.
- Bridge management system.
- Road network maintenance strategy (research being undertaken) which includes:
  – Road corridor prioritisation based on freight value, a pavement assessment procedure, a pavement management system, an economic appraisal system for road maintenance projects and an optimisation system for road maintenance resources allocation under budgetary constraints.

Netherlands

- Pavement management systems.
- Bridge and tunnel management systems.
- Environmental management systems.
- Integrated infrastructure management (being studied).

Poland

- Pavement management system (consists of two sub-systems: pavement condition evaluation system and road data bank).
- Highway design and maintenance standard model (economic evaluation module used at project level).
- Highway investment programming system (planning of pavement maintenance at network level).
- Bridge management system.
- Winter maintenance system.

United Kingdom

- Road network (data bank).
- Condition assessment (assessment of trunk-road condition).
- Maintenance prioritisation (based on pavement condition).
- Bridge management system.
- Pavement management system (research being undertaken).
- Whole of life-cost models for road network (research being undertaken).

United States*

Research is currently underway with the objective of developing:

- A first-generation Asset Management Guide for use by AASHTO member administrations.
- A synthesis of current practices and available tools.
- A framework for an asset management system.
- Recommended research for filling gaps in existing knowledge and developing tools for the generation of the Guide.

* Highway transportation assets are owned and operated by the individual states. A number of individual single-asset management systems are in place (*e.g.* bridge management systems and pavement management systems), but no integrated management system is in place in any of the states.

Appendix 6

THE USE OF ASSET MANAGEMENT SYSTEMS IN OTHER SECTORS

As an example of the use of asset management systems in other sectors, the City of Devonport in Tasmania, Australia, uses asset management practices to manage assets other than roads. By this means, Devonport City Council meets not only the corporate responsibilities of its elected officials, but also the expectations of the Council's ratepayers, the users of its services.

Australian local government councils now require information systems and formal approaches that enable their technical staff to present a more accurate picture of the assets under their control. From these, councils can evaluate and provide funds for the necessary maintenance and replacement, to ensure the assets remain available to customers.

Suitable information systems, processes and practices mean that staff can provide council with an accurate picture of the complex questions relating to assets for which they have responsibility. It also enables them to clearly identify and quantify the best investment opportunities that allow council to meet stated objectives and missions from a financial and technical sense, *e.g.* "getting more for less". Such systems are meaningful and beneficial only if they also have regard to the political and social aspects of managing community assets, *e.g.* the types of service and levels of service expected by the customers and the costs the customers are prepared to pay for each level of service. Effective outputs are only possible if financial and technical information needs are integrated.

Australian councillors – as boards of management – increasingly need to address the issue of custodial responsibility, to maintain or justify the loss in value of their non-current asset stocks and their annual reporting, as well as to develop effective asset management strategies.

Australia Accounting Standard 27 (AAS27) raises the accountability of those responsible for managing assets from field staff up to the level of elected members (councillors). AAS27 is a catalyst for integrating technical and financial information needs and offers organisations the opportunity to upgrade the technical management systems for their assets.

Devonport is a city of 25 000 people located in Northern Tasmania. Devonport City Council (DCC) manages some AUD 250 million of assets of behalf of Devonport's residents. The Council has adopted the principles of Asset Management, and uses a system based on the Institute of Municipal Engineering Australia's N*ational Asset* M*anagement* M*anual* (IMEA, 1994). The M*anual* is designed for councils and other organisations managing infrastructure assets such as roads, bridges, water supply, sewerage, parks and gardens, recreation facilities, drainage, buildings, and plant and equipment.

DCC has adopted the physical concept of capital, *i.e.* it treats capital as the operating capability provided by the city's physical resources. The council's point of reporting reference is to maintain the physical operating capacity of the city's assets.

DCC's annual financial statements reflect the extent to which it has (or has not) achieved maintenance of its physical operating capacity. DCC believes that it is a tenet of good financial management that the operating capability be at least maintained.

DCC's drive for asset management is also driven by Australian Accounting Standard 27, which sets standards for the form and content of general-purpose financial reports of local government. The purpose of AAS27 is to provide information useful to users in making and evaluating decisions about the allocation of scarce resources, and to present this information in a manner which assists councils to discharge their accountability for the use and maintenance of the resources under their control.

AAS27 applies accrual accounting to local government. It requires councils to have a balance sheet with the value of infrastructure assets reported in the balance sheet and an operating statement with the rate of consumption of infrastructure assets reported as a depreciation expense.

To this end, councils are required to identify their assets, create an asset register, assess the condition of those assets, assess consumption of the assets in the reporting period, and report the value and consumption of the assets in general purpose financial reports.

DCC manages its assets using information provided by accrual accounting, and undertakes activity budgeting, where depreciation is shown as an expense of carrying out that activity. The condition of DCC's assets is assessed and revalued every year, recognising changes in cost and technology.

The technical AMS that DCC uses is designed to assist in managing its assets. It is not an accounting exercise of entering dollar values in the right boxes; rather it is a joint technical and financial management system. An Asset Management Task Force within DCC, made up of an interdepartmental staff committee, manages the process. The committee comprises staff from DCC's Engineering, Finance, Information Technology, Corporate Services and Operations. All Departments are involved in the process, as asset management is a corporate process. The Committee has met 56 times since 1990.

DCC has a fully integrated management information system (MIS). Where data is entered once and held in one location. The data, however, is accessible to all staff, and is designed to ensure council maximises use of its IT systems. Data is accessed by text inquiry or by an integrated geographic information system (GIS).

The emphasis of the DCC's AMS is on managing its assets. The financial outputs required under AAS27, are secondary outputs. DCC defines an asset as "a discrete unit, which is able to be valued, has a discrete life, and is a suitable unit for management".

DCC has adopted the following asset management units for the different classes of its assets:*, **

Parent asset	Child asset	Asset management unit	Management methods
Roads	• Land • Pavement • Wearing surface • Kerbs and channels • Footpaths	• Urban roads – block lengths and intersections • Rural roads – approx. 1 km lengths	• Planning of reseals • Assessment of condition by Pavement Management System (PMS) and Footpath Management System (FMS) • Monitoring of service requests
Sewer and drainage	As for parent assets	• Pipe length and upstream manhole	• Assessment of condition • Monitoring of service requests
Water		• Pipe length between nodes (intersections)	
Building		• Item	
Plant		• Item	• Service history

Council engineers assess the condition of the assets, in terms of asset age and remaining life of the asset. Assessment of condition is an engineering assessment, not an accounting calculation. The carrying value of the assets is a financial representation therefore of the actual condition as assessed by council engineers. DCC carries out an annual revaluation to replacement value, and an annual assessment of condition.

Consumption of assets, or depreciation, is reported in the council's financial statements as an expense, and is a charge against present and future users of the assets. Depreciation is regarded as a manageable expense and is estimated and budgeted annually.

DCC's financial planning therefore is able to prepare asset management plans and 20-year financial plans that will take account the rate of consumption of its assets and, depending on the level of services for residents it wishes to maintain, the cost to DCC of maintaining and operating those assets, and of replacing them when their life has expired. Such planning is essential for a council with limited means of raising revenues, and with ongoing community pressures to improve service levels and reduce rates and charges. Continuous improvement of both management and maintenance practices is, of course, essential, and incentives for these are provided through the greater accountability of DCC through its financial reporting.

DCC's AMS will enable it to meet the expectations placed on it to show it is providing an acceptable level of service for an acceptable cost in the most efficient and effective (business-like) manner.

The assistance of John Howard, Manager Technical Services of Devonport City Council, in preparing this appendix is gratefully acknowledged.

* Asset attributes (length, age, etc.), condition and financial data is held for each asset at the child asset level.
** DCC expresses the condition of all infrastructure assets in financial terms (AUD).

Appendix 7

GETTING STARTED: AN ASSET MANAGEMENT DEVELOPMENT MODEL

Introduction

The Shire of Swan, Western Australia, initiated a project to further develop the practice of asset management (Pike and Binning, 1996). The project was primarily about providing direction in a structured and systematic way, so guiding future effort on asset management, rather than specifying a detailed approach to asset management. Accordingly, the project goal was to devise a suitable "Getting Started" asset management development model.

The development model comprises the components of:

- Best practice.
- Asset information.
- Organisation practice.
- Change management.

Each of these components is described in the following sections.

Best practice

Approach

Best practice for asset management is described in various documents. However, these tend to present primarily a technical (engineering and accounting) view of asset management. It was therefore necessary to broaden the approach to consider some of the more pertinent non-technical (organisational) aspects of asset management. The description of best practice that is presented therefore represents a merging of both the technical and non-technical aspects.

About assets

A broad definition of an asset adopted for the purposes of the project states: "Asset means service potential or future common benefit controlled by the entity as a result of past transactions or other past events" (IMEA, 1994).

There are various types (or classes) of asset. In general the major types of asset can be considered to be:

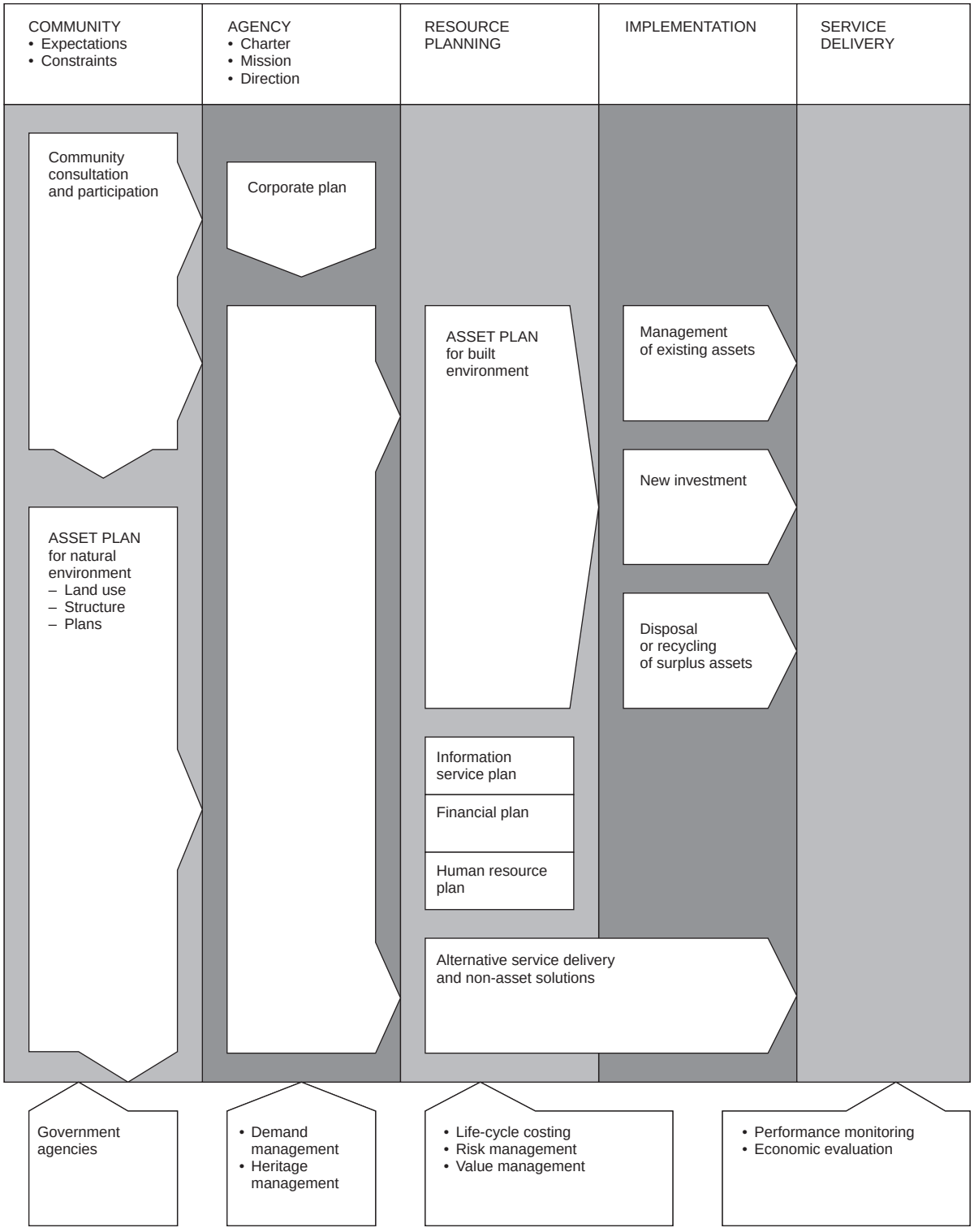
- Natural environment (land and the associated ecosystem).
- Built environment (infrastructure, fixed and mobile plant).
- Heritage (within both the natural and built environments).
- Intangible (such as intellectual property and corporate reputation/image).

Local government is concerned in a varying degree with almost all types of asset. It has a key role to play, often in conjunction with other public sector agencies, in managing what may generally be termed community assets from both the natural and built environments. These types of asset generally serve the community as a whole, tending to provide social as distinct from purely commercial services.

Some basic characteristics of assets and the associated implications for management were also considered as a part of providing a suitable background to determining best practice. These concerned:

- Life cycle.
- Influencing life-cycle costs.
- Project initiation process.
- Optimising costs.

Figure 4. **Hierarchy of plans and integrated planning process**



Source : Adapted from NPWC Total Asset Management, May 1996.

The context of assets as a means of providing service to customers was also considered. In general, customers tend to expect a high level of service at a low cost. However, as the level of service provided by the asset increases, so too does the cost of service. It therefore becomes necessary to address the balance (or trade-off) between level of service and cost of service.

Techniques

There are particular techniques that are often employed as a part of asset management. These include:

- Demand management.
- Heritage management.
- Life-cycle costing.
- Risk management.
- Value management.

Overall

Assets must be managed throughout their life cycle as a part of a service delivery system. Planning, particularly at the strategic level, is key to determining the role of assets in the particular service delivery system and to ensuring that the appropriate level of service is provided at the least long-term (life-cycle) cost. Best practice in asset management is primarily about "seeing" assets as part of delivering cost effective services to customers.

In its simplest form, best practice can be described in terms of:

- Plans.
- Planning.
- Information.
- Roles, responsibilities and relationships.

A hierarchy of plans, from the corporate, through strategic to the operational level is required. These serve to align and so synchronise effort toward achieving the desired goals. An appropriate hierarchy of plans is apparent in Figure 4, as is the integrated planning process required to produce them.

In essence, from Figure 4:

Community expectations and constraints are interpreted (through consultation and participation in decision making) into:	• An appropriate direction for the organisation overall – *Corporate plan*. • The framing of services the organisation is to be provide – *Service delivery plan*. – In the short to medium term. – In the longer term based on the *asset plan for the* ***natural*** *environment*.
Resources available to the organisation are then allocated and so allow further detailing of the *service delivery plan* into the operational level of plans:	• A*sset plan for the* ***built*** *environment*. • I*nformation service plan*. • H*uman resource plan*. • H*eritage* and *intangible* type assets are usually implicitly addressed.
Of note is that the *Service Delivery Plan* can be progressed through use of non-built alternative service delivery mechanisms.	• The techniques of *demand management* and *value management* are useful in assisting to identify viable non-built alternate service delivery mechanisms.
The operational plans are then implemented with subsequent *performance monitoring* and *economic evaluation* as part of an overall management cycle.	

In order to facilitate such an integrated planning process, timely accurate and relevant Information is required. This aspect is considered further later in this appendix.

In addition to the best practice elements of plans, planning and information are other asset management aspects. These primarily relate to asset management being inherently multidisciplinary. The way in which the different disciplines can best contribute is addressed by clarifying the different roles, responsibilities and relationships that relate to asset management. This is especially important in the public (local government) sector where it is often not so apparent as for organisations in the private sector.

In this regard, the "funder-purchaser-provider" model was considered, together with "managed competition", "outsourcing" and "output-based management". It was determined that these reforms serve to focus effort on the best way of achieving the required outputs and not on seeking to simply maintain (or possibly increase) the existing level of funding regardless of whether past funds were used to good effect.

The various roles, responsibilities and relationships must inevitably be "tied together" through the use of appropriate *performance agreements* – from those for personnel within the organisation through to those that take the form of specific competitively awarded contracts.

Overall, all of the elements of best practice must be addressed – plans, planning, information plus roles, responsibilities and relationships. That is, it is not sufficient for instance, to just assign "funder-purchaser-provider" roles without the support of appropriate planning processes and performance agreements.

Development framework

The best practice so far described represents a summary view of an "ideal" end state. However, there is also the equally important view of how to develop best practice. This is most conveniently described in terms of an asset management development framework – an indicative version of which is provided in Table 19.

The matrix is based on that used for the development of *total quality management* (TQM) that is used for the Australian Quality Award. As with the TQM matrix, the asset management development framework recognises the progressively more advanced stages of development, from *ignoring*, *informing*, *formalising*, *practising* and *achieving* through to *excelling* (best practice).

The key difference is that the asset management development framework is based on the specific attributes of managing assets as distinct from an organisation, via:

- Planning.
- Implementing (life-cycle phases of acquisition, operation, maintenance, rejuvenate and rationalise).
- Reviewing.
- Improving.

A subtle but significant feature of the asset management development framework is that the attributes of managing assets used in the framework relate directly to the TQM "P-D-C-A" (**P**lan-**D**o-**C**heck-**A**ct) cycle for promoting continuous improvement. That is, the asset management attribute of planning relates to **P**lan, similarly with implementing relating to **D**o, reviewing to **C**heck and improving to **A**ct.

The framework provides a short description of the asset management practice that would be present for each attribute for the different stages of development. These descriptions are of an indicative nature.

Some of the more significant asset management development themes inherent in the framework are:

- Changing from being reactive through formal reporting to being proactive.
- Progressively increasing the breadth and depth of asset management to include all asset types.
- Progressing from a focus on the assets themselves toward the role of assets as part of a service delivery mechanism.
- Becoming increasingly "business"-oriented through use of comprehensive cost-benefit-risk analysis to guide asset management decisions.
- Progressively merging asset management with overall corporate management at the more advanced stages of development, so that it becomes an integral aspect to all management practices.

Overall, the framework provides a basis to determine the current stage of development of asset management being practised in an organisation and in turn the areas which should most logically be addressed next in order to progress in a structured systematic way towards best practice – *excellence*.

Table 19. **Asset management development framework**

		Planning	Implementing					Reviewing	Improving
			Acquisition	Operation	Maintenance	Rejuvenate – Refurbish/Augment	Rationalise – Reduce/Dispose		
Excelling	10	• Competitive positioning proactively pursued	• Highly responsive to market and community forces – Monitored, assessed and used to advantage	• Highly responsive to market and community forces – Monitored, assessed and used to advantage	• Highly responsive to market and community forces – Monitored, assessed and used to advantage	• Highly responsive to market and community forces – Monitored, assessed and used to advantage	• Highly responsive to market and community forces – Monitored, assessed and used to advantage	• Performance measured and assessed on basis of benchmarking against best practice for asset management	• Benchmarking programme itself based on best practice
	9	• Strategic planning practised – As a part of a fully integrated corporate planning system	• Needs identified in advance – Customer focus – Strategic context of service delivery	• Industry Best Practice achieved	• Optimised preventative maintenance practised – For all major assets and/or classes of assets	• Needs identified in advance – Customer focus – Strategic context of service delivery	• Negligible backlog	• Comprehensive framework of performance indicators (past, present and predictive) established and used as basis for review and evaluation	• Benchmarking programme established – Based on best practice for asset management
Achieving	8	• Demand management practised	• Major capital asset acquisition avoided or deferred	• Utilisation of existing assets is matched to capacity – Unit rates minimised	• Utilisation of existing assets is matched to capacity – Unit rates minimised	• Major capital asset rejuvenation avoided or deferred	• Surplus capacity identified and assets rationalised – Forward estimates	• Review and evaluation based on extent to which demand is matched to capacity	• Change management for asset management integrated with overall corporate change programme
		• Business case approach practised	• Costs, benefits and risks for all options known and considered – Decisions based on value over the long term (not just initial outlay)	• Costs, benefits and risks for all options known and considered – Decisions based on value over the long term (not just initial outlay)	• Costs, benefits and risks for all options known and considered – Decisions based on value over the long term (not just initial outlay)	• Costs, benefits and risks for all options known and considered – Decisions based on value over the long term (not just initial outlay)	• Costs, benefits and risks for all options known and considered – Decisions based on value over the long term (not just initial outlay)	• Review and evaluation based on extent to which priority objectives and targets are achieved	
	7	• Risk management practised – Financial, technical, social and environmental	• Risk management plan developed – Including contingency plans – Across whole asset portfolio	• Risk management plan developed – Including contingency plans – Across whole asset portfolio	• Risk management plan developed – Including contingency plans – Across whole asset portfolio	• Risk management plan developed – Including contingency plans – Across whole asset portfolio	• Risk management plan developed – Including contingency plans – Across whole asset portfolio	• Analysis of service reliability – Trends, causes and effects	• Asset management related process Improvement teams established

Table 19. **Asset management development framework** (*cont.*)

		Planning	Implementing					Reviewing	Improving
			Acquisition	Operation	Maintenance	Rejuvenate – Refurbish/Augment	Rationalise – Reduce/Dispose		
Achieving	7	• Optimisation practised – Acquisition, rejuvenation and rationalisation – Level of service to cost of service balance determined	• Optimisation – Across whole asset portfolio	• Operating strategic plan developed for all major assets and/or classes of asset	• Maintenance strategic plan developed for all major assets and/or classes of asset	• Optimisation – Across whole asset portfolio	• Optimisation – Across whole asset portfolio	• Based on degree of compliance to specified service delivery criteria	• Asset management related process Improvement teams established
Practising	6	• Optimisation practised – Existing assets only – Level of service to cost of service balance determined	• n.a.	• Optimisation of policies and procedures – All major assets	• Optimisation of policies and procedures – All major assets	• n.a.	• n.a.	• Formal audit of compliance to policies and practices	• All relevant staff appropriately trained – Ongoing skills enhancement programme in place
		• Planning and evaluation (project initiation process) – Value management practised	• Project initiation process used – All major assets acquisition proposals	• n.a.	• n.a.	• Project initiation process used – All major assets acquisition proposals	• Project initiation process used – All major assets acquisition proposals	• Formal audit of compliance to project initiation policy and procedure	
	5	• Four-year plans – As per New Local Government Act	• Forward estimate – Long-term but not strategic focus	• Forward estimate – Long-term but not strategic focus	• Forward estimate – Long-term but not strategic focus	• Forward estimate – Long-term but not strategic focus	• Forward estimate – Long-term but not strategic focus	• Monitoring and review in terms of compliance to Four-year plans – New Local Government Act	• Roles, responsibilities and relationships for asset management clearly determined and being established
Formalising	4	• Assignment of asset related costs to programme areas – As per AAS27	• Assessment includes impact on unit rates for customer service delivery	• Work practices reviewed – Including occupational health, safety and welfare • Disability services plan, policies and procedures established and practised	• Work practices reviewed – Including occupational health safety and welfare	• Assessment includes impact on unit rates for customer service delivery	• Asset rationalisation policy, procedures and programme established	• Monitoring and review in terms of compliance to – AAS27 – Occupational health, Safety and Welfare requirements – Disability Services requirements	• Basic asset management related policies and procedures documented and being established

Table 19. **Asset management development framework** (*cont.*)

		Planning	Implementing					Reviewing	Improving
			Acquisition	Operation	Maintenance	Rejuvenate – Refurbish/Augment	Rationalise – Reduce/Dispose		
Formalising	3	• Cost reduction emphasised	• Current commitments reviewed – Potential for cost savings identified	• Costs identified and routinely measured • Cost reduction programme established.	• Costs identified and routinely measured • Cost reduction programme established.	• Current commitments reviewed – Potential for cost savings identified	• Surplus to requirement assets identified – Current backlog	• Basic performance indicator framework established and used as basis for review and evaluation • Independent audits conducted	• Change Management practised – Structure – Process
Informing	2	• Formal capital and recurrent cost budgeting policies, procedures and processes being established	• Cost not customer focused • Short-term not long-term (nor strategically) focused	• Cost not customer focused • Short-term not long-term (nor strategically) focused	• Cost not customer focused • Short-term not long-term (nor strategically) focused	• Cost not customer focused • Short-term not long-term (nor strategically) focused	• Cost not customer focused • Short-term not long- term (nor strategically) focused	• Major asset management issues requiring attention have been determined	• Basic asset management training needs determined and being addressed
	1	• Informal/*Ad hoc*	• Bias to lowest initial capital cost option • Supply (of asset) lags demand by a considerable period	• Bias to recurrent cost budgeting on basis of past precedent	• Bias to recurrent cost budgeting on basis of past precedent	• Bias to lowest initial capital cost option • Supply (of rejuvenated asset) lags demand by a considerable period	• Propensity to retain all major assets – No formal asset rationalisation programme	• Need for a formal systematic review process is recognised	• Basic asset management development framework and plan determined
Ignoring	0	• Reactionary – Crisis-oriented	• Lacking a complete strategic context of service delivery	• Status quo maintained	• Repair-orientated	• Generally lagging behind identified needs	• Generally not addressed	• *Ad hoc* – Reactionary	• *Ad hoc* – Reactionary

Asset information

Information needs

The provision of timely accurate and relevant information to facilitate an integrated planning process was identified as an element of *best practice* asset management.

Some insight into these information needs is provided by examining the requirements of two current reform initiatives that are arguably the current key "drivers" of change in local government in Western Australia. These are:

- Adoption of Australian Accounting Standard AAS27 [June 1996].
- The New Local Government Act [1995].

The overall asset management intent of AAS27 is to require a local government to relate the costs associated with its assets to the various services or programmes to which they contribute. Implicit in AAS27 is that financial information (valuation and depreciation) is derived in conjunction with technical information – that concerning the condition and rate of "wear and tear" (deterioration) of an asset. Overall, through use of AAS27, a clear picture of past and present circumstances is presented. This facilitates improved accountability and decision making.

From an asset management perspective the New Local Government Act, among other things, simply "picks up and carries on" from AAS27. It requires a view of the likely future circumstances of the assets of the particular local government. This is implicit in the stipulation that "principal activities" of the local government be identified and that *four-year plans* be determined for these to identify future commitments. Given that assets are inherent to the "principal activities" of a local government, the likely future asset acquisition, rejuvenation and disposal intentions of the local government would be identified as would the recurrent costs associated with the asset life-cycle phases of operation and maintenance. As with AAS27, the New Local Government Act facilitates improved accountability and decision making.

There are however, other dimensions to asset management that tend to be at more advanced levels of asset management than the AAS27 and New local Government Act requirements. These concern matters of looking beyond the assets themselves to the service delivery context to which they must ultimately relate. This is especially so for the strategic application of asset management and involves the use of such techniques as *demand management* and *risk management*.

Asset registers

It is apparent that some information about the current asset stock of an organisation is a basic component of the overall asset management information needs. To this end, asset registers are required. The use of an appropriate asset register structure allows basic data to be gathered about all assets, and then progressively more specifically focused data relating to the component parts of those assets to be added as the need dictates. This is an important consideration because the effort (and therefore cost) of collecting and storing data increases exponentially as the level of detail increases.

Information systems

The basic data available from asset registers must be related to that from other sources to provide the necessary asset management information and so facilitate informed decision making. To this end, it is appropriate that the various data sets and associated data processing systems (modules) be effectively and efficiently linked.

Ideally, this requires a computer-based information system with automated interfacing of the various modules through use of appropriate (compatible) hardware and software – that is a suitable information technology (IT) platform. However, considerable extra value is added if the interfacing also allows the relationship between the different data sets to be identified; that is, a relational data base structure exists within the information system. By this means the information "contained within" different data sets is greatly enhanced because there is, in effect, a "built-in" relationship.

In terms of the location aspect of providing a common reference basis for recording of data, the *geographic information system* (GIS) is highly suitable for local government. This is especially so, given that land information is increasingly being recorded in this way and that land (part of the natural environment) was identified as being an important type of asset which local government manage.

Interfacing of the various modules and the relational data issue is addressed through GIS. Also of note, is that should a GIS-based system be adopted, data collection methods can be automated to a large extent through use of *global positioning systems* (GPS). By this means, data is collected using electronic equipment that allows accurate measurement of location in terms of the co-ordinate system that is the basis of GIS. This type of equipment is increasingly offering very cost-effective means of collecting asset-management-related data.

Development framework

Of significance is that the information element of *best practice* so far described represents a summary view of an "ideal" end state and that there is also the equally important view of how to systematically develop that element and the use of a suitable framework to guide future development effort. Consequently, a more specific version of the asset management development framework that is focused on just the information element of *best practice* has been devised – an indicative asset management information framework is provided in Table 20.

It is based on the same stages of development – progressing from *ignoring* through to the most advanced stage of *excelling* (best practice), as was adopted in the asset management development framework. The attributes used are those that are specific to asset management information. These are:

- Decision types.
- Analysis methods.
- Information types: financial/economic, technical, social and environmental.
- Data collection methods.
- Storage retrieval system.

A short description is given in each cell of the asset management information framework for each attribute at the different stages of development. These descriptions are of an indicative nature.

Worthy of note is the fact that the last two attributes: data collection methods and storage retrieval system, collectively provide an overview of the information technology (IT) support required for asset management. Accordingly, with further definition and detailing this could be expanded into a basic IT development plan – from an asset management perspective which as previously noted, becomes progressively merged with overall corporate management at the more advanced stages.

Some of the more significant asset management development themes inherent in the asset management information framework are:

- Moving from past precedent and historic data based decision making through to strategic "positioning" utilising predictive data.
- Progressing through long range planning to optimising and in turn to addressing the "trade-off"/balance between level of service and cost of service.
- Utilising increasingly more sophisticated analysis methods and associated data.
- Extending beyond just financial and technical data to embrace all data types.

Overall, the asset management information framework should complement the more general asset management development framework described earlier in this appendix.

Organisation practice

Asset management practice in the Shire of Swan needed to be assessed from two key aspects. These were present practice and future intentions. Both were assessed to determine the required change (difference or gap) to be addressed.

The asset management frameworks for development and information are ideal to include as a part of the process of assessing Shire practice. It should be noted, however, that the actual process used involved far more than just the use of the frameworks.

The required change (difference or gap) is shown indicatively overleaf in the "marked-up" (shaded) asset management development framework in Table 21. The darker shading represents the very approximate extent of present practice, and the lighter shading the extent of future intentions to be addressed within the next two years. A similar indication is evident on a "marked-up" asset management information framework.

Table 20. **Asset management information framework**

		Decision types	Analysis methods	Information types				Data collection methods	Storage/Retrieval system
				Financial/Economic	Technical	Social	Environmental		
Excelling	10	• Competitive positioning with respect to: – Competitive markets – Community expectations and constraints – Technology	• Benchmarking	• Industry performance data	• Industry performance data	• Industry performance data	• Industry performance data	• "Real time" linkage to relevant data sets external to the organisation	• Comparative (with other organisations) "real time" information available: – "Exception" reports according to prescribed criteria – "Online" user enquiry
	9	• Strategic planning: – Technological change – Strategic marketing (service level expectations) – Environmental change – Social change – Demographic change – Economic change	Scenario building ("What if…") • Economic Forecasting	• Economic "Futures" Reports/Studies	• Technological "Futures" Reports/ Studies	• Social "Futures" Reports/Studies – Lifestyle options	• Environmental "Futures" Reports/Studies – Sustainability options	• "Real time" remote monitoring on "critical" assets (determined on a cost-benefit-risk basis) measuring: – Condition – Utilisation – Damage	• "Real time" information available: – "Exception" reports according to prescribed criteria – Management reports – Trend analysis
Achieving	8	• Demand management – Avoid/defer capital investment (acquisition and rejuvenation) – Better utilisation of existing assets	• Long term forecasting • Sensitivity analysis	• Service delivery cost estimates • Opportunity cost of capital	• Current asset performance data	• Demographic studies	• Environmental studies – Air quality – Energy use	• GPS (Global Positioning System) and other automated remote sensing techniques used where appropriate	• Fully integrated information system established – GIS (Geographic Information System) basis
		• Business case approach – Costs, benefits and risks considered – All asset management related decisions	• Various	• Past and predictive data	• Past and predictive data	• Past and predictive data	• Past and predictive data		

Table 20. **Asset management information framework** (*cont.*)

		Decision types	Analysis methods	Information types				Data collection methods	Storage/Retrieval system
				Financial/Economic	Technical	Social	Environmental		
Achieving	7	• Risk management – Including litigation aspect	• Risk analysis • Contingency planning	• Direct and indirect costs of failure modes	• Failure modes and associated probabilities	• Industrial relations criteria • Corporate image/ reputation criteria	• Direct and indirect potential environmental impacts • Mapping of environmentally sensitive areas	• Scope of data collection increased to include component and sub-components of assets – On the basis of a positive benefit to cost ratio and risk considerations	• Comprehensive data sets with "online" access to users – Staff – External stakeholders
		• Optimising: – Acquisition – Rejuvenation (refurbish/ augment) – Rationalisation (reduce/dispose)	• Level of service/ cost of service • Financing options – Cost of capital	• Predictive performance data	• Predictive performance data	• Predictive performance data	• Predictive performance data		
Practising	6	• Optimising – Operation – Maintenance	• Benefit to cost ratio • Level of service/ cost of service	• Return on investment	• Demand modelling	• Customer needs survey	• Environmental condition survey	• Data collection included as an integral part of work method where appropriate – Not a separate task – Including for contract work	• Integrated MMS (Maintenance Management System) established
		• Planning and evaluation (Project Initiation Process) for: – Acquisition – Rejuvenation (refurbish/ augment) – Rationalisation (reduce/dispose)	• Value management	• Life-cycle costing of alternative solutions	• Functional analysis • Identification and feasibility of alternative solutions	• Social Impact Statements • Including Disability Services legislative requirements	• Environmental Impact Statements		
	5	• 4 year plans – As per New Local Government Act	• Forward estimates	• Past performance data	• Past performance data	• Past performance data	• Past performance data	• Electronic recording systems (hand-held loggers) used where appropriate • Photogrammetry used where appropriate	• Distributed Computing Environment – Such as networked personal computers interfaced to corporate mainframe
		• Operating planning • Maintenance planning	• Long-term estimates	• Industry Best Practice unit rates	• Failures • Complaints	• Customer satisfaction surveys	• Environmental condition surveys		

Table 20. **Asset management information framework** (*cont.*)

		Decision types	Analysis methods	Information types				Data collection methods	Storage/Retrieval system
				Financial/Economic	Technical	Social	Environmental		
Formalising	4	• Assignment of asset related costs to programme areas – As per AAS27 requirements	• Asset valuations and depreciation • Life-cycle Costing	• Written down current cost • Accumulated depreciations • Annual depreciation charge	• Deterioration models • Age profile	• Occupational health, safety and welfare	• Base/background data measured	• Data collection "back log" addressed • Data collected as assets are acquired – No "back log" allowed to develop	• Need for interfacing/ integration of asset registers with other information system modules is clearly documented – With associated benefits, costs and risks identified
	3	• Cost control	• Sensitivity analysis on cost estimates – Customer services – Asset work	• Comprehensive accurate unit rates for customer service types	• Physical condition of assets for all attributes recorded	• Performance criteria identified	• Performance criteria identified	• Data accuracy verification programme is in place – audit • Roles and responsibilities for data collection are clearly established and relevant staff have been adequately trained	• Data security programme is in place – for data input and access • Networked personal computers where appropriate
Informing	2	• Formal capital and recurrent cost budgeting • Short-term focus	• Extrapolation of current trends	• Comprehensive accurate unit rates available for asset work types	• Physical attributes describing assets determined	• Past complaints registered	• Past problems registered	• Most cost-effective methods of data collection have been identified • Data accuracy requirements and verification methods have been determined	• Most cost-effective methods of data storage and retrieval have been identified • Computerised approach adopted: – Spreadsheets – Stand-alone personal computers • Asset register architecture/ structure identified • Key staff are fully aware of available asset management related software

Table 20. **Asset management information framework** (*cont.*)

Decision types			Analysis methods	Information types				Data collection methods	Storage/Retrieval system
				Financial/Economic	Technical	Social	Environmental		
Informing	1	• Informal – Bias towards lowest initial capital cost option – Bias to recurrent budgeting on basis of past precedent	• Past precedent	• Historic costs • Some unit rates for asset work types	• Work records – Assigned to specific assets	• Negligible	• Negligible	• Data required for asset registers has been identified • Asset labelling/ numbering system established • Existing sources of asset related data have been identified	• Graphic plans and maps • Written notations on maps, specifications and the like • Assets themselves – Measurements made as required • Staff knowledge, photographs and other miscellaneous records
Ignoring	0	• *Ad hoc* – Reactionary	• Past precedent	• Historic costs	• Past work records	• Negligible	• Negligible	• Mainly manual records	• Basic card/record indexes

Table 21. **Asset management development framework: required changes**

		Planning	Implementing					Reviewing	Improving
			Acquisition	Operation	Maintenance	Rejuvenate Refurbish/Augment	Rationalise Reduce/Dispose		
Excelling	10								
	9								
Achieving	8								
	7								
Practising	6								
	5								
Formalising	4								
	3								
Informing	2								
	1								
Ignoring	0								

1. The required change (difference or gap) is shown indicatively in the "marked-up" (shaded) asset management development framework in Table 21. The darker shading represents the very approximate extent of present practice, and the lighter shading the extent of future intentions to be addressed within the next two years.

Change management

Structuring the change

The required changes should be addressed in a structured manner. The basic sequence and nature of the change for the two-year planning period nominated by the Shire of Swan being:

Year 1	Awareness	To provide council and key staff with an understanding of the fundamentals of asset management to enable them to participate in and guide the further development of asset management in the Shire.
	Major assets and issues	To resolve the future of some major assets which are currently of concern.
		To address the need for a formal *project initiation process*, particularly in respect of major asset acquisitions.
		To address the need for an appropriate *business model* or (framework) that embraces a programme/portfolio and related asset register structure suitable to support the requirements of AAS 27 and the New Local Government Act (and so also allow the need for clarification and communication of roles and responsibilities for asset management within the Shire to be addressed).
Year 2	Major processes	To address *risk management*.
		To address the need for a *business case* approach to decision making (accommodating costs, benefits and risks).
		To address the need for *four-year plans* in support of the New Local Government Act.
	Management system and information system	To provide policy, procedures and plans that allow for the formal practice and ongoing development of asset management.

This sequence of structured change will result in the Shire becoming more systematic in its asset management. From this position, it would be well placed to progress in a more "routine" continuous improvement mode towards a "vision of excellence" in asset management.

Change issues

The development of asset management through structured change will require ongoing efforts in regard to change issues:

- Marketing (to adequately inform key staff of the need and nature of the required change together with the progress being made and staff involvement).
- Employee participation (to enhance the perceived ownership of the change and to ensure that external expertise is transferred to key staff).
- Structural changes to organisation (that may be identified as a result of asset management development).

Change projects

The structured change will be given effect through a suitable suite of change projects. The required projects have been determined and are separately documented. These include some preliminary projects that are intended to establish the support necessary to initiate and manage the required change.

Of note is that one of the projects scheduled for early in the two-year planning period is that concerning a series of *value management studies*. The studies will focus on the management of specific Shire assets, selected to give coverage to the different phases of an asset life cycle – from an asset that is still in the planning phase, for which funding has yet to be committed, through to the disposal of a "surplus to requirements" asset.

This project is intended to achieve several objectives:

- Address the more significant asset management issues currently before the Shire.
- Better acquaint key staff and stakeholders with the size and seriousness of the asset management situations with which it must deal.

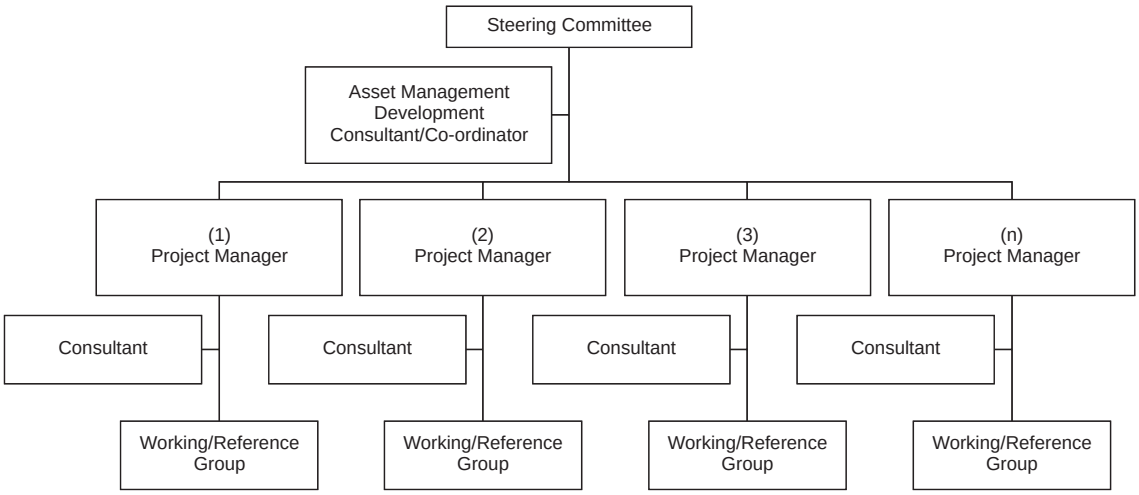
- Demonstrate the decreasing extent to which the total life-cycle cost potential of an asset can be influenced as it progresses through its life cycle.
- "Sell" *value management* as a useful asset management technique.
- "Create" sufficient savings to fund the asset management development programme.

Change management structure

In order to progress the structured change it is also necessary to provide an appropriate change management structure. A suitable structure is shown in Figure 5. Key features are:

- Steering Committee.
- Asset Management Development Consultant/Co-ordinator.
- Project Teams (Project Manager, Consultant and Working/Reference Group).

Figure 5. **Change management structure for development of asset management**



Note: Extensive use of external expertise (secondments/consultants).
Steering Committee – to include external Asset Management expertise.

A key theme inherent in the change management structure is that it will facilitate the transfer of knowledge acquired through the course of each project to key staff. This will better equip them for the successful implementation of required change.

Change management process

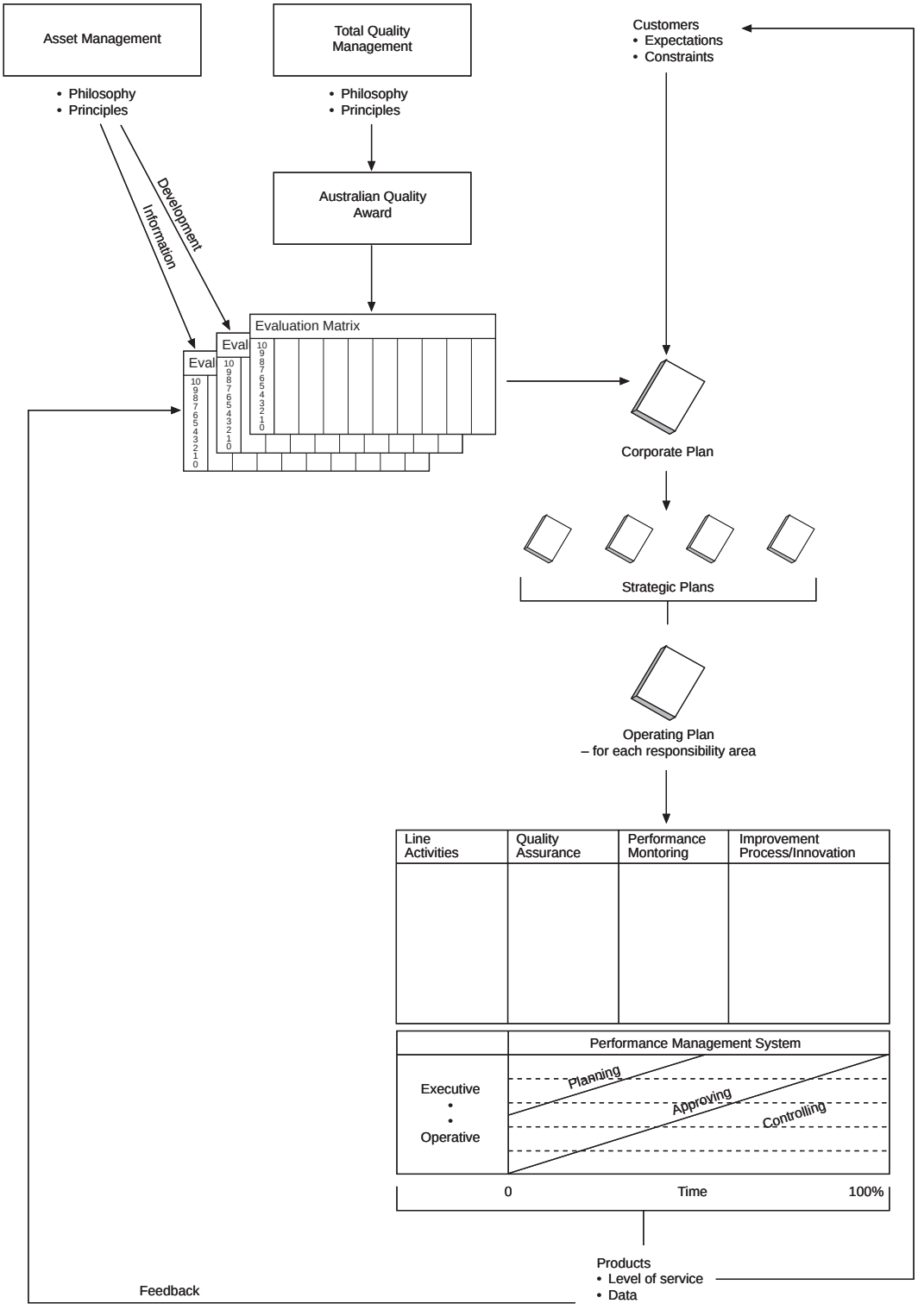
In support of the change management structure is a change management process. This is shown in Figure 6.

In essence, Figure 6 shows the basic organisational process of translating customer expectations and constraints through corporate, strategic and operating plans into products that provide a particular level of service. This results in feedback to customers, which in turn shapes the formation of revised expectations and constraints.

In addition however, the feedback also provides a basis to further develop the organisation and improve its performance. To this end, the philosophy and principles of TQM as interpreted through the Australian Quality Award into an evaluation matrix, give guidance to best target organisational development effort.

TQM and the related evaluation matrix concerns the organisation overall, as does asset management. In effect then, the asset management development and information frameworks are more focused interpretations of the TQM evaluation matrix – based on the compatible philosophy and principles of asset management (especially in regard to customer focus and data-based decision making). Collectively then, the three evaluation matrices/frameworks enable organisation performance to be improved in a coherent, consistent and co-ordinated manner.

Figure 6. **Change management structure**



Source : Shire of Swan, Western Australia.

Conclusion

The project resulted in a "Getting Started" asset management development model suitable for the Shire of Swan. It has been endorsed by the Steering Committee and implementation is already proceeding. The model is of a form that allows further refinement through use by key Shire staff as their understanding of asset management increases and so is a dynamic management device.

The model cost approximately AUD 10 000 in consulting related charges and identifies approximately AUD 90 000 of further work for each of the next two years. As already mentioned, it is intended to identify "savings" sufficient to fund proposed development programme through the use of *value management studies* that, among other things, will seek to address major asset management issues of current concern to the Shire. In any event, however, the costs need to be considered in the context of a Shire which has in recent years committed in the order of AUD 7 000 000 per year on capital expenditure (excluding roads, footpaths and drains) and has building assets alone that are worth well over AUD 30 000 000. The benefit to cost ratio of the Shire's investment in the model through improved asset management decisions is confidently expected to be very high.

Overall, the asset management development model provides an expedient means for any organisation to achieve best practice.

Project success

The project to devise the asset management development model is considered to have been successful because:

- Key staff of the Shire of Swan were closely involved and so understand the model and are keen for it to be applied.
- The model allows the many change initiatives concerning the Shire to be managed in a consistent co-ordinated manner.
- The project goal was achieved within the agreed tight time frame and with minimal disruption to the work routines of Shire staff.

Overall, in a relatively short time period, the project has served to instil key staff with considerable interest in asset management. It has also provided them with a means of harnessing that interest to good effect.

Table 22. **Innovative elements of the asset management development model**

Innovative element	Details
All asset types are recognised.	This is particularly relevant given that the natural environment and less tangible assets such as intellectual property (technology) and corporate reputation are rapidly becoming more significant to business success.
	Land use structure plans are presented in terms of being a key strategic "driver" to service delivery planning – which is especially relevant to the context within which local governments operate.
An ideal "end state" best practice is described.	Including for the information aspect of asset management.
	Which allows formulation of an appropriate "vision" by key staff.
The staged adoption of progressively more advanced asset management practices is provided for.	Through the asset management development framework.
	Supported by the asset management information framework.
The structured change approach that is described shows the shift in emphasis from addressing the backlog of major asset management issues toward a more proactive continuous improvement approach.	Capitalising on the use of value management studies to simultaneously address the major asset management issues, to increase the awareness of key staff as to size and seriousness of the asset management function and also to identify cost savings sufficient to fund the asset management development programme.
The change management structure promotes a project team approach, which allows a progressive transfer of external asset anagement expertise to key staff within the organisation.	Resulting in higher perceived ownership and so likelihood of successful adoption of the required change.
The change management process allows integration of asset management development initiatives with those concerning other aspects of the organisation.	Within the well-proven total quality management approach.

Relevance to other organisations

Whilst devised specifically for the Shire of Swan, the asset management development model has potential application to any organisation. This is a consequence of the model being deliberately designed to be generic so as to cater for the many and varied asset management situations of interest to the Shire of Swan.

In essence, the asset management development model is a dynamic device for use by the executive and senior management team of any organisation. It will allow key staff to confidently determine the detail of asset management development for their particular organisation by robustly ensuring that the appropriate direction is pursued.

The direction however, is consistent for all organisations. The very high potential for use of the model by other organisations is therefore quite apparent.

Innovative elements

The asset management development model that has been devised has several elements that are considered to be innovative. These are shown in Table 22.

Appendix 8

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