This is the third edition of the International Infrastructure Management Manual.

This Manual was developed with public and private sector industry input from Australia, New Zealand, United States, South Africa and the United Kingdom. It was developed to promote best management practice for all infrastructure assets regardless of ownership or location.

Important Note to Readers
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FOREWORD

We are pleased to support this global public works industry initiative which has resulted in the development of the latest edition of the International Infrastructure Management Manual.

This 2006 edition of the manual has been a truly international effort to ensure the manual represents best modern practice across the globe. Industry working parties in the United Kingdom, United States and South Africa have supported the New Zealand and Australia original initiative and provided case studies and theories which reflect the best infrastructure management approaches in the respective countries.

Infrastructure networks, such as our transport, water utility and power supply systems, represent a vast investment, made over many generations by both public and private sector organisations that support the fabric of modern living in our communities. It is important that we employ the very best management skills and practices to ensure that related services are delivered economically and sustainably.

There has been a growing recognition that it is not sustainable to focus on meeting infrastructure needs through investment in infrastructure creation, without recognising the long-term lifecycle costs associated with the ongoing operation, maintenance and renewal of their networks. Improving the management of infrastructure can bring major benefits by ensuring that scarce resources are used in the most cost-effective manner, thereby enhancing economic growth, improving living standards and improving environmental sustainability.

The effects of major infrastructure failures often dramatically focus attention on the need to understand and manage the consequences of such events. This Manual provides guidelines for organisations to manage all areas of infrastructure risk, develop and operate sustainable asset networks and deliver the required services to our communities at the lowest lifecycle cost.

The Manual authors have ensured that this 2006 edition, whilst representing the most advanced infrastructure management practices, is also accessible to managers starting out on the 'asset management' process. Each sub-section provides a brief overview of the theory, how to get started, and what would be expected in a first asset management plan. Case studies illustrate both core and advanced approaches tailored to the size and complexity of the organisation.

We commend this Manual to all public and private sector organisations and persons involved in providing services based on the effective use of infrastructure assets.

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ABOUT THE MANUAL

This Manual is divided into five sections:

Section 1: Introducing Infrastructure Asset Management
The benefits that infrastructure managers will gain from using the techniques described in this Manual are outlined in this section. It introduces the concepts of holistic Asset Management (asset management as an integrated part of all organisations' activities) and Lifecycle Asset Management (decisions are made based on costs associated with all stages of an asset's life).

Section 2: Asset Management Framework and Implementation
This section describes the principles and processes for successfully implementing asset management planning. It is designed to help asset managers to progress quickly through the steps of developing meaningful asset management plans and establishing a framework for the ongoing enhancement of asset management plans to meet real business needs.

Section 3: Enabling Processes for Asset Management
Section three contains details of asset management standards, guidelines, techniques and references together with examples of key asset management activities such as:
- developing and consulting
- on service levels
- demand forecasting
- and management
- performance monitoring
- optimised decision-making
- maintenance management planning
- risk management methods
- condition assessment
- financial management planning and reporting

Section 4: Asset Management Information Systems and Data Management
This section advises how to evaluate and implement information systems to support good asset management planning and decision-making. The section includes guidelines for good data capture and ongoing data management processes.

Section 5: Country Specific Issues
This section provides separate country specific information for Australia, New Zealand, United States, South Africa and the United Kingdom outlining the current context of infrastructure asset management planning practices in each country, the relevant drivers, legislation, regulations and related documents which support this Manual.
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GLOSSARY

The following terms and acronyms (in brackets) are used in this Manual.

**ACCURAL ACCOUNTING**
Recognition of revenues as they are earned and expenses as they are incurred.

**ACTIVITY**
An activity is the work undertaken on an asset or group of assets to achieve a desired outcome.

**ADVANCED ASSET MANAGEMENT (AAM)**
Asset management which employs predictive modelling, risk management and optimised decision-making techniques to establish asset lifecycle treatment options and related long term cashflow predictions. (See Core Asset Management).

**ANNUAL PLAN**
A document produced annually by an organisation to inform stakeholders of its objectives, intended activities, performance, income and expenditure required for a period of one financial year. It may also indicate anticipated future short-term income and expenditure.

**ASSET**
A physical component of a facility which has value, enables services to be provided and has an economic life of greater than 12 months. Dynamic assets have some moving parts, while passive assets have none.

**ASSET HIERARCHY**
A framework for segmenting an asset base into appropriate classifications. The asset hierarchy can be based on asset function, asset type or a combination of the two.

**ASSET MANAGEMENT (AM)**
The combination of management, financial, economic, engineering and other practices applied to physical assets with the objective of providing the required level of service in the most cost-effective manner.

**ASSET MANAGEMENT CO-ORDINATOR**
The person appointed by an organisation to ensure the corporate asset management goals, objectives and legal obligations are met. The asset management co-ordinator may also be required to lead the asset management team.

**ASSET MANAGEMENT INFORMATION SYSTEM**
An asset management system is a combination of processes, data and software applied to provide the essential outputs for effective asset management such as reduced risk and optimum infrastructure investment.

**ASSET MANAGEMENT PLAN**
A plan developed for the management of one or more infrastructure assets that combines multi-disciplinary management techniques (including technical and financial) over the lifecycle of the asset in the most cost-effective manner to provide a specified level of service. A significant component of the plan is a long-term cashflow projection for the activities.

**ASSET MANAGEMENT STRATEGY**
A strategy for asset management covering the development and implementation of plans and programmes for asset creation, operation, maintenance, rehabilitation/replacement, disposal and performance monitoring to ensure that the desired levels of service and other operational objectives are achieved at optimum cost.

**ASSET MANAGEMENT TEAM**
The team appointed by an organisation to review and monitor the corporate asset management improvement programme and ensure the development of integrated asset management systems and plans consistent with organisational goals and objectives.

**ASSET REGISTER**
A record of asset information considered worthy of separate identification including inventory, historical, financial, condition, construction, technical and financial information about each.

**BASIC ASSET MANAGEMENT**
(See Core Asset Management.)

**BENEFIT-COST RATIO (B/C)**
The sum of the present values of all benefits (including residual value, if any) over a specified period, or the lifecycle of the asset or facility, divided by the sum of the present value of all costs.

**BROOKES LAW**
A method of assessing tenders for contracts where tenders are assessed solely on non-price (quality) attributes, and price negotiations are entered into with the highest attribute scorer.

**BUSINESS PLAN**
A plan produced by an organisation (or business units within it) which translates the objectives contained in an Annual Plan into detailed work plans for a particular, or range of, business activities. Activities may include marketing, development, operations, management, personnel, technology and financial planning.
CAPITAL EXPENDITURE (CAPEX)
Expenditure used to create new assets or to increase the capacity of existing assets beyond their original design capacity or service potential. CAPEX increases the value of asset stock.

CASH FLOW
The stream of costs and/or benefits over time resulting from a project investment or ownership of an asset.

CLOSED CIRCUIT TELEVISION (CCTV)
A method of inspecting pipes by sending a mobile camera along the length of the pipe to visually record the interior.

COMPONENTS
Specific parts of an asset having independent physical or functional identity and having specific attributes such as different life expectancy, maintenance regimes, risk or criticality.

CONDITION-BASED PREVENTIVE MAINTENANCE
Preventive maintenance initiated as a result of knowledge of an items condition from routine or continuous monitoring.

CONDITION MONITORING
Continuous or periodic inspection, assessment, measurement and interpretation of the resultant data, to indicate the condition of a specific component so as to determine the need for some preventive or remedial action.

CORE ASSET MANAGEMENT
Asset management which relies primarily on the use of an asset register, maintenance management systems, job/resource management, inventory control, condition assessment, simple risk assessment and defined levels of service, in order to establish alternative treatment options and long-term cashflow predictions. Priorities are usually established on the basis of financial return gained by carrying out the work (rather than detailed risk analysis and optimised decision-making).

CORRECTIVE MAINTENANCE
The remedial actions performed as a result of failure, to restore an item to a specified condition. Corrective maintenance may or may not be programmed.

CRITICAL ASSETS
Assets for which the financial, business or service level consequences of failure are sufficiently severe to justify proactive inspection and rehabilitation. Critical assets have a lower threshold for action than non-critical assets.

CURRENT ASSETS
Those assets which are expected to be realised in cash or sold or consumed within one year of an organisation’s balance date.

CURRENT NET REALISABLE VALUE
The net value obtained upon sale.

CURRENT REPLACEMENT COST
The cost of replacing the service potential of an existing asset, by reference to some measure of capacity, with an appropriate modern equivalent asset.

DATA WAREHOUSE
A system that is used to centralise a group of disparate databases in an organisation to facilitate access into each of those databases.

DECOMMISSION
Activities required to take an asset out of service.

DEFERRED MAINTENANCE
The shortfall in rehabilitation work required to maintain the service potential of an asset.

DELPHI APPROACH
A group decision-making technique where a number of people are asked their opinions, which are then analysed to produce a best fit result.

DEMAND MANAGEMENT
The active intervention in the market to influence demand for services and assets with forecast consequences, usually to avoid or defer CAPEX expenditure. Demand management is based on the notion that as needs are satisfied expectations rise automatically and almost every action taken to satisfy demand will stimulate further demand.

DEPRECIATED REPLACEMENT COST (DRC)
The replacement cost of an existing asset less an allowance for wear or consumption having regard for the remaining economic life of the existing asset.

DEPRECIATION
The wearing out, consumption or other loss of value of an asset whether arising from use, passing of time or obsolescence through technological and market changes. It is accounted for by the allocation of the cost (or revalued amount) of the asset less its residual value over its useful life.

DEPRIVAL VALUE
The value of an asset to the present owner if the owner were deprived of the asset and was required to continue to deliver the same level of service. Assets are valued at an amount that represents the entire loss that might be expected to be incurred if the entity were deprived of the service potential or future economic benefits of particular assets at the reporting date. This is a valuation basis that reflects a non-market concept of the value in use of assets as part of a going concern.

DETERIORATION RATE
The rate at which an asset approaches failure.
DISCOUNTING
A technique for converting cash flows that occur over time to equivalent amounts at a common point in time.

DISCOUNT RATE
A rate used to relate present and future money values, e.g. to convert the value of all future dollars to the value of dollars at a common point in time, usually the present.

DISPOSAL
Activities necessary to dispose of decommissioned assets.

ECONOMIC LIFE
The period from the acquisition of the asset to the time when the asset, while physically able to provide a service, ceases to be the lowest cost alternative to satisfy a particular level of service. The economic life is at the maximum when equal to the physical life, however obsolescence will often ensure that the economic life is less than the physical life.

ECONOMIC VALUE
An assets discounted cashflow value derived by discounting the free cashflow of the asset by an appropriate risk adjusted discount rate.

EQUITY
The residual interest in the assets of the entity after deduction of its liabilities.

FACILITIES AUDIT
The physical audit of a facility, usually required for valuation, lifecycle cost analysis, short-term maintenance planning and long-term planning purposes.

FACILITY
A complex comprising many assets (e.g. a hospital, water treatment plant, recreation complex, etc.) which represents a single management unit for financial, operational, maintenance or other purposes.

FAILURE MODES, EFFECTS AND CRITICALITY ANALYSIS (FMECA)
A technique for analysing and evaluating a maintenance strategy or life-cycle strategy to ensure that the application has the desired reliability characteristics by obviating those critical failure modes through employment of redundancy, providing alternate modes of operation, derating, or any other means.

FAIR VALUE
The amount for which an asset could be exchanged, or a liability settled, between knowledgeable, willing parties in an arm's length transaction.

FINANCIAL REPORTING STANDARDS (FRS)
Reporting Standards approved by the Council of the New Zealand Society of Accountants for application for all financial reporting.

FINANCIAL STATEMENTS
Balance sheets, profit and loss accounts, statements of changes in financial position, notes and other statements which collectively are intended to give a true and fair view of the state of affairs and profit or loss for an entity for a defined period.

FOCUS GROUP
A method of consulting with customers about the service provided. A focus group typically comprises 6 to 8 people, invited to participate in a discussion about a specified topic.

GAP ANALYSIS
A method of assessing the gap between a business’s current asset management practices and the future desirable asset management practices. Also called needs analysis.

GENERALLY ACCEPTED ACCOUNTING PRACTICES (GAAP)
Approved financial reporting standards so far as those standards apply to a particular entity; or, where there are no approved standards, accounting policies that are appropriate to the entity and have authoritative support within the accounting profession.

GEOGRAPHIC INFORMATION SYSTEM (GIS)
Software which provides a means of spatially viewing, searching, manipulating, and analysing an electronic database.

INFLATION RATE
A rate of increase applied to costs incurred at a future date to reflect the relative purchasing power of money relative to a particular time, usually the present.

INFRASTRUCTURE ASSETS
Stationary systems forming a network and serving whole communities, where the system as a whole is intended to be maintained indefinitely at a particular level of service potential by the continuing replacement and refurbishment of its components. The network may include normally recognised ordinary assets as components.

INTERNAL RATE OF RETURN
The discount rate for which the net present value is zero.

KEY PERFORMANCE INDICATOR
A qualitative or quantitative measure of a service or activity used to compare actual performance against a standard or other target. Performance indicators commonly relate to statutory limits, safety, responsiveness, cost, comfort, asset performance, reliability, efficiency, environmental protection and customer satisfaction.
LEVEL OF SERVICE
The defined service quality for a particular activity (i.e. reading) or service area (i.e. streetlighting) against which service performance may be measured. Service levels usually relate to quality, quantity, reliability, responsiveness, environmental acceptability and cost.

LIFE
A measure of the anticipated life of an asset or component, such as time, number of cycles, distance intervals, etc.

LIFECYCLE
The cycle of activities that an asset (or facility) goes through while it retains an identity as a particular asset i.e. from planning and design to decommissioning or disposal.

LIFECYCLE COST
The total cost of an asset throughout its life including planning, design, construction, acquisition, operation, maintenance, rehabilitation and disposal costs.

LIFECYCLE COST ANALYSIS
Any technique which allows assessment of a given solution, or choice from among alternative solutions, on the basis of all relevant economic consequences over the service life of the asset.

LOWEST PRICE CONFORMING (LPC)
A method of assessing tenders for contracts where the lowest priced tender that passes a minimum set standard for non-price attributes is accepted.

MAINTAINABILITY
A characteristic of design and installation usually identified by the time and effort that will be required to retain an asset as near as practicable to its new or desired condition within a given period of time.

MAINTENANCE
All actions necessary for retaining an asset as near as practicable to its original condition, but excluding rehabilitation or renewal. Fixed interval maintenance is used to express the maximum interval between maintenance tasks. On-condition maintenance is where the maintenance action depends upon the item reaching some predetermined condition.

MAINTENANCE MANAGED ITEM (MMI)
Either an asset or a component of an asset. The MMI level establishes the lowest level of asset that should be recognised and maintained individually. Also known as an item.

MAINTENANCE PLAN
Collated information, policies and procedures for the optimum maintenance of an asset, or group of assets.

MAINTENANCE STANDARDS
The standards set for the maintenance service, usually contained in preventive maintenance schedules, operation and maintenance manuals, codes of practice, estimating criteria, statutory regulations and mandatory requirements, in accordance with maintenance quality objectives.

MARKET VALUE
The estimated amount at which an asset would be exchanged on the date of valuation, between a willing buyer and a willing seller, in an arm's length transaction after proper marketing, and when the parties have each acted knowledgeably, prudently and without compulsion. Market value is based on highest and best use of the asset and not necessarily the existing uses.

MODERN EQUIVALENT ASSETS
Assets that replicate what is in existence with the most cost-effective asset performing the same level of service.

NET PRESENT VALUE (NPV)
The value of an asset to the organisation, derived from the continued use and subsequent disposal in present monetary values. It is the net amount of discounted total cash inflows arising from the continued use and subsequent disposal of the asset minus the value of the discounted total cash outflows.

NON-CURRENT ASSETS
All assets other than current assets, including assets held but not traded by a business in order to carry out its activities. Such assets are intended for use, not exchange, and normally include physical resources such as land, buildings, drains, parks, water supply and sewerage systems, furniture and fittings.

OPERATION
The active process of utilising an asset which will consume resources such as manpower, energy, chemicals and materials. Operation costs are part of the lifecycle costs of an asset.

OPTIMISED DECISION-MAKING (ODM)
Two definitions are: 1. ODM is a formal process to identify and prioritise all potential solutions with consideration of financial viability, social and environmental responsibility and cultural outcomes. 2. An optimisation process for considering and prioritising all options to rectify existing or potential performance failure of assets. The process encompasses NPV analysis and risk assessment.

OPTIMISED DEPRECIATED REPLACEMENT COST (ODRC)
The optimised replacement cost after deducting an allowance for wear or consumption to reflect the remaining economic or service life of an existing asset. ODRC is the surrogate for valuing assets in use where there are no competitive markets for assets, or for their services or outputs.
OPTIMISED DEPRIVAL VALUE (ODV)
This is a set of rules, rather than a valuation approach, which describe the value boundaries for specified assets employed in monopoly markets. The rules are a combination of a cost based approach (ODRC) and the economic value where the ODV is taken to be the lowest of these.

OPTIMISED REPLACEMENT COST (ORC)
The minimum cost of replacing an existing asset with modern equivalent assets offering the same level of service. The optimisation process adjusts the value for technical and functional obsolescence, surplus assets or over-design.

PAYBACK PERIOD
The time it takes for the cumulative benefits or savings of an investment to pay back the original investment and other accrued costs.

PERFORMANCE MONITORING
Continuous or periodic quantitative and qualitative assessments of the actual performance compared with specific objectives, targets or standards.

PLANNED MAINTENANCE
Planned maintenance activities fall into three categories:
(i) Periodic - necessary to ensure the reliability or to sustain the design life of an asset.
(ii) Predictive - condition monitoring activities used to predict failure.
(iii) Preventive - maintenance that can be initiated without routine or continuous checking (e.g. using information contained in maintenance manuals or manufacturers' recommendations) and is not condition-based.

RECOVERABLE AMOUNT
Is the greater of the amount recoverable from an asset's further use and ultimate disposal, and its current net realisable value.

REHABILITATION
Works to rebuild or replace parts or components of an asset, to restore it to a required functional condition and extend its life, which may incorporate some modification. Generally involves repairing the asset to deliver its original level of service (i.e. heavy patching of roads, slippinng of sewer mains, etc.) without resorting to significant upgrading or renewal, using available techniques and standards.

RELIABILITY CENTRED MAINTENANCE (RCM)
A process for optimising maintenance based on the reliability characteristics of the asset.

RENEWAL
Works to upgrade, refurbish or replace existing facilities with facilities of equivalent capacity or performance capability.

REMAINING ECONOMIC LIFE
The time remaining until an asset ceases to provide the required service level or economic usefulness.

REPAIR
Action to restore an item to its previous condition after failure or damage.

REPLACEMENT
The complete replacement of an asset that has reached the end of its life, so as to provide a similar, or agreed alternative, level of service.

REPLACEMENT COST
The cost of replacing an existing asset with a substantially identical new asset.

RESIDUAL VALUE
The net market or recoverable value which would be realised from disposal of an asset or facility at the end of its life.

RISK COST
The assessed annual cost or benefit relating to the consequence of an event. Risk cost equals the costs relating to the event multiplied by the probability of the event occurring.

RISK MANAGEMENT
The application of a formal process to the range of possible values relating to key factors associated with a risk in order to determine the resultant ranges of outcomes and their probability of occurrence.

ROAD ASSESSMENT MAINTENANCE MANAGEMENT SYSTEM (RAMM)
The computerised road maintenance management software system developed by Transit New Zealand for use nationally by all New Zealand road asset managers.

ROUTINE CORRECTIVE MAINTENANCE
Corrective maintenance, excluding emergency corrective and programmed corrective maintenance.

ROUTINE MAINTENANCE
Day-to-day operational activities to keep the asset operating (replacement of light bulbs, cleaning of drains, repairing leaks, etc.) and which form part of the annual operating budget, including preventive maintenance.

SENSITIVITY ANALYSIS
Testing of the variations in the outcome of an evaluation by altering the values of key factors about which there might be uncertainty.

SERVICE MAINTENANCE
Service undertaken seasonally or annually to enable the required level of service to be delivered.
SERVICE POTENTIAL
The total future service capacity of an asset. It is
normally determined by reference to the operating
capacity and economic life of an asset.

STATEMENT OF CASHFLOWS
Disclosure of cashflows from all sources relating to the
operating, financing, and investing activities of the
entity, encompassing all funds maintained by the entity.

STATEMENT OF COST OF SERVICES
Disclosure of the costs incurred for each significant
activity by the reporting entity.

STATEMENT OF FINANCIAL
PERFORMANCE
A report on the net surplus/deficit, and its components,
arising from activities or events during a given period,
that are significant for the assessment of both past and
future financial performance.

STATEMENT OF FINANCIAL POSITION
Disclosure of all assets and liabilities of the entity,
appropriately classified including resources, financing
structure and contingencies.

STATEMENT OF MOVEMENTS IN EQUITY
A reconciliation of the equity of an entity at the
beginning of a period with the equity at the end of that
period.

STATEMENT OF OBJECTIVES
A formal expression of the mission and overall
objectives of the reporting entity.

STATEMENT OF RESOURCES
A description in physical terms of the major resources
held by the reporting entity.

STATEMENT OF SERVICE PERFORMANCE
A report for each significant activity undertaken by the
reporting entity, on the degree of success achieved in
meeting agreed targets, in qualitative and quantitative
terms.

STRATEGIC PLAN
A plan containing the long-term goals and strategies of
an organisation. Strategic plans have a strong external
focus, cover major portions of the organisation and
identify major targets, actions and resource allocations
relating to the long-term survival, value and growth of
the organisation.

UNPLANNED MAINTENANCE
Corrective work required in the short-term to restore
an asset to working condition so it can continue to
deliver the required service or to maintain its level of
security and integrity.

USEFUL LIFE
May be expressed as either:
(a) The period over which a depreciable asset is
expected to be used, or
(b) The number of production or similar units
(i.e. intervals, cycles) that is expected to be
obtained from the asset.

VALUATION
Assessed asset value which may depend on the purpose
for which the valuation is required, i.e. replacement
value for determining maintenance levels, market value
for lifecycle costing and optimised deprival value for
tariff setting.

VALUE IN USE
The value that specific assets contribute to the
organisation of which they are a part, without regard to
the assets’ highest and best use, or the monetary
amount that might be realised upon a sale. It is the
value a specific asset has for a specific use to a specific
user and is therefore non-market related.

VALUE MANAGEMENT
An evaluation process which addresses the technical
and functional dimensions at the early stages of a
project (i.e. establishment of project objectives,
preparation of project brief and consideration of
concept/design options) to ensure a fully integrated
approach has been taken, the project is consistent with
strategic goals, and non-build solutions (including
demand management) have been properly assessed.

WEIGHTED ATTRIBUTE METHOD
A method of assessing tenders for contracts where
attributes relating to both quality and price are
weighted according to the requirements of the business.
# ACRONYMS

The following acronyms also appear in this Manual:

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>AAS</td>
<td>Australian Accounting Standard</td>
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<tr>
<td>AM</td>
<td>Asset Management</td>
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<tr>
<td>AMIS</td>
<td>Asset Management Information System</td>
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<tr>
<td>AMP</td>
<td>Asset Management Plan</td>
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<tr>
<td>B/C</td>
<td>Benefit/Cost</td>
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<tr>
<td>BOO</td>
<td>Build, Own, Operate</td>
</tr>
<tr>
<td>BOOT</td>
<td>Build, Own, Operate, Transfer</td>
</tr>
<tr>
<td>CAD</td>
<td>Computer Aided Design</td>
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<tr>
<td>CAPEX</td>
<td>Capital Expenditure</td>
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<tr>
<td>CCTV</td>
<td>Closed Circuit Television</td>
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<tr>
<td>DCF</td>
<td>Discounted Cashflow</td>
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<tr>
<td>DRC</td>
<td>Depreciated Replacement Cost</td>
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<tr>
<td>FMECA</td>
<td>Failure Modes, Effects and Criticality Analysis</td>
</tr>
<tr>
<td>FMM</td>
<td>Facilities Maintenance Management</td>
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<tr>
<td>GAAP</td>
<td>Generally Accepted Accounting Practices</td>
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<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
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<tr>
<td>GIS</td>
<td>Geographic Information System</td>
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<tr>
<td>HVAC</td>
<td>Heating Ventilation Air Conditioning</td>
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<td>IFRS</td>
<td>International Financial Reporting Standards</td>
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<td>IMM</td>
<td>International Infrastructure Management Manual</td>
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<tr>
<td>IMEASA</td>
<td>Institution of Municipal Engineers in Southern Africa</td>
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<tr>
<td>IMS</td>
<td>Information Management System</td>
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<tr>
<td>IPWEA</td>
<td>Institute of Public Works Engineering, Australia</td>
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<tr>
<td>IQP</td>
<td>Independent Qualified Person (NZ)</td>
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<tr>
<td>IRR</td>
<td>Internal Rate of Return</td>
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<td>KPI</td>
<td>Key Performance Indicator</td>
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<td>LGA</td>
<td>Local Government Act</td>
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<td>LTCCP</td>
<td>Long Term Council Community Plan (NZ)</td>
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<tr>
<td>MEA</td>
<td>Maintenance Engineering Analysis</td>
</tr>
<tr>
<td>MMI</td>
<td>Maintenance Managed Item</td>
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<td>NAASSRA</td>
<td>National Association of Australian State Road Authorities</td>
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<tr>
<td>NAMS</td>
<td>National Asset Management Steering Group</td>
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<tr>
<td>NPV</td>
<td>Net Present Value</td>
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<tr>
<td>ODM</td>
<td>Optimised Decision Making</td>
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<tr>
<td>ODRC</td>
<td>Optimised Depreciated Replacement Cost</td>
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<td>O&amp;M</td>
<td>Operations and Maintenance</td>
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<tr>
<td>ODV</td>
<td>Optimised Deprival Value</td>
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<td>PFI</td>
<td>Private Finance Initiative</td>
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<td>RCM</td>
<td>Reliability Centred Maintenance</td>
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<td>PV</td>
<td>Present Value</td>
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<td>REL</td>
<td>Remaining Economic Life</td>
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<td>ROT</td>
<td>Rehabilitate, Operate, Transfer</td>
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<td>SAC</td>
<td>Statement of Accounting Concepts</td>
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<td>SCADA</td>
<td>Supervisory Control And Data Acquisition System</td>
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<td>SCR</td>
<td>Benefit-Cost Ratio</td>
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<td>SLA</td>
<td>Service Level Agreement</td>
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<tr>
<td>SCRIM</td>
<td>Sideways-force Coefficient Routine Investigation Machine</td>
</tr>
<tr>
<td>SMART</td>
<td>Specific Measurable Achievable Relevant Timebound</td>
</tr>
<tr>
<td>SSAP</td>
<td>Statements of Standard Accounting Practice (NZ)</td>
</tr>
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</table>
SECTION 1: INTRODUCING INFRASTRUCTURE ASSET MANAGEMENT

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   1.1.2 What are Infrastructure Assets?
   1.1.3 What is Infrastructure Asset Management?
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1.5 USING THIS MANUAL TO DEVELOP AN ASSET MANAGEMENT PLAN
1.1 INTRODUCTION

1.1.1 Why Infrastructure Asset Management?

All modern economies are underpinned by a vast infrastructure of roads and other transport systems, water supply, waste disposal, energy, telecommunications, recreational networks and property. The infrastructure of a nation supports the fabric of modern living which is taken for granted until something fails or no longer provides the expected service.

Infrastructure represents a major investment which, in developed countries, has been built up progressively over the last 100 years or longer. This is reason enough for applying the best management skills to ensure that it continues to provide sustainable and economic service.

But there are even more compelling reasons for ensuring that the best practices are applied to our national infrastructure. These include:

Infrastructure networks provide the platform for economic and social development

Before developing countries’ economies can flourish they need a basic infrastructure to provide the foundation for efficient distribution of services; particularly transportation, telecommunications, energy, property, water supply and sanitation.

As an example, the German Government had to invest heavily to develop the telecommunications network in East Germany following reunification in 1990. This was seen as just one precursor to putting East Germany on a more equal footing with surrounding developed economies.

The World Bank has also recognised the link between effective infrastructure and living standards by introducing an Urban and Local Government Strategy. The strategy outlines a vision of Sustainable Cities which are liveable, competitive, well-governed and financially sound. Infrastructure management planning supports this strategy by promoting sustainable use of the physical, as well as natural, environment.

Infrastructure and property assets increasingly meet recreational and other needs of the community

Traditionally parks and open spaces have provided recreation opportunities to the community. Buildings have provided communities with places to meet and celebrate, to obtain information and access to community resources, and to enjoy the arts and cultural activities. Other infrastructure such as telecommunication networks have become a medium (through the Internet) for interaction and general recreation.

Good quality infrastructure is the cornerstone of public health and safety

It is generally acknowledged that the development of a safe drinking water supply as well as waste collection and treatment, are the biggest factors in advancing the overall health of the community and increasing individual longevity. Communication networks have become fundamental to public safety because of their use in emergency response.

Good quality infrastructure mitigates potential adverse environmental impacts of society

The environmental impacts of urban, industrial and rural development are mitigated by the provision of infrastructure to effectively and reliably collect, treat and dispose of contaminants.

Asset management practices advance the sustainability of infrastructure services

There is recognition that simply chasing efficiency improvements leads to false economies in the short-term that aren’t always sustained in the long-term. Efficiency in asset management will assist asset owners to continue to deliver the desired services for as long as required.

Benchmarking condition and performance promotes innovation and efficiencies

By benchmarking the asset management activities of network organisations and developing clear asset management plans linking current and future network condition and performance, organisations have a basis
for promoting innovation through performance-based facilities management contracts.

Thus infrastructure networks not only provide an essential platform for economic advancement, but also increasingly deal with recreational, artistic and cultural pursuits to support the wellbeing of communities.

1.1.2 What are Infrastructure Assets?

Infrastructure assets are stationary systems (or networks) that serve defined communities where the system as a whole is intended to be maintained indefinitely to a specified level of service by the continuing replacement and refurbishment of its components.

Typical infrastructure assets are found in:

- transportation networks (roads, rail, ports, airports)
- energy supply systems (gas/electricity/oil production, transmission and distribution)
- parks and recreation facilities
- water utilities (water supply, wastewater and stormwater systems)
- flood protection and land drainage systems
- solid waste facilities
- educational and health sector facilities
- libraries, administration, and other community facilities
- manufacturing and process plants
- telecommunication networks.

One of the most important features of infrastructure networks is the degree of inter-dependency, not only within a particular asset network, but also from one network to another. The failure of one component within a network may undermine the ability of other networks to perform (for example a water main burst may disrupt traffic on a city street).

1.1.3 What is Infrastructure Asset Management?

The goal of infrastructure asset management is to meet a required level of service, in the most cost effective manner, through the management of assets for present and future customers.

The key elements of infrastructure asset management are:

- taking a lifecycle approach
- developing cost-effective management strategies for the long-term
- providing a defined level of service and monitoring performance
- understanding and meeting the impact of growth through demand management and infrastructure investment
- managing risks associated with asset failures
- sustainable use of physical resources
- continuous improvement in asset management practices.

A formal approach to the management of infrastructure assets is essential in order to provide services in the most cost-effective manner, and to demonstrate this to customers, investors and other stakeholders.

Case Study: Asset Management – UK Approach

Asset management as defined in the Asset Management Standard PAS 55 published by the British Standards Institution is:

"The systematic and coordinated activities and practices through which an organisation optimally manages its physical assets, and their associated performance, risks and expenditures over their lifecycle for the purpose of achieving its organisational strategic plan".

![Figure 1.1.1: Asset Management Process (PAS 55)](Image)

The elements of this definition, which is depicted in Figure 1.1.1 and reflected in the overall structure of this manual, are:

- Asset management philosophy and framework – setting the direction and plans for implementing asset management (Section 2).
- Implementing the Asset Management plan – the optimal programme of capital (asset development and renewals), operational, maintenance and management activities.
- Enabling Asset Management processes (Section 3) and supporting Asset Management systems and data analysis (Section 4) applied to identify needs (level of service and demand) and design these optimal programmes.
1.1.4 The Benefits of Improved Asset Management

Asset management benefits relate to accountability, risk management, service management, and financial efficiency.

Improved governance and accountability by
- demonstrating to owners, customers and stakeholders that services are being managed sustainably and delivered effectively and efficiently
- providing the basis for evaluating and balancing service/price/quality trade-offs
- improving accountability for use of resources through published performance and financial measures
- clear audit trail for the appropriateness of decisions taken and the associated risks
- providing the ability to benchmark results against similar organisations.

Enhanced service management and customer satisfaction through
- improved performance and control of service delivery to the required standards
- improved understanding of service requirements and options
- formal consultation/agreement with users on the service levels
- a more holistic approach to asset management within the organisation, through multi-disciplinary management teams.

Improved risk management by
- assessing the probability and consequences of asset failure
- addressing continuity of service
- addressing the inter-relationships between different networks (a chain is only as good as its weakest link) and risk management strategies.

Improved financial efficiency by
- improved decision making based on costs and benefits of alternatives
- prioritisation of investments, interventions and asset care activities
- justification for forward works programmes and funding requirements
- recognition of all costs of owning/operating assets over the lifecycle of the assets.

More sustainable decisions by
- improved decision making considering all viable options (including demand management) and all aspects of decisions.

1.1.5 Catalysts for Improved Asset Management Practices

The overall importance to a community of its infrastructure should be a sufficient driver for more formalised asset management practices. In real life, however, it is often the chance events (failures) which put into focus what should have been done all along.

In many countries the following events and trends have emerged as catalysts for providing a better standard of infrastructure management:
- In many cases utility and other networks are thought to be nearing the end of their economic life.
- Little systematic analysis has been done to gain reliable information about the condition and

Case Study: Benefits of Asset Management Planning

In Australia, substantial demonstrable benefits have been achieved by the country’s major urban utilities in service reliability, lower life cycle costs, reduced risk exposure and improved overall service levels to customers.

For example, Hunter Water Corp. (serving nearly 500,000 people on the East Coast) has:
- Cut operating costs per property by more than 40% (refer figure).
- Reduced capital expenditure by US$185 million (about 4 years of planned capital expenditure).
- Reduced real costs per property by 34% in terms of revenue charged.
- Improved the level of service by reducing the number of properties with low pressure from 4800 properties in 2000 to 1700 in 2004.

Figure: Australian water industry and Hunter Water: Reduction in operating costs per property.
performance of out-of-sight infrastructure assets to support maintenance and renewal decisions.

- Environmental regulators are applying stricter criteria.
- Financial regulators are insisting that local governments recognise and equitably recover the full costs of owning and operating infrastructure over the life of the assets, and that both public and private sector network operators fully justify their capital and operations expenditure programmes and related price structures.
- Failure of networks to deliver services through not acknowledging the twin issues of lack of strategic thinking causing such failures and poor response to them (Auckland power crisis, Melbourne gas failure and Sydney water supply scare).
- Increased customer expectations resulting from greater awareness of regulatory requirements, consumer rights and the reasons for previous service failures.
- New output measures and performance indicators being used by regulators have triggered fundamental questions about what is necessary to do in order to influence these deliverables.
- New technology is providing asset owners with increasing capability to monitor, evaluate and optimise asset management activities and expenditure.

An example from the UK of drivers for strengthening Asset Management practice comes from the North Sea oil and gas industry, which faced survival challenges following oil price reductions, major safety incidents, new legislation and market deregulation. These factors combined to force a fundamental reappraisal of business models and cost-effectiveness in the short and long terms.

The integration of competing business drivers to form a sustainable optimum compromise was found to generate significant net benefits for the industry, including the creation of small company culture (flexibility, clarity of focus & efficiencies) while retaining the momentum and strength of large organisations.

1.1.6 Purpose of this Manual

This Manual outlines a formal systematic process for infrastructure asset management.

Asset Management is a generic discipline and the authors have sought to align the content of this Manual with the principles and expectations embodied in other international standards and guidelines, including the British Standard PAS 55.

The Manual includes a tool-kit of approaches that can be used to undertake asset management activities.

The Manual is not only oriented toward the asset managers within an organisation which owns and/or operates one or more infrastructure networks. Because of the multi-disciplinary nature of asset management, executive management as well as financial, information technology, and planning specialists will also benefit greatly from this Manual.

Case Study: The Benefits of Asset Management Planning

Developing Strategic Asset Management Plans

Hydro Electric Corporation (Hydro) has developed the first of several proposed strategic asset management plans for the future management of critical elements in its electricity supply chain. The plan comprises a comprehensive assessment of transformer condition, risk exposure, future maintenance, and management strategies to minimise lifecycle costs.

The assessment of the situation prior to adopting this process was:

- Less than optimal maintenance practices in the past.
- Limited quality knowledge of condition and performance.
- Ageing assets approaching the at-risk phase of the lifecycle.
- The magnitude of lost income due to asset failure.

Project objectives for the asset management strategy development were:

- Develop high level corporate policies for the future management of critical switchyard assets.
- Assess the condition of all hydro power transformers.
- Determine a strategic asset management plan based on the power transformer policy, quantifying business risk exposure and strategies to mitigate risk to an acceptable level.
- Develop lifecycle management strategies for transformers.
- Produce an optimised refurbishment and replacement expenditure profile for transformers over the next ten years.
- Develop a user-friendly condition assessment and prioritisation tool for field personnel and management reporting.

This first plan is expected to result in an overall cost saving of 30% ($3 million) over the next 10 years.

By adopting this plan, Hydro will:

- Extend the nominal transformer service life by 13%.
- Achieve a reduction of risk exposure in the order of 60%.
- Marginally reduce transformer refurbishment expenditure, but rearrange priorities.
- Significantly defer transformer replacement expenditure by 68% due to life extension.
- Reduce the existing 79 transformers to 64 and maintain an average transformer age profile of 35 to 40 years.

Source: AMQ International, Issue 22, Nov 99, by Hydro Electric Corporation, Australia
1.2 TOTAL ASSET MANAGEMENT PROCESS

1.2.1 The Planning Process

The scope of asset management activities extends from the establishment of an asset management policy and the identification of service level targets which match stakeholder expectations and legal requirements, to the daily operation of facilities required to meet the defined level of service.

The process of linking legal and stakeholder requirements and expectations to implementing the optimum operational activities for the business is achieved through the asset management planning process illustrated in Figure 1.2.1. Underpinning asset management decision-making at each stage and the monitoring and review process is asset data and asset information systems.

The identification, assessment and control of risk is a key focus at all levels of planning, with the results from this process providing inputs into the asset management strategy, policies, objectives, processes, plans, controls and resourcing.

1.2.2 Strategic Planning

Strategic plans typically have a 10-25 year horizon for financial planning purposes, although asset managers may look well beyond this period in order to fully assess optimum lifecycle strategies. Strategic plans represent the translation of legal and stakeholder requirements and expectations into service outcomes and an overall long-term strategy.

The main components of the strategic planning process are:

- The development of vision, mission and values statements which describe the long-term desired position of the organisation and the manner in which the organisation will conduct itself in achieving this.
- A review of the operating environment, to ensure that all elements that affect the organisation's activities have been considered. Such elements include corporate, community, environmental, financial, legislative, institutional and regulatory factors.
- Identification and evaluation of strategic options to achieve strategic goals arising from the vision and mission statements.
- A clear statement of strategic direction, policies, risk management and desired outcomes.

Figure 1.2.1: The Total Asset Management Process
Public sector strategic plans may give weighting to environmental, social and economic factors in determining strategic goals, whereas private sector owners will typically place the most emphasis on economic factors. The determination of levels of service in terms of criteria such as quality, quantity, timeliness and cost provides the link between the strategic plan and the tactical plans outlined in Figure 1.2.2.

The asset management planning process will need to be aligned with the corporate business plan cycles (strategic planning and/or financial reporting or other criteria imposed by regulation).

1.2.3 Asset Management Policy

Asset management policy and strategy development translates an organisation's broad strategic outcomes and plans into specific objectives, targets and plans relevant to a particular portion of the organisation.

An adopted asset management policy provides the framework which, together with the organisational strategic plan, enables the asset management strategy and specific asset management objectives, targets and plans to be produced.

1.2.4 Asset Management Tactical Planning

Tactical planning involves the application of detailed asset management processes, procedures and standards to develop separate sub-plans that allocate resources (natural, physical, financial, etc.) to achieve strategic goals through meeting defined levels of service.

These processes, procedures and standards cover the following asset management activities:
- managing asset management information systems, information and data – (asset attributes, location, condition, performance, capacity/ utilisation, risk, lifecycle costs, maintenance history, etc.)
- risk identification, assessment and control
- optimised decision-making
- setting asset management objectives, including technical and customer service levels (including customer consultation), legal and regulatory, financial
- asset performance and condition monitoring
- operational control: plans, procedures.

Depending on an organisation's purpose, different tactical plans may have varying priorities. For example, owners of infrastructure assets are usually directly concerned with asset management plans and customer service plans, which then become an input into other tactical (resource allocation) plans.

Asset management plans are tactical plans for managing an organisation's infrastructure and other assets so as to cost-effectively achieve the organisation's strategic goals in the long-term. Figure 1.2.2 illustrates how asset management plans relate to other organisational plans.

1.2.5 Operational Planning

Operational plans generally comprise detailed implementation plans and information with a 1-3 year (short-term) outlook. Examples of operational plans include local authority annual plans and departmental or activity business plans. These plans typically provide
firm direction for a 12-month period plus 2 year indicative plans, and emphasise practical rather than visionary elements.

Operational plans typically cover:
- operational control to ensure delivery of asset management policy, strategy, legal requirements, objectives and plans
- structure, authority and responsibilities for asset management
- Staffing issues - training, awareness and competence;
- consultation, communication, documentation; ta/ from stakeholders and employees
- information and data control
- emergency preparedness and response.

An effective operational plan should:
- correctly reflect priorities arising from tactical plans
- deliver defined levels of service cost-effectively
- be achievable and appropriate to the organisation
- contain appropriate auditable performance measures
- promote efficient and innovative service delivery.

1.2.6 Review and Continuous Improvement

The total asset management process incorporates processes to monitor both the performance of the physical assets and the adequacy, suitability and effectiveness of all asset management planning activities to assess associated risks and drive a continuous cycle of review, corrective action and improvement.

Case Study: The Asset Management Improvement Approach of a USA Water Authority

In 2002 the Orange County Sanitation District Board adopted an Asset Management Strategic Plan and Framework and implemented a programme of asset management improvement projects to work towards achieving the strategic asset management vision.

The initial priority improvement projects undertaken were focused on achieving basic best practice (as characterised in this Manual) in the following activities:

1. Definition of the present and future levels of service requirement and documentation of the key performance indicators linked to the triple bottom line categories—environmental, social and economic.
2. Improvement in the asset inventories (registers).
3. Completion of a robust asset valuation process.
4. Development of a risk exposure model to identify critical assets and prioritise data collection, inspections and preventive maintenance activity.
5. Development of a financial model to produce future expenditure forecasts (operations, maintenance, renewal and capital improvements).

This initial work culminated in the preparation of an asset management plan, which will be updated annually and continually refined as part of the ongoing improvement and implementation of asset management and business planning processes.