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AM 'down under': a focus on Australia

Welcome to the second issue of Water Asset Management International. This issue focuses in particular on the practice of asset management in Australia, with papers from five different utilities and consultants providing an overview of the advanced state of AM uptake 'down under'.

The contribution that Australia is making in this field is underlined in this issue's 'CEO Viewpoint', where Chuck Clarke, of Seattle Public Utilities in the US, sets out how his organisation has embraced asset management and the influence that developments in Australia have had. We also look at: how Melbourne Water adapted its processes to meet the requirements of economic regulation; Ipswich Water's model for making consistent decisions on meter replacement; and feedback from a participant utility, Goulburn Valley Water, on the Water Services Association of Australia's asset management benchmarking project. We also hear from South East Water on implementation of a new 'data warehouse' system, and Jason Cox of UMS Group Global Management Consultants on the latest developments in investment planning and project evaluation. Meanwhile, in this issue's news you can read about Penny Burns' intention to 'take asset management to the streets'.

IWA Specialist Group on Asset Management

Writing in the June issue of IWA magazine Water21, IWA President Laszlo Somlyody called for the formation of a new IWA Water Asset Management Specialist Group. Interested professionals, utilities, utility people, regulators, scientists and others are invited to contact Andrew Speers, Director, Member Services and Programmes: andrew.speers@iwahq.org.uk. Further information will follow in the September issue of Water Asset Management International.

WRc wins World Bank IBNET benchmarking contract

The WRc Group has announced that it has won a second contract with the World Bank to further develop and improve the International Benchmarking Network known as IBNET. The contract value is $300,000 and will be undertaken over the next nine months.

'Benchmarking at a local, national and international level can help all water and sanitation utilities, whatever their developmental status, to measure their performance and identify their shortcomings, find comparators for identifying and sharing best practice and new knowledge as well as driving performance improvement,' comments Simon Gordon-Walker of the WRc Group.

IBNET is an online resource that allows users to access and share data with utilities from dozens of countries and regional groups worldwide. A search option allows users to select specific groups of data from a range including:

- Service Coverage
- Water Production and Consumption
- Assets
- Non-Revenue Water
- Network Performance
- Operating Costs and Staff
- Quality of Service

Users can also define 'peer groups', enabling you to compare the performance of your utility with those that share similar characteristics and operational circumstances. It is also possible to set up a number of different peer groups either based on geographic region, on economic status or type of utility operation, such as water supply only utilities. You can also select individual or groups of indicators.

'By providing the mechanics whereby many national benchmarking schemes are developed and linked in a common framework, IBNET widens the benchmarking horizon, allowing any utility to compare its performance internationally and to access the wealth of data and knowledge available in the sector worldwide,' adds Simon.

Additionally, IBNET is designed to meet the needs of other stakeholders in the water industry. This encompasses governments and public bodies, the regulatory authorities, funding bodies including commercial funders, development institutions and funding agencies, as well as customers.

The value of the network increases with each new partner and data set that is added. More information, and the IBNET Benchmarking Toolkit can be found at www.ib-net.org. ●

water
asset management
INTERNATIONAL

Water Asset Management International is an international newsletter on asset management in water and wastewater utilities. The focus of the newsletter is on the strategic aspects of this developing field, providing utilities with international perspectives on infrastructure planning and maintenance as they seek to deliver cost-effective services to their customers.

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Asset management on the agenda at GWRC workshop

To advance research into water asset management, a Global Water Research Coalition workshop was recently held in Alexandria with the objective: to allow practitioners from Research organisations around the world to meet, to discuss issues of interest and to identify areas where projects could be proposed. Participating coalition members in asset management research include: UKWIR (Lead Agent), AwwaRF, EAWAG, EPA, Kiwa, WERF, WRC-SA and WRF, with remote input from Stowa (Rioned) and WSAA.

The two day workshop was arranged to coincide with a Collaborative Working Session on Asset Management being organised by US EPA, NSF and a number of US utilities in Washington DC. Coordinating the two events in this way ensured maximum global learning and understanding could be taken into account when developing proposed research topics.

Day one of the workshop had a theme of sharing knowledge and agreeing general principles of asset management relating to the water industry. Key areas were agreed, that had to be taken into account when developing a sustainable asset management strategy, as illustrated below.

Day two was devoted to the identification of research proposals for further development and recommendation to the GWRC Board. Research proposals were identified as shown below:

- International Asset Management Framework - making the case for asset management
- Process Map - standard approach to agreeing process and definitions
- Tools Models and Techniques
- Risk Management

These proposals are now being developed in more detail to ensure the objectives of the research are well defined and able to be clearly articulated.

About the GWRC

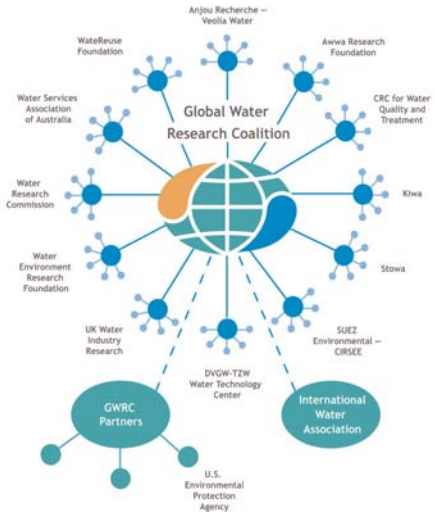
The water industry has become a global community with common issues and concerns arising around the world. Global coordination of research must occur to improve the knowledge and science supporting the invaluable water resources of the world. An actively managed, centralised approach to global issues will allow coordinated research strategies and avoid duplication of efforts.

Twelve world-leading research organisations saw the compelling need for a coordinated effort and have established an international water research alliance: the Global Water Research Coalition (GWRC). GWRC is a non-profit organisation that serves as the collaborative mechanism for water research. The Coalition focuses on water supply and wastewater issues and renewable water resources: the water cycle. The GWRC is dedicated to promoting international cooperation and collaboration in water-related research. The GWRC was officially formed in April 2002 with the signing of the partnership agreement at the International Water Association 3rd World Water Congress.

GWRC plans to expand its membership to enable a good global representation with respect to knowledge and needs of the whole world water community.

Issues of the present GWRC research agenda are: Water Quality and Health (Algal Toxins and Waterborne Pathogens), Emerging Contaminants like Endocrine Disrupting Compounds, Pharmaceuticasl, MTBE and NDMA, and Water Quality in Distribution Systems. New areas which were recently selected are Water Reuse, Asset Management, Wastewater Treatment (membrane bioreactors) and Water Concepts of the Future. ●

Andrew Smith and Frans Schulting
www.globalwaterresearchcoalition.net



The founding members of the Global Water Research Coalition (GWRC)

A simple illustration of the three key areas of consideration when developing a sustainable asset management strategy

The Australian influence

Asset management - a CEO's point of view

Chuck Clarke, Seattle Public Utilities

Internationally, water and wastewater utilities are challenged to manage their assets in an ever-changing regulatory environment, where rate pressures and public scrutiny are inescapable, infrastructure is ageing, and environmental sensitivity is essential.

In early 2002, Seattle Public Utilities (SPU) was acutely aware of the many challenges facing all water and wastewater utilities, but had not yet adopted a corporate strategy to effectively manage them. In response to the need to meet these challenges, SPU began the implementation of a comprehensive asset management programme. Although our asset management concept is years away from reaching full operation, major advances have been achieved that have resulted in immediate and significant benefits to customers.

Asset Management at SPU is defined as: 'Meeting agreed customer and environmental service levels while minimising life cycle costs.' At SPU we now think of asset management as nearly analogous to utility management. Asset management at SPU has been developed around a core philosophy that focuses on the delivery of cost-effective services to customers – today and into the future. Asset management penetrates nearly every facet of our capital and operational resource allocation decision making, including risk management, customer and environmental service levels, trade-offs between capital and O&M dollars, efficiency in our delivery of services, and the tracking and reporting of results.

The Australian Influence

Australian and New Zealand asset management methods have been highly influential. Starting in 2002, with the assistance of Kevin Young, Managing Director of Hunter Water, and Simon Zander, Hunter Water's Asset Manager, SPU has transformed the way infrastructure decisions are made. Based on influence from Kevin and Simon, SPU is now working to:

- Clearly establish customer and environmental service levels along with precise performance indicators
- Assess and quantify risk and consider the likelihood and consequence of failure when making resource allocation decisions,
- Consider life-cycle costs and benefits when making initial investment commitments,
- Assess projects and initiatives based on a triple bottom line approach (wherein we consider financial, social, and environmental costs and benefits);
- Consider the importance of asset data and data systems, and manage our data systems with a corporate focus on asset management needs;
- Clarify roles and responsibilities within the utility (including distinguishing between specifiers and service providers);
- Develop short-term planning documents wherein information about various asset categories is compiled and capital renewal plans are developed along with maintenance strategies;
- Create a more explicit capital resource decision-making body where decisions are made in a transparent manner based on asset management concepts;
- Track, assess, and focus improvement initiatives on efficiency and effectiveness of project management as well as our operations and maintenance activities, and;
- Assess our performance relative to others through benchmarking.

Results to date

The asset management programme has helped reduce operations and maintenance budgets by ten percent, and productivity levels have increased. The utility has reduced its six-year Capital Improvement Program by about $150M – or fifteen percent. Staffing, as measured by regular, temporary, and contract employees has been reduced over the past two years by eight percent. Utility rates have been reduced in comparison to earlier planned levels, cash reserves have increased, and projects are being financed with less reliance on debt.

> ***…asset management penetrates nearly every facet of our decision making…***

Asset management initiatives are integrated into SPU's Strategic Business Plan and budget, and SPU continues to benchmark with other organisations. Capital investment decisions are made based on life-cycle financial, social, and environmental costs and benefits – and the discipline required for this analysis has created more interactions among internal stakeholders when planning for capital improvements.

Most significantly, we believe that we are on a path to permanently change the organisational culture at SPU. We are becoming a 'customer-centric' organisation. We understand the importance of transparency in how we make decisions and the importance of holding ourselves accountable.

The results of an internal survey conducted in February 2005 indicated that staff within *cont:* ➤

biography

CHUCK CLARKE BECAME DIRECTOR of Seattle Public Utilities in January 2002. Prior to joining SPU, Clarke served as one of former Seattle Mayor Paul Schell's two deputy mayors, responsible for issues and projects dealing with utilities, transportation and the environment.

He is the former Regional Administrator for the Environmental Protection Agency and managed its operations in Alaska, Washington, Oregon and Idaho for six years. He worked with community, business, environmental, tribal and local government leaders from the region, dealing with issues ranging from endangered salmon to transportation and growth management.

Clarke has served in a variety of state jobs in Washington, including Director for the Department of Community Development and the Department of Ecology. He also served as Agency Director at the Vermont Agency of Natural Resources.

Clarke grew up in Bremerton, Washington, and earned both a Bachelor of Arts degree and a Masters degree in business administration from Pacific Lutheran University in Tacoma. He is a member of the Board at the Association of Metropolitan Water Agencies and at the Washington Academy of Performing Arts. ●

Washington hosts Advanced Asset Management working session

On May 5-6 2005, Washington DC, approximately 140 water and asset management professionals from 12 countries attended a Working Session to explore opportunities to enhance collaboration by water and wastewater utilities in advancing asset management.

Convened by the US Environmental Protection Agency Office Of Wastewater Management, the session brought together representatives from the water/wastewater industry, academics, professional associations, the research community and the consultant engineering and related consultant sector for two days of intensive collaboration, to develop an agenda for advancing asset management throughout the water industry.

The meeting was the first of its kind to take place in the US, as Steve Allbee of the EPA pointed out: 'In America, this is the first time that we have brought together leading elements of the water and wastewater utilities, education and research interest, consulting and business interest at a session where we have substantially exploration of the opportunities to advance asset management practices. This was, without a doubt, the single most important session that we have held on Asset Management.'

The US EPA set out with the aim of identifying a three to five-year action agenda for the advancement of asset management practices in the water industry and in state and local government.

In view of the disparate interests of the attendees, a series of ballots were held in which participants from each of the sectors represented voted, from a list of approximately 40 'Action items', on their top ten most important action steps. As might be expected, the voting for specific Action items 'varied rather widely based on the sector represented'; however from these polls a final shortlist of ten action items was compiled (see box).

The prevailingtheme that emerged from the meeting was, in the words of Steve Allbee: 'the need for and benefits of knowledge transfer - the effective and efficient accumulation, organization and dissemination of 'best practices' regarding asset management concepts, processes and practices.'

The organisers hope that follow-up sessions will build on the foundations laid at this initial conference.

In the meantime, full details of the organisation of the first session and its outcomes are now available to view online at: www.epa.gov.owm/assets1_management. ●

Top 10 Asset Management Action Items, as voted by Working Session attendees

- Best Practices
- Defining AM/building business cases
- Development of a central depository of high quality data available to researchers
- Develop an international training and resource clearing house
- LOS/AM business model
- Research on tools for cost effective physical conditions assessment including design standards
- Develop uniform national standards for conditions assessment and asset reporting
- Develop common/best practice for risk management framework
- Asset management plans be made requirements for Governent funding
- Culture change

➤ SPU who have been closest to the new asset management capital approval process believe that it has added value, created better decisions, and is a very good change in emphasis for SPU. Employees appreciate the transparency created by the open session decision meetings, and believe that the added rigour now required for investment decisions is a good thing for our customers.

As we continue to make asset management operational at SPU, we are not only focusing on the technical work of asset management, we are also increasing the emphasis on the change in management work that must take place within SPU's work force to embed asset management principles. Leadership is working to enhance the broad ability of SPU to truly operationalise asset management and to create a future where asset management is not just a business model, but our way of doing business.

Conclusion

When SPU management made the decision to implement an asset management program, we sought best practices and made a deliberate decision to launch into what we termed an 'early gains approach'. We felt that a comprehensive gap analysis with the resultant massive programme would 'drown' progress. Instead, we chose to establish a core philosophy, implement key asset management elements, and focus on early gains to build staff confidence. We obtained assistance from peers outside the United States while adopting new techniques.

At SPU we are now nearly three years into our Asset Management programme. There will be continuous improvements and course corrections, but results to date are extremely compelling. We are on a course towards a future that is becoming clearer every day. Our journey, however, is just beginning.

Chuck Clarke
Director, Seattle Public Utilities, USA

Seattle Public Utilities provides water, wastewater, drainage, and solid waste services to customers within Seattle and throughout the region; in total about 1.3 million people receive services from SPU. The utility has an annual operating budget of about $600M, a 6-year capital programme of about $1 billion, a workforce of 1400, and assets totaling about $4.5 billion.

Taking asset management to the streets

ACORN Inc is a new, Australia-based community group with the goal of fostering positive community development through improved communication between decision makers and asset managers. The group does not restrict its scope solely to the water industry, but encourages participation from all parties involved in infrastructure maintenance and development through a raft of innovative communication initiatives. Below Dr Penny Burns of ACORN Inc introduces the group's aims and scope:

'ACORN Inc is a public interest association designed to open the communication lines between community leaders and opinion formers on the one hand and asset specialists on the other, with the aim of generating better infrastructure decisions that are sustainable and support present and future communities. There is, of course, much more to life than infrastructure asset management - but there is very little of that life that does not depend in one way or another on the kind of infrastructure we choose and the way that we maintain it. ACORN Inc is designed for asset specialists who don't want to sit and whinge about being misunderstood but are prepared to do something about communicating; are prepared to listen to what the community really want; and to take a creative look at the way the world might look in the future. Develop Sim City as a training tool, explore being "A Tourist in Your Own Town", take part in Hypotheticals - and join us at ACORN Live!'

Visit: www.acorninc.org

Regulation and Asset Management: driving value within Melbourne Water

Charmaine Quick
Manager M&E Asset Management and Asset Information
Susan Farr
Senior Pricing and Regulatory Analyst
Melbourne Water
Australia

Driving value through asset management makes good business sense. Melbourne Water's approach has evolved over the past 15 years, with strategic leaps being made following:

- Contracting out in the early 1990s
- Process Benchmarking from the mid 1990s
- Asset risk management from the mid 1990s

Economic Regulation introduces rigorous scrutiny of asset management processes, where prices and revenue depend on satisfying four regulatory tests:

- Reasonableness of expenditure to satisfy obligations
- Likelihood that expenditure will deliver outcomes
- Sufficient processes for planning
- Deliverability of proposed expenditure

This paper explores how Melbourne Water's processes have adapted to the requirements of economic regulation and improved value in the latest evolution for asset management.

Melbourne Water is owned by the Victorian Government. We manage Melbourne's water supply catchments, remove and treat most of Melbourne's sewage, and manage rivers and creeks and major drainage systems in and around Melbourne.

Melbourne Water is a significant business, managing $7.9 billion of natural and built assets. The annual operating revenue of more than $520M is earned from water supply, sewage treatment and drainage rates. This is used to fund operational and infrastructure projects including water, sewerage and drainage upgrades, as well as projects to improve and protect Melbourne's rivers and creeks. Melbourne Water is committed to decision-making based on economic, social and environmental considerations.

An independent Board of Directors is responsible for the governance of Melbourne Water. The responsible Minister is the Minister for Water.

Regulation of the Victorian Water Industry

Figure 1 shows the industry structure and regulatory framework for the metropolitan Melbourne water industry.

Technical regulators set the parameters for environmental outcomes and water quality. Supply agreements with the retail water businesses specify customer performance parameters.

The Essential Services Commission (ESC) became the economic regulator for the water industry in Victoria from 1 January 2004. Melbourne Water submitted its first price submission (Water Plan) to the ESC on 1 September 2004. The Water Plan is a comprehensive plan describing Melbourne Water's regulatory and customer service obligations, demand forecasts, planning processes, proposed capital expenditure, operating expenditure, required revenue and tariffs.

The process of preparing the organisation for economic regulation and producing the Water Plan has provided an incentive to improve

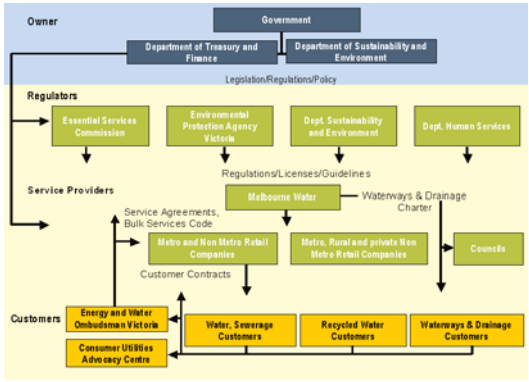


Figure 1 Industry and regulatory framework

Figure 2 Tests applied to expenditure proposals

Test	Description
Reasonableness	That the forecast operational and capital expenditures under existing obligations and service standards are reasonable
Likelihood	That the proposed operational and capital expenditures are likely to meet new obligations and/or higher service levels
Sufficiency	That asset management planning and processes are sufficient for forecasting and long term views
Deliverability	That the proposed programme of expenditure is deliverable over the three year regulatory period

asset management disciplines and transparency.

The ESC review process applied four tests to expenditure proposed in the Water Plan: see Figure 2.

This paper will discuss how Melbourne Water's asset management process has adapted to suit a changed regulatory environment.

Reasonableness Test - Removing shades of grey

Demonstrating 'reasonableness' to a third party introduced a number of new disciplines for Melbourne Water and provided a useful framework for clarifying accountabilities that had previously been 'grey'. Improvements to processes included:

- Documentation of all regulatory and customer service obligations
- Creation of a Statement of Obligations between the Minster for Water Resources and Melbourne Water, clarifying accountabilities for government obligations not regulated through legislation or licences (eg recycling, water conservation, dam safety, risk management, river health, drainage)
- Review of performance indicators and targets
- Consultation process and sign-off from technical regulators (environment, health) and customers of requirements driving expenditure.

Prioritising projects and determining optimum timing is also more transparent and takes account of input from our customers and stakeholders.

Figure 3 describes the prioritisation considerations and stakeholder involvement for different programme/ project drivers.

Demonstrating that proposed expenditure is efficient to a third party has required the capture and documentation of historical and proposed efficiency initiatives for both operating and capital expenditure. It is not enough to know it - you have to be able to show it!

Regulation has improved Melbourne Water's capture and documentation of:

- Contract and procurement savings
- Case studies of innovation
- Value management / engineering improvements
- Process improvements
- IT benefits

This was a bit of a treasure hunt the first time around; however, processes to systematically capture the 'gems' are being implemented.

Likelihood Test – Linking expenditure to outcomes

The regulatory environment requires much stronger linkages between regulatory and customer expectations, planning, expenditure and prices. Figure 4 shows Melbourne Water's Strategic Framework and the linkages between planning, outcomes, expenditure and prices.

A thorough review of business drivers for all capital and operational expenditure helped to demonstrate how expenditure would achieve outcomes, and differentiated between 'business as usual' expenditure to meet existing service standards and 'new obligations' to meet new or improved service standards. Figure 5 shows how new obligations account for 42% of Melbourne Water's capital expenditure during the Water Plan period.

The Water Plan clearly shows which obligations are driving price increases, which has benefited our technical regulator's understanding and appreciation of cost/price implications for changes in standards.

Sufficiency Test – Right tools for the job

Recent benchmarking of Asset Management shows that Melbourne Water's performance is above average and close to best practice in all categories, except asset acquisition: refer Figure 6. The lower performance in this category is due to the lack of standard design processes, which are not generally applicable to headworks infrastructure.

In a regulatory environment benchmarking is a key tool for demonstrating sufficient processes and for identifying improvement opportunities.

Melbourne Water has developed a comprehensive set of asset management processes known as the 'Value Engine' (Figure 7). The Value Engine comprises the policies, frameworks and procedures to deliver outcomes and improve value at all stages of the asset management process. 'Value' can be captured through:

- Improvements in lifecycle costs, asset operability, maintainability
- Protection of environment, people or contractors
- Reduced risk
- Innovation and continuous improvement

The core components of the Value Engine existed prior to economic regulation. The main challenge arising from regulation has been translating internally oriented information and processes to an external audience. Adaptations have included:

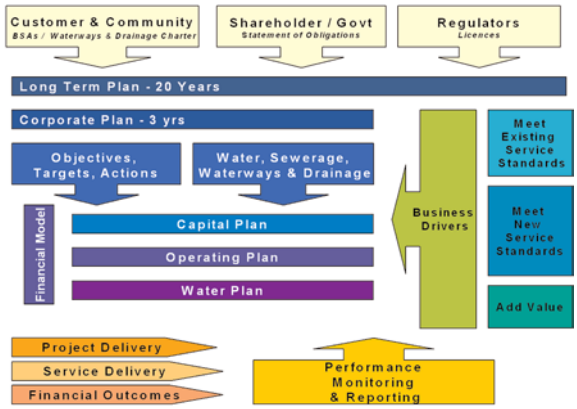


Figure 4
Melbourne Water strategic framework

20 Year Capital Plan Template

A review of the Planning Framework and Capital Investment Policy resulted in changes to the 20 year capital plan template, enabling the assessment of project information from a range of perspectives including:

- Product (Water, Sewerage, etc)
- Programme (Production, transfer, water quality, etc)
- Asset class (water mains, pump stations, etc)
- Primary and secondary business driver (renewals, compliance, growth, etc)

Figure 3
Planning and prioritisation concerns

Driver	Planning and prioritisation considerations	Stakeholders
Meet existing service standards	**Not if but when?**	
Renewals	● Maintenance opportunities optimised? ● Consequences of deferral (residual risk)	● Internal ● Retail water businesses
Growth	● Can demand/peaks be influenced? ● Consequences of deferral (residual risk)	● Retail water businesses ● Developers
Meet new service standards	**Do we have to do it? If so, when?**	
Compliance	● Can timing/standard be negotiated? ● Consequences of deferral (residual risk)	● Technical regulators
Other	● Can it demonstrate positive effficiency gains? ● Will it meet environmental or social strategic objectives? ● Will it mitigate risk? ● Is the community willing to pay?	● Community ● Board

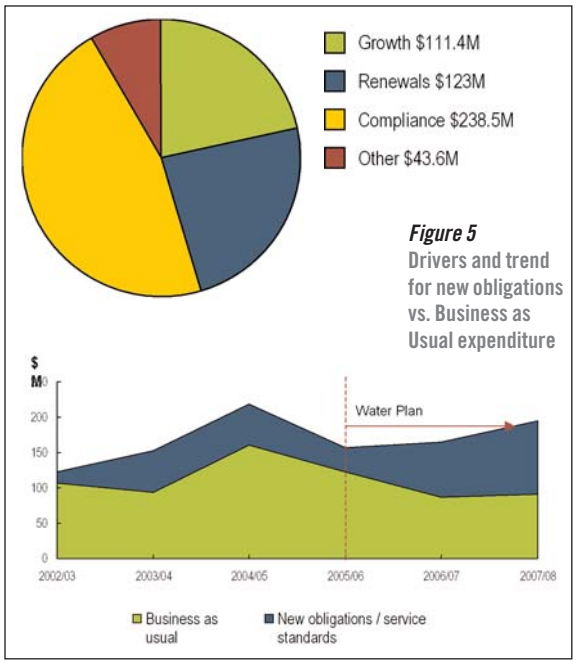


Figure 5
Drivers and trend for new obligations vs. Business as Usual expenditure

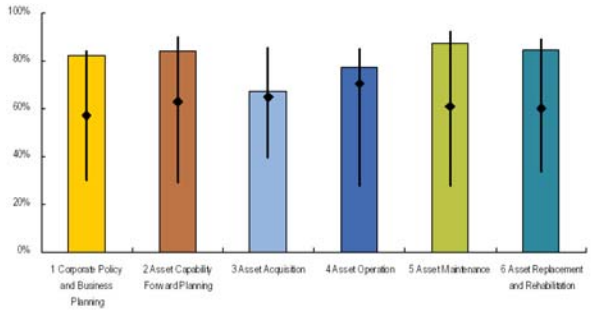


Figure 6
WSAA Asset Management Benchmarking 2004, Melbourne results summary

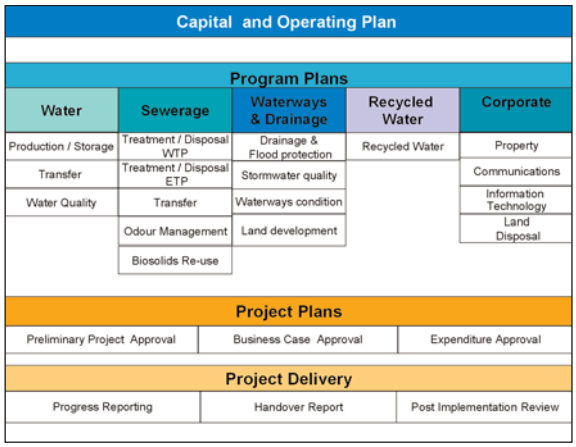


Figure 8
Programme plans, project plans and project delivery

- Business objective (Melbourne Water business objectives)

Programme Plans
A new layer of planning was introduced at a Programme level. Programme Plans provide a strategic perspective and common understanding for stakeholders and regulators for a group of projects without needing to convey the individual details of hundreds of projects (see Figure 8).

Programme Plans summarise the strategic context, performance obligations, historical and future expenditure for significant asset classes and strategies. The age profile and risk assessment of existing assets are used to inform planning for the future, including allocations for renewals.

Programme Plans also help to optimise lifecycle costs by analysing operating and capital expenditure together. Strategies for efficient delivery of common projects and synergies with other programmes are now considered at a programme level.

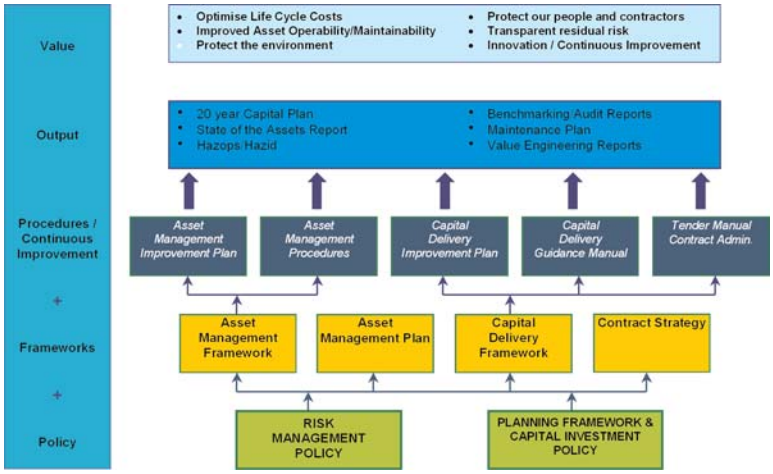


Figure 7
Melbourne Water Value Engine

Maintenance Data
The reporting of operational performance did not require significant modification as we had seven years of detailed costs and future maintenance projections in our asset management information system, 'Hansen'. Data on past efficiencies in maintenance management and the introduction of new assets was easily extracted from the system in a format that could be presented to a regulator.

Figure 9 (overleaf) shows how total maintenance costs have decreased in real terms, despite an increase in the asset base. Better asset management planning and improvements to the maintenance contracts have increased the proportion of scheduled maintenance and improved efficiency.

Deliverability Test – Plan to deliver
Figure 10 shows the forecast capital expenditure for the Water Plan period in the context of actual expenditure over the last four years and the long-term forecast.

The investment profile for the water industry and Melbourne Water in particular can be quite variable due to peaks caused by ageing assets and the size of significant projects.

The capital plan peaks in 2004/05 and 2007/08 are due to aberrations caused by significant individual projects. This capital profile requires a flexible approach to delivery that can be scaled up or down.

The majority of project management and contract management is outsourced, providing flexibility and access to specialised skills through competitive processes as required. Internal resources are focused on the capital programme delivery and development of delivery strategies.

Melbourne Water's Contract Strategy, Capital Delivery Framework and new Project Portfolio Management System (PPMS) aim to improve efficiency and reduce project management risk.

PPMS has been integrated with Melbourne Water's finance system and capital procedures and aims to improve forecasting, scheduling, tracking and process disciplines during the project management process. PPMS captures project information and progress from the inception of the project to handover and post implementation reviews. This will improve management of individual projects and overall oversight of the delivery programme.

Regulation has shifted the delivery focus from spending planned dollars to delivering planned outcomes, more efficiently than planned. Corporate targets, performance plans and culture have had to adapt to this shift. Reporting will need to show how outcomes have been delivered, in addition to time and cost, and track variations from the Water Plan for all three dimensions.

Committing to the delivery of capital plan outcomes four years in advance will be one of the most significant changes. In the past there has been much greater flexibility to reprioritise projects and respond to

customer and stakeholder requirements. Greater discipline will be required as revenue will be fixed for the regulatory period and prices are tied to the delivery of specified outcomes. Unscheduled increases in expenditure will negatively impact Melbourne Water's bottom line and business value. Conversely, innovations that result in outcomes being delivered below budget will result in improved value.

Processes will need to ensure justified variations are accounted for in prices during the next regulatory period. External organisations who contact us mid-cycle are already getting a surprise when we say 'you will have to wait for the next boat'.

The road ahead

Just as we breathe a sigh of relief that the Water Plan has been delivered, the next regulatory cycle looms around the corner. The first Water Plan period was for three years (2005/06 – 2007/08). Future regulatory periods will be for five years. Planning and consultation for the next Water Plan will commence in July 2005. Challenges for asset management going forward include:

- Synchronise planning and consultation with customers/ technical regulators with the regulatory cycle
- Improve triple bottom line business case assessment
- Improve processes for estimating and recording stage of planning 'accuracy'
- Incorporate incentives for achieving outcomes below plan in corporate targets, performance plans, contracts
- Tracking and reporting variations to the Water Plan
- Capturing value of efficiencies achieved
- Improving cost allocation model for customers

From a cultural perspective, regulation means that the economists, scientists and engineers are working together creating stronger links between assets, outcomes, prices and business value. Ultimately, we think this is a great thing for our customers and the community.

Conclusion

Overall there have been few material changes to Melbourne Water's core asset management processes as a result of economic regulation. The key challenge has been translating an internally oriented process to enable external evaluation and understanding through documentation of Melbourne Water's processes, procedures and expenditure profiles – 'it is not enough to know it: you have to be able to show it'.

There is a transaction cost in increasing transparency; however, the benefits include greater credibility and accountability with a focus on delivering better value to our customers and the community. ●

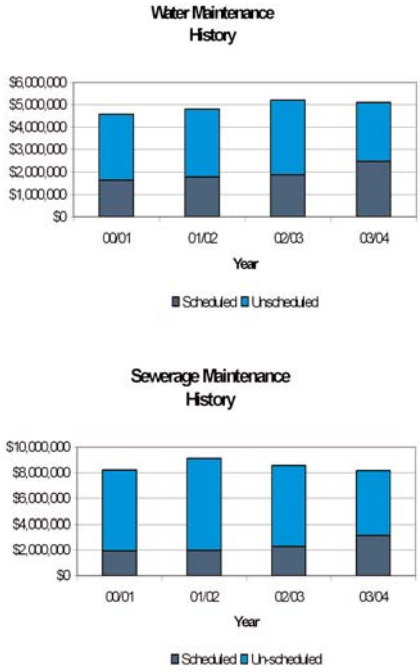
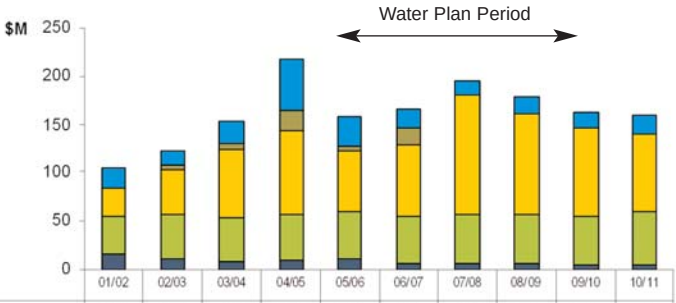


Figure 9
Water and sewerage direct maintenance costs (2003/04 AU$)



	01/02	02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11
Water	20.6	14.3	22.7	53.8	30.8	18.7	14.3	17.3	15.8	20.1
Recycling	0.2	4.9	6.5	19.8	4.4	17.1	0	0	0	1
Sewerage	30.1	47.8	70	86.2	62.1	74.8	124.1	105.6	92.5	79.7
Waterways & Drainage	38.7	45	46.2	48.4	49.6	48.3	50.5	49.1	49.1	54.5
Corporate	14.9	9.9	7.1	8.9	10.1	5.8	6	5.9	5.1	5.1

Figure 10
Actual and forecast capital expenditure 2001/02 to 2010/11

New developments in investment planning and project evaluation

Optimising expenditure to meet multiple objectives with limited resource

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As Asset Management continues to develop into a business function in its own right, separate from asset ownership and asset services (maintenance etc), leading utility companies are recognizing the different business drivers between Asset Owner, Asset Manager and Asset Service Provider, and are organising their businesses accordingly. Asset Managers are focusing on extracting value from Assets whilst managing the long-term sustainability of those assets for their key stakeholders, whilst Asset Owners set their expectations and performance targets and Service Providers perform the physical work on the asset.

For Asset Managers, the ability to optimally ration capital and operational expenditure is crucial to both deliver short term value and ensure this sustainability. Most utilities have historically made investment and project selection decisions based on a prioritisation of projects according to risk assessment and therefore are finding the philosophical transition towards achieving goals and objectives a difficult one. Leading Asset Managers are realising that if the company's strategic objective and key performance indicators are appropriate, and support the medium and long term sustainability of the company, investment should be targeted at meeting those objectives. Utilities are realising that to be world-class Asset Managers they must become pro-active businesses rather than asset caretakers.

This paper considers the processes and strategies being purchased or developed by Best Performing companies, in seeking an answer to the question: 'What is it that leading Asset Management companies are doing, and doing well?'

Against a background of increasing pressure to better manage assets, utility companies are extremely concerned about the effectiveness of their asset management capabilities. Whilst the Asset Management concept has been embraced globally by the utilities industry, for most utilities their Asset Management capabilities have yet to be tested by the pressures of a truly competitive environment. There are a number of key areas of Asset Management that will be critical to the success of utilities facing regulatory, shareholder or competitor pressures, and each area has an underlying process that is intertwined with the next, such that each is as vital a link in the chain as the next. One area that has achieved particular attention recently is the Investment Planning process which will be the focus of this article; however, before considering the value and the methodologies required for Investment Planning, we need first to consider its place in the Strategic Asset Management (SAM) value chain.

Figure 1
UMS strategic asset management model

Asset intensive businesses have opted for Asset Management business models to effectively tie together core processes and focus their businesses on extracting optimal returns from their assets in accordance with short and longer term financial and risk strategies decided by their owners.

Successful Asset Management requires a fundamental change in philosophy from a tendency to target maximum performance, minimum risk and least cost approach to one that targets minimum acceptable performance, active risk management and an approach where all spend is based on benefit and risk trade-offs, rather than historical budget or rate-based mentality[1] . Hence there is a fundamental culture shift required of companies embracing these concepts, in addition to organisational structure

changes, supporting systems and processes and asset information.

What is asset management?

The Asset Management model provides the tools and processes to enable and sustain the transformation of a business to a commercially driven and dynamic organisation that continuously operates to optimise its value. When done correctly, the result can be a dramatic reduction in costs coupled with increases in shareholder value, reliability, customer satisfaction, and employee productivity, satisfaction, and skill level. Each of these parameters are important for the viability and long term sustainability of an organisation. Effective Asset Management requires the highest level of commitment to three fundamental tenets:

- A clear focus on maximising return on assets, by achieving secondary goals of lifecycle cost minimisation, optimised renewal and capital deployment, and effective risk and performance management.
- Contestability of services driving costs to the minimum consistent with required timing, logistics and quality.
- Separation of responsibility for the management of the workforce from the management of the assets (see Figure 1).

Asset Owner

In this model, the asset owner, asset manager and asset service provider play distinct and important roles supporting the economics and performance of the asset. Asset Owner roles include managing the license, corporate governance, corporate performance, business development, merger and acquisition strategy, regulatory relations, profitability management, stakeholder management, competitive strategy and asset manager interface.

Asset Manager

Asset Management involves several key changes in the way the business is managed, whereby the responsibilities and accountabilities for asset management decisions, regarding O&M or capital investment in plant and equipment (including design, acquisition, commissioning, operation, maintenance, performance, retirement, and replacement) are separated from the management of the workforce. All decisions must be understood in terms of financial impact and viewed in the context of implications for existing assets (returns, prioritisation, utilisation, risk, future replacement/ refurbishment costs, etc.). A shift in focus to a longer-term lifecycle view of costs, risk objectives and return on investment must be an integral part of day to day asset management decisions.

The business of Asset Manager includes those processes, sub-processes and applications (tools) necessary to make consistent, effective and efficient decisions related to the assets. These decisions deal with optimising the operation, maintenance, upgrade, design of new portions of the asset, retirement of assets, and investment/business opportunities. Effective risk management is the cornerstone of all decision-making processes within the Asset Management business function.

Asset Service Provider

Workforce management decisions regarding staffing, skills, training, incentives, productivity, work rules, and union relations are made within the context of a focused market competitive services organisation. Asset Service providers therefore take care of the 'field' work associated with the asset, covering processes such as Design and Construction, Operate, Maintain and Restore, Performance Management and involving core competencies such as works management and resource management.

Key Asset Management Processes

The UMS Group SAM model considers Asset Management to be comprised of several intertwined processes that are supported by tools, systems and capabilities to enable optimal CapEx and Opex decisions for a given asset that has a range of desired objectives and targets. These processes are described in brief below:

- **Ownership Interface**. Through this process, the Asset Owner should clearly communicate objectives and high level corporate strategy as well as expectations for the performance of the asset whilst the Asset Manager should communicate asset performance, risk and strategy so that the owner has adequate information for decision making.

- **Asset Strategy**. All technical considerations related to the asset are contained within Asset Strategy processes and are integrated and applied to the asset through the Asset Management process. Asset Strategy is a broad process incorporating a number of sub-processes that merge traditional utility planning concepts with the performance and risk focus of the Asset Management philosophy. These include:
  - System Planning: Process for system design to maximise asset utilisation and system reliability, ensure system integrity and public safety, minimise load loss, etc.
  - Standards: Standards development and maintenance is essential to cost effective system planning and asset strategy as well as assisting supply chain management, etc.
  - Maintenance Optimisation: Links Condition Based Assessment (CBA), Reliability Centred Maintenance (RCM) and End of Life analysis (EOL) into an effective maintenance process.

- **Investment Planning**. All financial considerations and investment proposals are addressed within Investment Planning processes and are integrated and applied to the asset and to the overall business through Asset Management process. Investment Planning links tightly to Asset Strategy, Performance Management, Risk Management, Regulatory Management and Contract Management. However, owners are concerned about more than current returns and future risk. They are concerned about the long term viability of their business and hence desire the appropriate trade-off between returns, risk, public image, employee satisfaction and any number of other objectives. A detailed analysis of Investment Planning is presented later in this paper.

- **Risk Management**. Risk management is an intricate process that combines market influences, asset performance capability, and acceptable levels of risk to determine the optimal direction. The inputs to the process are highly dynamic and the processes and models need to be flexible enough to respond to changing conditions. Risk analysis actually fits into a number of areas within the Asset Management processes but is fundamental to Asset Strategy and the development of Asset Plans and Life Cycle Plans as well as the development of strategy scenarios.

- **Contracting Strategy**. Contract Strategy does not include the specific management of the workforce in the field, performed by project managers, supervisors or foremen. What it does include is decisions around contracting, such as maintenance insourcing versus outsourcing, standard versus performance-based contracts, single versus multiple contractors and decisions on whether asset management and/or network services are insourced or outsourced.

- **Performance Management**. Performance Management involves all the people, processes, systems, initiatives, functions, and activities currently conducting performance monitoring analysis, continuous improvement, initiatives and/or quality control for the assets of the company. Performance Management includes all the processes and steps required to develop, define and track performance of the assets and service providers necessary to provide quality management data for strategic decision making for the owner. It is fundamental in that it pervades all business owner, asset management and service provision processes.

- **Supporting Technology**. Data collection, storage, and retrieval systems, transposing effective SLA's and contracts across many parts of the business, inventory optimisation tools, etc, are vital to the effective operation of an Asset Management business.

Investment Planning: a critical competency in leading asset management businesses

Increasingly executives are seeking to make appropriate investment trade-offs between tangible and intangible company assets, but whilst the value of tangible assets tend to be measurable through formulae and calculation, intangible assets such as employee competencies and knowledge management systems are very difficult to evaluate. The latest tools and investment planning processes attempt to add method, process and calculation to the 'intuition' upon which such decisions have historically been made.

Developers of the original Balance Scorecard model, Kaplan and Norton, believe that 'measuring the value of intangible assets is really about estimating how closely aligned those assets are to the company's strategy'.[2]

An effective investment planning process must align spend decisions to company strategy and ensure appropriate weighting between tangible and intangible assets. Intangible assets tend to be the key differentiators between businesses and therefore a chief potential source of competitive advantage as they are not easily transferred. Kaplan and Norton go on to say: 'if the company has a sound strategy and if the intangible assets are aligned with that strategy, then the assets will create value for the organisation. If the assets are not aligned with the strategy or if the strategy is flawed, then intangible assets will create little value, even if large amounts have been spent on them.'

Figure 2 Basic investment planning process

Most utilities have historically made investment and project selection decisions based on a prioritisation of projects, based upon risk assessment, and therefore find the philosophical transition towards achieving goals and objectives a difficult one. Leading companies are realising that if the company's strategic objective and key performance indicators are appropriate, and the strategy is sound, investment should be targeted at meeting those objectives. Utilities are realising they must become pro-active businesses rather than asset caretakers.

Investment Planning Defined

The process begins with the definition of asset portfolio and business goals. It proceeds with monitoring and measurement of asset performance, initiation of a business case for an investment decision and then analyses a range of investments to determine the recommended course of action to maximise strategic and economic value. At a high level, the Investment Planning Process essentially follows five key steps; Gathering Information, Analysis and Decision and Implementation (see Figure 2).

How well are utilities managing this process?

Most utilities we work with perform reasonably well at gathering information, particularly with the advent of technologies to remotely monitor, capture and upload data such as equipment faults, alarms, etc. Monitoring and communicating information is an area some companies struggle with but generally there is adequate information available somewhere in the organisation to enable informed decisions on assets. One common problem for utilities is that information dispersed throughout the business can be time consuming to gather, as has been the experience for many utilities involved in multi-company benchmarking programs in recent years. Leading works management systems and detailed fixed asset registers facilitate data collection and monitoring and thus support the Performance Management process but can be expensive to implement.

The Analyse and Decision step of the process however, is where many Asset Managers find real difficulties in making consistent and defensible investment decisions in a timely manner. System planners have different views on expenditure from financiers or from operations or back office and planners are often unclear as to the objectives of their executive or are not aligned to these objectives and try to push 'pet' projects through. This trend is consistent across electricity, gas, water, telecommunications and rail infrastructure utilities and is one of the key reasons that Investment Planning processes have come under close scrutiny by companies and their stakeholders across the world in recent years.

A Best Practice approach to Investment Planning

Best Practice Investment Planning ensures that different business units within an organisation do not make investment decisions in isolation, and that the overall objectives of the business are in sight for any expenditure scenario. Furthermore, all investment decisions are aligned to the organisational risk appetite and there is a transparency, accountability and a formal documentation of the investment decision process. Finally, the process should allow for an optimisation step to ensure that a 'balanced' spread of objectives is achieved and therefore investment is covering a range of corporate objectives. These key Investment Planning attributes will be discussed in more detail below.

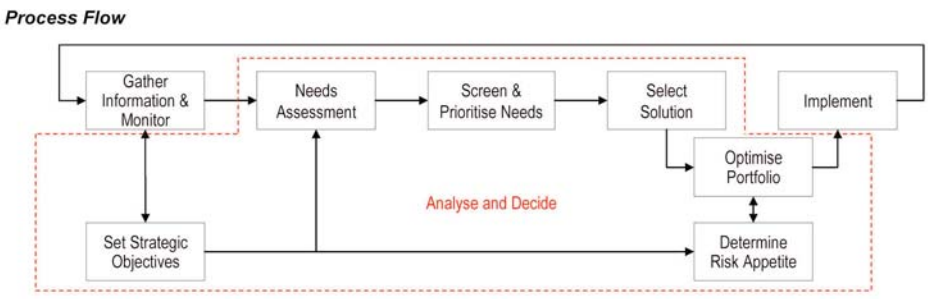

Figure 3 Advanced investment planning process

Portfolio Optimisation: a key concept in investment planning

Asset Owners are concerned about more than current returns and future risk. They are concerned about the long term viability of their business and hence desire their investments to address the appropriate trade-off between returns, risk, public image, employee satisfaction and any number of other objectives.

Many businesses are talking about triple bottom line objectives, but in fact some have moved past triple bottom line and are optimising their businesses to meet owner objectives over five or more 'bottom lines'. The process is known as investment Portfolio Optimisation and it is the latest tool available to companies intent on positioning themselves to achieve maximal alignment between strategy and spend.

Portfolio Optimisation takes a holistic view of all expenditure by project and enables the determination of a list of projects that fit a given budget constraint and produce the highest cumulative weighted benefit across all nominated strategic objectives and sub-measures (KPIs) of the business[3]. The principles of optimisation were first employed in the early 1950s when Harry Markowitz put forth his theories on modern portfolio management pertaining to financial assets and utilising the concepts of variance and co-variance to deliver maximum return for a given level of risk[4]. These principles have been expanded upon and applied across a number of domains including project portfolio analysis for business investment planning. The optimisation process thus focuses on selecting the optimum bundle of projects that maximise the strategic value with an acceptable risk exposure. It is not intended to support the analysis of limitations or formulation of projects that address these limitations. The contribution of individual projects is measured within the bundle that meets the financial restraints. Smaller high-value projects can be selected in the bundle because the basic process of optimisation is to maximise value for minimum cost.

Using Decision Support Tools

Supporting the decision step of the process should be a wealth of knowledge and information about the asset and the objectives the owner has for that asset and the business as a whole.

Furthermore, leading asset Managers are adopting tools to support decision analysis and leverage off the knowledge and information within the business. The leading decision analysis tools combine economics, logistics, technical and decision theory to select the best investments as measured by a balanced scorecard of business value and within an acceptable risk profile. Such decision assistance tools provide companies with a robust approach for maximising the returns from constrained funding, and optimising the value of investments across their current and future asset portfolios.

Why are decision support tools more than just a prioritisation calculator? Decision support tools provide many hard and soft benefits for the Asset Manager:

- They can reduce 'politicking' by project advocates which drives objectives instead of criticality of need.
- Decision makers tend to unconsciously discount objectives below their 'top 3' priorities.
- Snap judgments or 'gut calls' by decision-makers in the review process can overturn months of careful analysis.
- Proven but mature programs can starve more promising new programs of investment.
- They can provide greatly increased communication of investment constraints and limitations of the business to owners and regulators.
- They can achieve a transparent selection mechanism to display project selection criteria.
- They can communicate risk exposure and quickly highlight un-funded projects that fall within defined high risk categories.

It is not uncommon to find five Executives with five different views on what the corporate Vision Statement really means, and what the true objectives of the company are. Aligning the company around its true objectives is a difficult but critical step for any business and linking the objectives to actual investment and the activities of the company actually becomes an enabling factor in achieving the corporate Vision.

Decision support tools should not be expected to replace common sense, sound judgement and hard-earned experience[5]. Decision support tools are designed to assist planners and decision makers by arming them with adequate information with which to make a decision and by providing them with a flexible scenario planning calculator to assist in predicting benefits and risks associated with possible investment choices or portfolios. Any selected portfolio must be analysed to ensure the risks associated with that portfolio are acceptable to the business and the benefit align with overall business strategies.

Linking Investment to Strategic Objectives and Business Performance

A Best Practice Investment Planning process begins through the development of a Decision Framework based on the Strategic Objectives of the company. The framework consists of a set of weighted strategic objectives and sub-measures. Management must therefore first identify and reach consensus on a set of Strategic Objectives which typically cover financial drivers, any regulatory objectives, customer related objectives, employee or other internal objectives and reliability objectives. Each objective must be clearly defined and then weighted using a robust approach such as Analytical Hierarchy Preferencing (AHP) methodologies based on decision tree logic.[6]

Once a set of weighted strategic objectives is established the next step is to identify sub-measures of each Strategic Objective which must be measurable on a project by project basis. Sub-measures can therefore be thought of as Key Performance Indicators (KPIs) and each sub-measure is defined in terms of a scoring range against which projects can be assessed.

For each goal developed in the Strategic Objective Workshop, a set of contributing metrics is established into a project scoring matrix. Efforts should be undertaken to define the extremes of value for the range of projects and programs under consideration and the aim is to develop and test rigorous scoring criteria such that no two people in the organisation would score the same project differently. This is a critical and difficult step in the development of a robust framework and requires inputs from a range of areas within the organisation to achieve a well defined and widely accepted set of definitions and project scoring criteria. For each Objective and each sub-measure, it is a good idea to develop sample projects and programmes that would produce positive and negative scores in order to assist personnel in scoring their own projects.

For enterprise-wide engagements, a good 'road-test' of a Decision Framework is to conduct cross-functional challenges to assure the equivalent rigour of scoring is present across the enterprise. This will ensure further buy-in to the process, a better consensus on scoring parameters and a broader understanding of the reasoning behind each measure. Experience has also proven these workshops provide an excellent platform for communicating between business units and aligning the wider organisation

around company objectives. The final step is then to assemble the package of matrixes for review by Executive Leadership.

Risk Assessment

With the advent of commercialisation, privatisation and disaggregation of the utilities industries in Australia, many businesses have become significantly more commercially focused and considerate of ownership pressures, community obligations and the fundamental business tenets of cost minimisation, revenue growth, profits and sustainability. Management teams in many major utilities have developed strategies beyond those of network maintenance and demand management and have set their business objectives around satisfying financial, customer, regulator and employee requirements, often in conjunction with business growth strategies. Yet despite this commercial focus and clear objective from management teams to operate viable and sustainable businesses, most utilities base the investment decisions almost entirely on risk mitigation, with little or no consideration to their stated business objectives. In doing so, they face two major disadvantages:

1. They push important investment decision making out of the executive or management domain and into the engineering domain;
2. They operate without an intrinsic understanding of the impact of risk-based decision making on their ability to meet stated objectives.

Risk mitigation is just one of several important criteria for investment decisions and may not achieve any particular measurable benefit for the company. Investment planners are therefore beginning to think of the investment decision in two parts:

1. Benefits to be achieved for a given investment portfolio, and;
2. The Risk associated with that investment portfolio.

Within an Investment decision analysis tool there clearly must be a facility to determine the risk exposure the business faces for any given spend scenario. In other words, for any set of selected and deferred projects, the deferred projects are associated with a risk profile that the company will be exposed to if it does not go ahead with those projects. Many projects are designed to mitigate risk so to defer such a project is to leave the company exposed to that risk. The project portfolio should therefore serve not only as a project register and a register of potential strategic benefit to the company, but also a register of risk exposure that will at some point need to be addressed.

In addition to the Strategic Objective scoring framework, the Investment Decision Framework must also include a matrix of consequence and probability scores to allow each project and programme to be scored as to the resultant risk to the business of not being selected in the optimisation. In a similar manner to the Strategic Objective scoring definitions, risk is typically defined across a number of risk domains such as Financial Risk, Technical Risk, Socio-political Risk, etc.[7] Each domain of risk defines a range of potential consequences for each risk type and a probability of a risk event in that domain should the project be deferred.

Once all projects are assessed in terms of the consequence and probability of a risk event if the project is deferred, the Executive and Management of the company have a register of known risk to the company and its assets and can set the company 'risk appetite' – the level of risk deemed intolerable. The risk appetite of the company will be the defining factor as to whether a project should be selected on risk criteria.

Project Scoring

Each project is scored on Sub-Measures which are then weighted and summated to produce a score against each high level Strategic Objective. A project may receive a range of negative and positive scores across both Sub-Measures and Strategic Objectives. Each project is also scored for consequence and probability in each defined risk domain, typically using a scoring range 0 to 5 for each, where zero is low consequence (no impact) or low probability (very unlikely) and 5 is high consequence (catastrophic) or high probability (almost certain).

Scoring Training for Engineers and Planners will help ensure consistency and familiarity with scoring templates across the business. The Project Portfolio Manager is responsible for monitoring scoring consistency and should look for trends within departments or work groups that might undermine portfolio information quality. From time to time the Portfolio Manager may refine Scoring Descriptions, Definitions and examples as necessary to maintain scoring consistency.

All individual projects are scored and added to the project portfolio, or library, until a complete list of potential projects is developed.

Finding the Trade-offs

One key benefit from creating a project portfolio on a common assessment platform is the ability to see in a matter of minutes what impact a given subjective project selection decision has on the rest of the project portfolio and indeed on the objectives of the business. The Portfolio Manager can also utilise this holistic view of company projects to determine whether some projects could be bundled due to similarities in timing, geography or personnel that might result in an overall summated cost less than the summed cost of each individual project. This is sometimes referred to as 'the Portfolio Effect'.

There should be enough flexibility in the process and optimisation tool that the Portfolio Manager and indeed Management and Executive teams have the discretion to nominate 'Mandatory' projects, or to force-select projects fitting certain criteria such as Customer Requested Work, Governmental ad Compliance driven projects. However the question must be asked, 'when is something mandatory?' It must be recognised that a decision to nominate a project as Mandatory may render a portfolio sub-optimal and hence only projects which absolutely must go ahead should be labelled Mandatory. These might include projects that are almost completed from previous budget periods, projects that are legal requirements or political decisions that the company must abide by. Note however, that even Mandatory projects should be scored on both Strategic Objective benefit and Risk in order to determine their impact on the overall project portfolio.

Best Practices in Investment Planning

To summarise, we find that leading asset management companies exhibit a number of key characteristics:

- Optimise rather than simple rank or prioritise.
- Invest resources to accommodate specific needs and objectives rather than spend to a budget limit.
- Considering financial and non-financial indicators as go/no-go criteria.
- Consider risk as part of the analysis and decision making process.
- Understand the risk of NOT doing a project as a real risk scenario for the business.
- Do not treat everything as 'non discretionary' spending.

The Common Objections to Improving Investment Planning

UMS has worked with many utilities to implement Decision Support Tools and in particular our Portfolio Optimisation Process and

Optimisation Tool that is aligned with all the Investment Planning criteria discussed in this paper. Speaking to Planners, Asset Managers, Financial Controllers and CEOs in each business we often initially hear a number of common objections to an optimisation-based Investment Planning process, which are referred to below.

'It's too hard' - There is no question that portfolio optimisation requires both inspiration and perspiration, but the rewards are worth the effort. It is estimated that companies can improve 20-40%[8] through efficient deployment of investment expenditure as a result of a rigorous investment planning process.

'Scoring projects and setting up a framework is too time intensive' - Like anything worth doing, an effective Investment Planning process will require an upfront effort. The good news is that once an initial project portfolio is established, ongoing effort is incremental. As a project is conceptualised it should always be justified in terms of a business case. With a decision framework in place, that business case is given structure and rigour and ensures the business case targets key business objectives. Project scoring becomes an integral part of business case development and in many cases may replace existing business case templates.

'Scoring is subjective' – True, but so is any other method of investment decision making. Investment planning is a process that will always involve speculation about the impact of a current spend on future outcomes. Many utilities discard the value of a portfolio optimisation process on the basis that it involves subjective project assessment, but this is an illogical excuse considering historical decisions are entirely subjective and bases on the best thinking of one or two system planners. Investment Planning is not an exact science, but using knowledge, tools and a rigorous assessment methodology we can tighten up the speculation considerably.

'The error margins in the prediction of project outcomes outweighs precision of project selection' – Organisations will vary considerably in their access to historical failure rates, asset condition information, etc, and in their ability to forecast project impacts on intangible factors such as customer satisfaction, business growth opportunities and corporate citizenship. The aim of a robust decision framework and project portfolio analysis is to capture and record the best available information in the organisation and make decisions on that platform. There are a number of steps that can be taken to then obtain a reasonable understanding of the range of possible outcomes for a portfolio selection decision. Leading Asset Managers with best practice portfolio management processes in place will use confidence intervals on possible project outcomes and then portfolio scenario analysis to predict a range of possible outcomes and likelihoods (see next steps) for a given spend decision. The production of 'best case', 'worst case' and 95% confidence scenarios will give the Asset Manager an understanding of the probability of achieving targeted strategic objectives for a given budget and the risk that the investment will under-achieve or over-achieve. This is a separate risk assessment from the project-by-project scoring of the risk of deferring a project.

'Investment Planning should be human decision' – Absolutely. We do not advocate 'decision tools' but strongly suggest a 'decision support' tool suite can help provide people with the most up-to-date, comprehensive, accurate and timely information possible to help with the decision.

'How will portfolio optimisation link to business planning?' – Through the adoption of a Decision Support Framework based on the Strategic Objectives and Risk Domains of the business, there should be a direct link between Investment Planning and the wider Business Planning activities.

'Optimisation is just a fancy word for prioritisation' – Actually, optimisation is a significantly more complex process than prioritisation, which is why it is dependent on sophisticated mathematical modelling tools rather than the 'Sort' function of a standard spreadsheet application. Optimisation involves choosing a combination of projects based on their scores and individual costs that achieve the overall highest benefit to the business given a specific budget constraint. Prioritisation will only list the best projects by their value, or at best, by their value per dollar. Prioritisation tools cannot link project dependencies and exclusivities and will not re-shuffle projects to meet specific spend constraints.

'We don't have the data available to set up a portfolio optimisation process' – This is a very common response and highlights an even greater need for a Decision Framework. With the right measures and definitions, the 'best thinking' of the organisation can be captured without the need for extensive 'hard-data', and the resulting project portfolio will actually create an invaluable information repository for the business on risk, project types, budget requirements ad allocation, expenditure profiles, regional productivity, etc.

'Owners don't know what they want' – If this is true, the investment planning process is critical as a communications platform to educate the owner rather than fight with them. They are, after all, the key stakeholder.

'Everything is a risk decision and is done for engineering reasons' – The Asset Manager with this philosophy should not think of Asset Management as a business, but rather as a Community Service. Asset Managers talk about profit, NPV, ROI, ROA, EBIT, etc, and therefore decisions are not always relating to risk. If the organisation has a human resources department, a CFO position or a business development division then it is concerned about more than risk mitigation.

'If it is cash positive it will be done regardless' – Finance is not the only driver of a business. Sustainability requires customer support, employee commitment, capabilities and knowledge, system reliability, etc. Explore the trade-offs, understand them, and then make that decision.

'We only have about 10% discretionary spend, so this is a waste of time' – 10% probably still amounts to several million dollars and we should not lose sight of this, however the real issue is whether non discretionary spend is truly mandatory. Does the executive understand the decision on whether something is mandatory or not on a project by project basis? If not, there is work to do.

'The asset manager knows where money should be spent so it is his or her decision' – It is a high risk strategy to place all faith in one or two people to make these decisions. If that person leaves or is hurt, ill or dies, the decision making capabilities of the company are compromised, and worse, the basis of past and current project decisions will be lost. The allocation reasoning is lost and there is no-one accountable for decisions. In the time it takes to up-skill someone else you could waste millions. A documented, well understood analytical framework will provide a repeatable basis for decision making that enables knowledge to be retained by the business in those situations. Ultimately the loss of a decision maker would be difficult anyway, but at least there would be clear guides to his/her successor and clear documentation of past decisions.

'Budget is not a constraint!' – Few utilities can legitimately claim not to be cash-constrained, however there are some companies operating in lenient regulatory environments where a generous return on investment regime effectively removes financial constraints. Where this is the case, there tends to be a higher emphasis on resource constraints for internal labour, project management skills, contracting

and procurement processes and supply chain bottlenecks. A portfolio optimisation process need not optimise on budgets, but may optimise on labour hours, numbers of project managers, etc.

'What about resource limitations?' – An optimisation process can optimise on resource constraint as easily as it can on budget constraints.

Change Management – Enabling the Investment Portfolio Optimisation Process

Successful implementation of a Portfolio Optimisation Process for Investment Planning often requires a considerable change in organisational culture. A move away from incremental adjustments of historical budgets and towards funds allocation along optimised expenditure lines can cause anxiety and defensive behaviour from managers who perceive a loss of power when their budgets become less secure. On the other hand, many managers and planners feel a reduction in pressure with the introduction of this process as they are no longer individually accountable for risk management for their business unit or managed assets – the responsibility for risk, as previously discussed, moves higher in the organisation and has broader input.

Planners also sometimes have difficulty initially adjusting to the newly established strategic objective framework which may include objectives they do not have a personal interest in and therefore do not usually consider when nominating projects. This is actually a positive step for the organisation as it forces a common understanding of strategic direction. Consideration of such diverse factors as socio-political risk, training and development, occupational health and safety targets, revenue growth and public image typically produces more well-rounded project briefs with more rigorous financial review and a sound understanding of potential project benefits. This arms an investment planner with a strong understanding of the nature of each project within a project portfolio and thus enough information to make decisions on which projects to include in the upcoming budget period.

Another organisation consideration is when and where the Portfolio Optimisation step will be performed within the business. Ideally, Portfolio Optimisation takes place once project costs are firm and design is established such that a project can be reasonably accurately assessed for impact on KPIs and strategic objectives as well as risk. This information is collated in the project library, or portfolio. In most utilities there historically tends to be no single person or group who has accountability for portfolio analysis. Special OPEX (projects) tend to follow a different process and are managed in a separate area, adding to the complexity of the investment planning process. Portfolio optimisation should sit with the business unit responsible for setting budgets, and this is generally the Finance business unit. However, the process may be effectively implemented within each business unit in the organisation to ensure optimal effectiveness of expenditure of apportioned budgets, etc.

For longer term (five year) planning, obtaining accurate financial and benefit data is often not possible, however this does no preclude companies from using a Portfolio Optimisation process. Inherent errors bands around estimates, budgets and target objectives are the inherent nature of Investment Planning and the elements of the process – project register, thorough review of benefits and risks, scoring and assessment criteria and selection or deferring of projects – still applies. Projects can be assigned categories such as 'approved', 'pre-approval', 'preliminary design', 'identified need', etc, so that an indication of portfolio analysis accuracy can be determined. The process will add rigour to what is always a largely speculative planning horizon.

Where to now?

The wise Asset Manager understands that the business must crawl before it walks and walk before it runs. With investment planning, there are existing process that do enable companies to take large steps when moving towards an optimised portfolio selection process and indeed take large steps across a number of other SAM processes including risk management, ownership interface, contracting strategy and asset strategy.

However, as is always the case, there is a bigger picture and a more comprehensive view that can be taken and that must evolve following the adoption of a best practice Investment Planning process.

Some initial next steps once an Investment Optimisation Process is in place:

- Scenario modelling – learning what to target.
- Risk history – expansion on failure rate analysis. Improve predictability of risk using historic data.
- Benefit history and confidence interval revision – improve benefit predictability.
- Performance indicator selection – are we focussing on the right KPIS and are we correct about their relative importance?
- One year in, have we been successful with our 'optimal' list of projects?
  - What could we have done differently?
  - Has it been an academic exercise or have we learned something?

Some items for consideration as part of an expanded process:

- Benefit risk assessment – Monte Carlo analysis, risk distributions, etc. Probability of a given scenario outcomes.
- Understanding the business – if what we say is true, is this the business to be in? Are we just asset caretakers? Does our owner understand this?
- Tying in our new knowledge with other processes – are our Life Cycle Plans realistic? How often should we revisit them? Are we collecting a broad enough picture of the asset within the life cycle plan? ●

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Thumbs up for WSAA's Asset Management benchmarking programme

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This paper is for the information of water and wastewater asset managers and strategy planners considering involvement in future WSAA Asset Management Bench Marking studies. It presents a case study of Goulburn Valley Regional Water Authority's experience in participating in the benchmark study conducted during the first half of 2004. The paper provides background on the benchmark process, the perceived benefits that encouraged Goulburn Valley Water's participation and includes detailed discussion of the immediate outcomes and future implications for the Authority.

The Water Services Association of Australia (WSAA) Asset Management Benchmark study report details potential future asset management practices, supporting software packages and goals aimed at improving asset management functions.

The study confirmed that Goulburn Valley Water's relative asset management performance is advanced in comparison with a group of eight similar sized water supply utilities. Importantly, the Authority is now aware of aspects of its asset management performance in need of attention and has the tools and information to formulate effective strategy to improve its processes and systems.

Water Services Association of Australia (WSAA) developed the asset management benchmark study in response to its members call for a comprehensive benchmark survey capable of identifying best practice between comparable size and function water supply utilities.

A total of 23 water supply utilities participated in the study (see Figure 1). Of these, 19 were Australian, two New Zealand and two from the United States of America.

Goulburn Valley Water has approximately 54,000 property assessments and can therefore be directly compared with seven other water supply utilities that participated in the study.

Asset base

Goulburn Valley Water was formed via the amalgamation of 15 water supply bodies in 1996, and has an asset base with a replacement cost value of AU$680M. The Authority services 62 water supply facilities, 27 wastewater facilities and more than 330 wastewater pump stations. Its southern region is steeply undulating with the southern boundary being the ridge of Australia's Great Dividing Range, whereas the northern region is dominated by flat terrain with the northern boundary being the Murray River. The diverse environment and the dispersed nature of the assets is an ongoing challenge to service delivery.

Reasons for participation

Goulburn Valley Water's reasons for participation in the study included:

- With 22 other water supply utilities participating in the benchmark study, the exercise provided a comprehensive basis for comparison of asset management policies, procedures and practices between water supply utilities;
- WSAA proposes to repeat the benchmark study every five years providing a viable measure of performance improvement in asset management functions;
- Due to the significant regulatory pressure applied to manage assets in a cost effective manner, the asset benchmark study provides an objective appraisal of a water supply utility's asset management performance. This allows advanced asset managers to be recognised for their efficient and effective techniques while exposing developing asset managers to alternative asset management practices and the associated opportunities for improvement;
- The ability to demonstrate due diligence in asset management provides a sound background for service delivery risk management. Conversely, areas in need of improvement are comparatively identified with respect to best practice;
- The independent identification of areas of excellence within the

Number of property assessments	Number of water supply utilities
35,000 - 150,000*	8
150,000 - 500,000	7
Greater than 500,000	6

*Two other water supply utilities were in the range of 35,000 to 150,000 property assessments, however due to their function as only bulk water retailers were not included in this category.

Figure 1 Grouping by number of property assessments of participant supply utilities

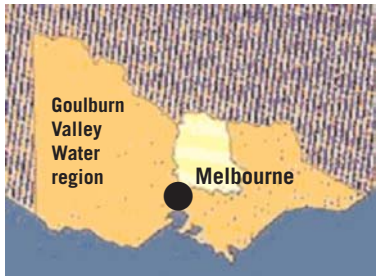

Figure 2 Map of Goulburn Valley, located in North Central Victoria in Australia's south eastern corner

Goulburn Valley Water business is an effective due diligence initiative facilitating confidence in the sole shareholder, the Victorian Government. It also provides recognition to the employees who have developed and maintain the asset management functions;

- The assessment process involves managers and line staff throughout the organisation improving communication and highlighting underlying success factors that may be applicable in other sections of the organisation.

In summary, Goulburn Valley Water has adopted a continuous improvement philosophy. The Benchmark Study provides a means of assessing the status of asset management practices, identifying gaps in need of improvement and facilitating strategy formulation to target the gaps of highest risk.

Structure of the study

The questions of the Asset Benchmark Study were structured in a hierarchy as shown below:

- 7 Functional Areas
  - 62 Processes
    - 319 Sub Processes
      - 918 Measures

The first six functional areas cover asset management functions, involving 540 measures. Each of these measures contains a prompt to four sub-measures: process development, process documentation, process coverage, and process frequency, each requiring a graded response (ie, 1 to 5 scoring). The seventh function covers Business Systems, involving 378 measures each of which has a single question requiring a similar graded response. Provision for a comment is provided with all measures allowing detailing of relevant documentation, systems and processes that support the rating.

Questions were answered online using the Internet and while response time was occasionally slow and dropping out of the service did occur, it did overcome formatting and configuration problems associated with bulk data transfer. At completion of the study this media also allowed online asset management performance comparison with the group of similar sized water supply utilities.

Management of the study

Senior management clearly communicated its commitment to the project at inception stage and established it as a high priority for all staff involved. A coordinator was appointed to manage the study, and was primarily responsible for identifying the most appropriate asset management specialists to respond to the questions and provide details of relevant documentation of asset management practices. The coordinator was also responsible for ensuring that the questionnaire was completed on schedule.

The challenge involved matching areas of responsibility with the Benchmark Study's process areas. Where the lines of responsibility were blurred across more than one specialist, all were requested to contribute. The WSAA benchmark study questions were downloaded in Microsoft Excel format enabling asset management specialists to prepare their responses. Time scheduling was used to coordinate online data entry.

At completion of the study two internal reviews were undertaken. The first review was a comprehensive evaluation of the accuracy of the responses by a manager with a comprehensive knowledge of the Authority's operation. This review looked for inconsistency in response throughout the questionnaire and gaps in information. A second independent review followed the first review and considered a sample of responses, with the aim of assessing their validity and reliability.

The project coordinator was involved in the Benchmark Study for a period of nine weeks full time. The collective sum of specialists' and managers' time amounted to six weeks of a full time equivalent.

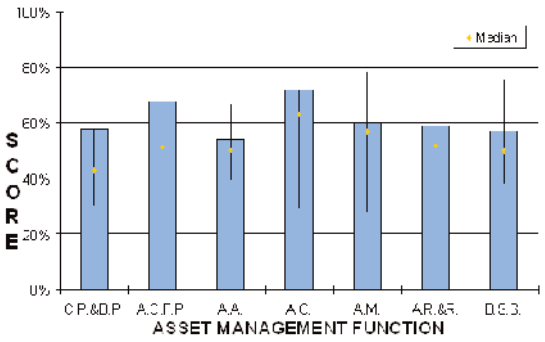

Figure 4 Goulburn Valley Water's asset management performance, relative to the seven other utilities in its range

Legend
Full titles of Asset Management Function acronyms are detailed in Figure 4; Vertical line indicates the range of scores within the group; Top of each bar indicates Goulburn Valley Water's score; Diamond indicates median score of group.

Audit process

Prior to the external audit being undertaken, Directors and Managers of Goulburn Valley Water directly involved with asset management completed a rating of importance for each of the functional areas: see Figure 3. This enabled the auditor to focus attention on areas considered of the highest priority by the Authority.

The external auditor carried out review and evaluation of 220 of the 918 measures. Attention was focused on questions with a higher priority as designated by Goulburn Valley Water, resulting in an audit of approximately 50% by weight of the total score.

The audit process took five days and involved detailed presentation of Goulburn Valley Water's asset management policy, procedures and practices. During the process Goulburn Valley Water's asset management specialists presented documentation supporting their response to the measure questions. Preparation for the audit by the project coordinator was a key success factor in its timely completion. Again, a schedule was developed to coordinate presentations.

As a result of the audit, the auditor increased the score of 24%, agreed with 73% and decreased the score of 3% of the responses. No translation of score adjustment on a relative basis was applied to the balance of the unaudited measures: ie, no adjustment was made to the balance of the 918 measures.

Comparative performance

In order for the water supply utility to proceed to the next study phase of comparative performance, it was necessary for the audit to be passed.

At successful completion of the

Figure 3 Summary of asset management functions identified for improvement

Item	Asset management function	Importance rating	Assessed score %	Estimated score after improvements	Suggested long-term target score
1	Corporate policy & business planning	5	58	68	75
2	Asset capability forward planning	5	68	72	75
3	Asset acquisition	3	54	59	70
4	Asset operation	4	72	75	75
5	Asset maintenance	4	60	65	75
6	Asset replacement and rehabilitation	3	59	64	70
7	Business support systems	2	57	57	57

audit, Goulburn Valley Water was able to view its asset management performance relative to the group of all water supply utilities that participated in the study and against its category of 35,000 to 150,000 property assessments via the Internet. The Authority attained the highest score in three of the functional areas and an above median score in the other four areas in its category: see Figure 4.

Report's recommendations

A key outcome of the independent audit was the report which detailed Goulburn Valley Water's relative performance in addition to specific recommendations for improvement to fill gaps identified in key functional areas.

Figure 3 is an extract from the consultant's report, and summarises the asset management function areas identified for improvement.

The assessed score is the score Goulburn Valley Water attained in the Benchmark study. The estimated score after improvements is the recommended short term (five year) improvement objective. The suggested long-term target score is the score that the auditor considered as the maximum target for the Goulburn Valley Water business from an overall benefit, economic and sustainability perspective.

The auditor focused on the function areas that Goulburn Valley Water considered of high importance to target an effective application of resources. For example, Business Support Systems, which has been assigned a relatively low rating by the Authority, did not attract attention in the improvement formulation process.

The auditor's report identified 80 individual measures for improvement along with a method for their improvement. Figure 5 details the format of this detailed analysis and a paraphrased example of one measure improvement.

Asset management improvement strategy

The 80 measures identified for improvement are yet to be considered in detail by the Authority for inclusion in its asset management improvement strategy. However, taking into consideration available resources, it has been concluded that there are too many measures to implement in the medium term. Going forward, Goulburn Valley Water proposes to prioritise the auditor's recommended improvements, arrive at a preferred shortlist and integrate the outcomes into a revised strategy.

A series of internal workshops is proposed to develop the revised asset management strategy. The evaluation method is planned to commence with workshop participants ranking the importance of each of the improvements. Calculation of mean and standard deviation for each improvement provides an indication of their relative importance to Goulburn Valley Water. This will enable short-listing approximately 20 improvements that are to be considered in detail. Detailed investigation of each of the short list items will involve identification of the method of implementing the improvement, on going resourcing requirements and associated costs and benefits. Workshop participants will be requested to evaluate the comparative benefit of the improvements compared to the cost of implementation, with the aim of developing a ranked list of measure improvements to be included in the revised strategy.

Lessons learnt

Having completed the benchmark assessment and audit for the first time, we have learnt a number of lessons from the process.

1. Greater attention should have been given in assigning the importance rating of the seven asset management functions. The auditor used these priorities as the basis for targeting measures to be audited and to identify the improvements that would most benefit the business. Consequently an error in the importance rating assigned by the Authority had significant ramifications for the audit and the future improvements recommended by the auditor.

2. While use of the Internet affords a degree of selective comparison of scores at completion of the benchmark study, it was a time consuming and sometimes frustrating medium. Reliability is sure to improve with improving communication media. However at present allowance should be made for Internet connection duration and response time difficulties.

3. A clearly communicated commitment to the project by senior management, assigning a dedicated project coordinator and adhering to fixed schedules for those involved were key success factors in its efficient and effective implementation. The Authority will repeat this management approach in future studies.

Figure 5 Consultant's measure improvement format and example of measure improvement

Function	2 Asset capability forward planning
Process	2.3 Planning for asset optimisation
Sub-process	2.3.1 Assign responsibilities and accountabilities
Measure	2.3.1.1 Clearly assigned responsibility and accountability for this process
Potential future practice	Defined and documented process for responsibility for asset optimisation management
Systems to support future practice	Database Flow charting framework capable of detailed responsibility assignment within a database format that provides identification of resources and liaison connections
Use of system to support future practice	Assign specific responsibilities and specialised roles ie, emergency management functions during interim period prior to upgrading works being undertaken to address identified risks
Example proprietary software	Human Resource Management Systems - Payglobal, HRVantage, HRIS-Pro, mySAP (ERP), JD Edwards
Goals	Clear definition of responsibilities and consistency in measuring progress. Capable of generating a limited focus organisation chart for a particular area, responsibility or task.

Conclusion

Goulburn Valley Water evaluated its relative asset management performance against all participating authorities and within its category of 35,000 to 150,000 property assessments.

The authority concluded that it is performing relatively well in the seven functional areas, providing a high level of confidence to senior management, the board and the sole shareholder that the business's asset management activities are conducted effectively.

Equally important was the identification of areas where performance could be improved. The 80 potential improvements suggested in the independent auditor's report will be considered for inclusion in the future revised asset management improvement strategy.

Involvement in the study has resulted in significant benefit to Goulburn Valley Water with further benefits to be realised by integrating the study's outcomes into an updated asset management improvement strategy. These benefits more than outweighed the resource intensive nature of the survey and audit process. Consequently Goulburn Valley Water will be a willing and active participant in future asset benchmark studies.●

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Allen Gale – Director Technical Services, Goulburn Valley Water

Ipswich Water's meter replacement strategy

Ipswich Water previously replaced 13-20mm diameter residential water meters when the usage reached 8000 kilolitres (kL), corresponding to the manufacturer's maximum life for a meter. Since meters typically under-register consumption with usage resulting in loss of potential revenue, an alternate approach was explored meeting the criteria of economic optimisation.

Sample meters were bench tested to determine error at different flow rates and usage versus error derived. The replacement model developed is based on the concept of achieving optimal return (recovered loss of revenue) on investment, from which the optimal time to replace each of the 42,800 residential meters is derived. Many factors are incorporated – tariff, discount rate, meter replacement cost less scrap value, average historical consumption, meter installation date and loss of revenue calculated from the meter accuracy equation.

The Microsoft Access model is linked to the customer information database to provide a dynamic replacement selection process depending on consumption trend for each meter. A detailed short-term work programme is prepared for meters due for replacement in priority order. This order is according to forecast annual loss of revenue per meter and further grouped according to location for efficient sequencing of replacements. Importantly, the optimum future number of replacements and related budget forecasting is determined on an ongoing basis as consumption varies. Further, this model provides many reporting capabilities for management and operational reporting.

Chris Egbars
and **Jayam Tennakoon**
Ipswich Water
Australia

Ipswich Water has some 49,100 water customers of which 93.5% are metered connections. The 42,800 residential users are on 13-20mm diameter meters with the average age of the fleet being eight years and average current registration 2300kL.

The total replacement value of all size water meters including revenue meters is $9.0M with a written down value of $4.5M and annual depreciation of approximately $0.6M. Between $0.2 and $0.3M is spent annually on meter replacements.

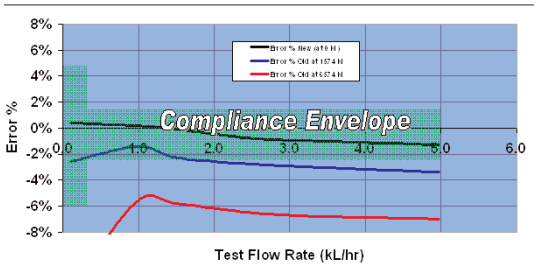


Figure 1
Typical meter performance at standard flow rates

As these expenses are significant, a detailed review of the meter replacement program was undertaken aimed at developing a strategy that gives optimum return on capital investment. The key drivers for meter replacement are the revenue loss and equity of customer charging, as a customer with a new meter subsidises the customer with an old meter due to under registering.

Meter accuracy determination

Meter registration is virtually the 'cash register' for the Ipswich water supply business and therefore accurate meter reading is a highly important activity under the current user pay two-part tariff system. Accuracy of meters is affected by natural wear and tear, impurities, type of meter and flow profile. It is reported that customer meters may under-register by up to 10% within 10 years of installation, rising rapidly by approximately 2% per annum thereafter. It is generally known that it becomes cost effective to replace meters after 12 to 15 years. As per the Standard Australia information the meter accuracy typically degrades at a rate of 0.8% to 1.0% per 1000kL.

Water meters have different errors at different flow rates due to the amount of water passing through without activating the registration mechanism. This phenomenon is referred to as 'meter slip'. The slippage varies due to a large number of factors including temperature, pressure, water quality, plumbing type, mechanism, water hammer and ageing. The combined effect of these parameters on the slippage varies as the meter registration increases due to wear and tear. Figure 1 shows a typical meter performance at standard flow rates. The envelope provides the limitation within which the measured errors should fall as per Australian Standard (AS) 3565.1.1998.

The results show that a very low flow through a new meter gives a positive error, and as flow rate increases

the error becomes negative. An old meter at low flow rates makes high negative error and as the flow rate increases the negative errors decrease around 1L/min and then increase over the remaining range increase. Therefore high consumption meter replacements operating at very low flow rates could also provide a greater benefit to Ipswich Water.

Weighted Average Error

Ipswich Water meters are tested at five flow rates by the Brisbane Water Meter Unit as per the AS 3565 1998. The actual domestic flow rates are highly variable over a 24-hour period. The percentages of total domestic flow per property occurring within each of the test flow rates is multiplied by the measured error to calculate the weighted average error. The error of the meter is calculated by adding weighted average errors at the five test flow rates.

The percentages of flow per property at test flow rates was manipulated from the study done by Sydney Water Corporation and Standard Australia verified by limited data logging for Ipswich Water.

Loss Of Revenue

Loss of revenue for a meter within a year is calculated using the weighted average error of the meter, tariff and the annual average consumption. The meter should be replaced when the cumulative loss of revenue recovered due to meter replacement exceeds the capital cost of the meter being replaced in present value terms. A 20-year horizon is adopted for the evaluation period.

Development of meter replacement model

Many factors are incorporated in the model calculation of the due date for meter replacement – tariff, discount rate, net meter replacement cost, average historical consumption, installation date and loss of revenue calculated from the meter accuracy equation as per the model input sheet in Figure 2.

In order to derive the meter accuracy curve and equation approximately 100 sample meters from a range of registrations were bench tested to determine error at different flow rates. A representative flow rate profile for Ipswich Water was derived using real time data logging on a few representative meters in-service. From this information a meter accuracy relationship (usage versus overall error) is derived as shown in Figure 3. The corresponding age versus overall error relationship is similar.

A conservative approach is taken, with only meter test results for overall error not exceeding 20% considered because:

- Unconfirmed that sample number is statistically acceptable;
- Type of meters tested possibly not representative of fleet range;
- High error likely indicates a meter is faulty/failed; and
- Resulting linear regression portion of curve is comparable to curves reported by City Water West (Melbourne) and American Water Works Association.

The overall meter accuracy curve adopted for the model is shown in Figure 4. It affords considerable flexibility since it is a combination of:

- Linear regression derived for the straight-line portion from zero kL to a selected registration 'limit' derived from test results plotted separately from the model; and
- Curve generated within the model between the 'limit' and a selected 'end point' (which gives a forced 100% error) to allow for the likely significant errorat higher registrations (although the number of meters in the database above 8000kL is low).

It is desirable that further investigation be undertaken of the required testing program to provide a statistically acceptable sample for improved accuracy curve determination.

Model development then consisted of deriving a relationship between optimal replacement age and annual usage. The resulting curve determines when it is feasible to replace a meter by optimising the balance between revenue loss associated with declining meter accuracy and meter replacement cost.

The optimal replacement age is when the net present value of the cash inflow is maximum, which is the difference between recovered revenue less the capital cost within the evaluation period of 20 years. This occurs when average annual long-term present value cost of loss of revenue plus meter replacement is a minimum. It varies with annual usage - 10 years for example 836 kL/yr usage in Figure 5.

For varying annual usage through a meter the optimal replacement age is derived as shown in Figure 6. In this example a maximum of 20 years of age is adopted in the model as the reasonable upper limit of replacement age.

The model is linked to the customer information system 'Pathway' to provide a dynamic replacement selection process using the historical consumption trend for each meter and the 'optimal replacement age curve'.

Cost - Benefit Analysis

The above analysis is based on the concept that a meter is replaced when average Net Present Value (NPV) cost is minimum based on historical cost. Further analysis was undertaken using a NPV analysis of net cash inflow between the 'do nothing' option versus meter replacement option. A sensitivity analysis was performed to identify maximum net positive cash inflow for a 20-year evaluation period.

Model outputs

The model output provides separate summary information on the current 13-20mm meter fleet and the meters due for replacement for a nominated date:

- Average replacement age;
- Total cost to replace;
- Average error;
- Total annual volume loss and average per meter; and
- Predicted total lost revenue for next 12 months and average per meter.

Figure 3
Meter accuracy relationship

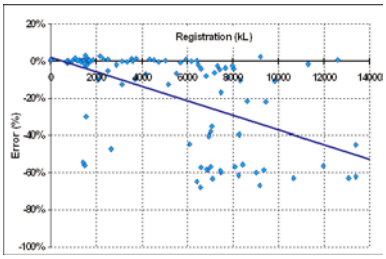


Figure 4
Overall meter curve adopted for model

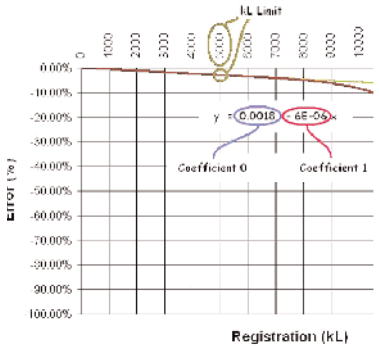
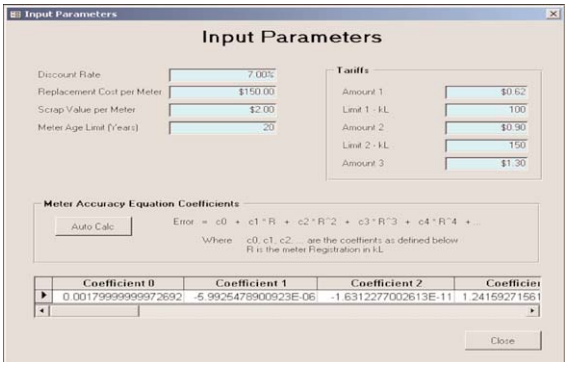


Figure 2
Input parameters for the meter replacement model



Year	1	2	3	8	9	10	11	12
Percent error for 836 kL/yr	-0.32%	-0.82%	-1.33%	-3.87%	-4.48%	-5.28%	-6.47%	-8.43
Lost kL	2.70	6.94	11.23	33.67	39.22	46.58	57.85	76.98
Lost revenue	$3.51	$9.03	$14.60	$43.77	$50.98	$60.55	$75.20	$100.08
NPV of lost $	$3.28	$7.88	$11.92	$25.47	$27.73	$30.78	$35.73	$44.44
Accumulated NPV of loss $	$3.28	$11.16	$23.08	$126.95	$154.68	$185.46	$221.18	$265.62
Net meter capital	148	148	148	$148	$148	$148	$148	$148
NPV of capital $	$138.32	$129.27	$120.81	$86.14	$80.50	$75.24	$70.31	$65.71
Total NPV	$141.60	$140.43	$143.89	$213.08	$235.18	$260.69	$291.50	$331.33
Annual average	$141.60	$70.22	$47.96	$26.64	$26.13	$26.07	$26.50	$27.61

Figure 5
Data used to calculate optimal replacement age of meters

Figure 6
Graph for plotting optimal meter replacement age

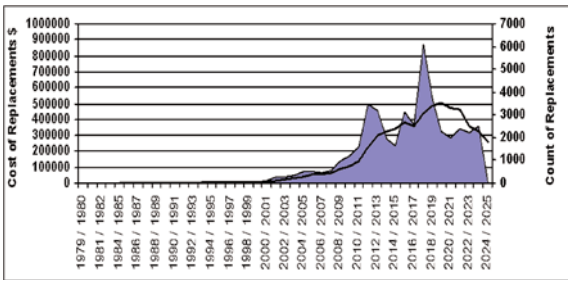


Figure 7
Forecast for annual number and cost of replacements

Since the optimum replacement year is generated for every meter the number of future replacements and related cost is able to be forecast on an on going basis as consumption varies as shown in Figure 7, with a moving five-year average included. This information is useful for long term budget forecasting.

Also, details of meters due for replacement at a nominated date are provided in three reports from which a short-term replacement program of priority meters is prepared:

- Summary by suburb of number and predicted average annual revenue loss per meter;
- Meter details in priority order of potential lost revenue for coming year (Figure 8); and
- Meter details by suburb according to the sequence meter readers follow.

The model is linked to the 'Pathway' system so that various Geographical Information System maps showing properties containing meters to be replaced can be produced. Maps of particular interest are Councillor divisional maps and meter reading route maps. The meter reading route maps linked to the meter replacement program assist the field crews to plan and minimise traveling distances between replacements.

A macro level single error equation is adopted in the model for all the meters. There is an opportunity to develop separate error equations for different meter brands and diameters. The model can be refined to include these concepts resulting in a high level reporting capability.

Conclusions

Previously, the list of meters exceeding 8,000kL was the basis for 13-20mm meter replacements which did not provide a strategic view for long term investment and cost-benefit analysis.

Ipswich Water developed a new replacement model based on the concept of achieving optimal return on investment. It is a first attempt to incorporate key factors and build a logical replacement programme. The next stage is to undertake a statistically valid sampling and testing programme in order to refine the accuracy curve for various meter types

The model provides an opportunity to prepare an up to date short-term works program of meters due for replacement in priority order. Importantly, the optimum future number of replacements and related budget forecasting is determined on an on going basis as consumption varies. Further, this model provides many reporting capabilities for management and operational reporting. ●

Figure 8
Meter details in priority order of potential lost revenue

Meter code	Name & address	Next year lost revenue	Install date	Average consumption (kL/yr)	Replacement	
					Age (yrs)	Date
005439		$88.80	11/08/1993	832	10.08	10/09/2003
062726	Details are withheld	$88.75	07/11/1998	1270	5.50	08/05/2004
005051		$85.46	05/06/1997	1099	6.75	05/03/2004
001389C		$83.90	16/05/1997	1087	6.86	26/03/2004

Acknowledgements

Ipswich Water acknowledges the advice provided by Brisbane Water in the early phases of the project including analysis of consumption data and meter testing provided by the Brisbane Water Meter Unit.

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New asset data warehouse offers improved accuracy and environmental performance

The development of a new and unique data warehousing system by South East Water has resulted in a range of benefits for everyone associated with the utility. This paper details:

- the factors leading to the decision to implement a new data system;
- how a systems architecture approach works;
- why South East Water's system is particularly suited to the unique, spatial nature of data in the water industry; and
- feedback on the system, lessons learned and future applications.

Martin Dunkley
South East Water
Australia

South East Water has achieved excellent results from the first phase of development of a revolutionary new data warehouse for its network asset data. The new warehouse system provides direct benefits for the community, the environment and South East Water by enabling the problems behind water quality failures and complaints to be analysed, understood and addressed more quickly.

The system successfully combines the business intelligence tools used for data warehousing with the geographic information system that maps the data. This is a unique achievement in Australia (it has been achieved only rarely overseas), although one large NSW water utility developed a similar process at about the same time as South East Water.

A key achievement of the warehouse is its interoperability – the interaction between business intelligence systems and geographic information systems. This allows all data to be geographically mapped, and allows the user to move back and forth between the two different business systems. This capability is essential in the water industry, as it enables the information to be regionally cross-referenced, putting all events and water quality issues into context.

A secondary achievement is that the quality of information generated by the new warehouse provides a 'big picture view' for preventative planning.

The warehouse centrally stores all the information used to generate reports about its asset performance and replaces a variety of individually maintained databases. The quality of reports generated using the data warehouse is superior to the previous system, providing improved consistency and accuracy of information gathered and stored in the data warehouse.

The information is arranged according to complexity (ranging from most complex to least complex), allowing it to be accessed at different levels, according to the user's skill levels and business requirements. The automatic cross-referencing of regional information allows the problems behind failures and complaints to be analysed, understood and addressed more quickly, and provides the 'big picture view'.

The strategy and investigation phase of the project spanned three years. IT Architecture consultants Charter Wilson were brought in to look at outputs, conduct a situation analysis and project a return on investment. The initial financial outlay for the project was a significant investment, but was justified by the long-term cost savings and increased efficiency it will create.

Situation analysis

The majority of South East Water's core systems were developed in-house, evolving over time to meet the company's business requirements.

Data is stored in the company's core operational systems. Information includes history for trend analysis, reference details such as customer or account numbers, and transaction or event data. Reporting tools are currently used to individually extract information from each operational system.

Reports had been generated using a variety of Access and Excel spreadsheets linked to the operational systems, all custom-built by various users to meet their own reporting needs. Accordingly, definitions and classifications varied slightly between the systems, occasionally resulting in idiosyncrasies between reports. Facts retrospectively updated on separate databases created further minor differences, both between systems and between reports generated for particular time periods. There was clearly a need for consistent reporting, as well as a growing demand for increased access to information.

A significant amount of time had been spent generating and formatting monthly reports. It was recognised that automated report generation would not only ensure consistency, but save time spent on reports, freeing it up for the data analysis essential for guiding and supporting the company's decision-making.

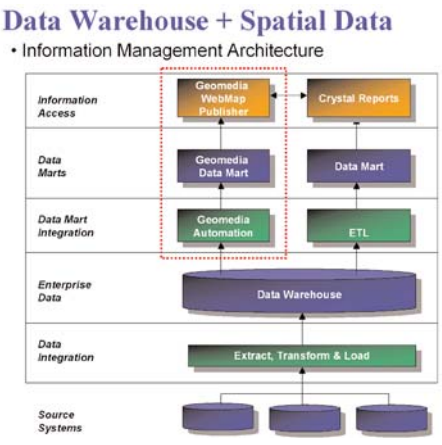

Figure 1 Data warehouse: the information management architecture

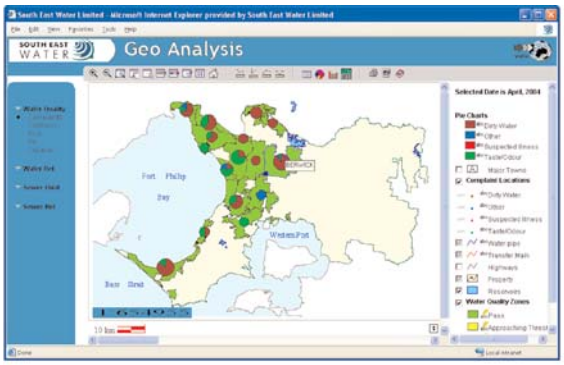

Figure 2
Display showing water quality zones and monthly results with pie charts that indicate, number of complaints (circle size) and breakup (pie slice). Berwick has several: the majority are dirty water.

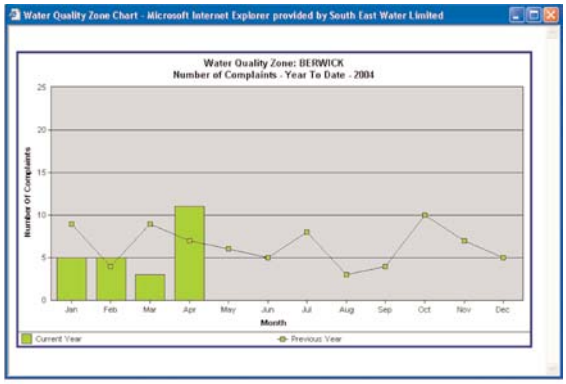

Figure 3
Picking a zone on the map shown in Figure 2 displays a graph of complaints for the zone; in this case Berwick.

Figure 4
The user can then click on the bar chart to bring up individual dirty water records.

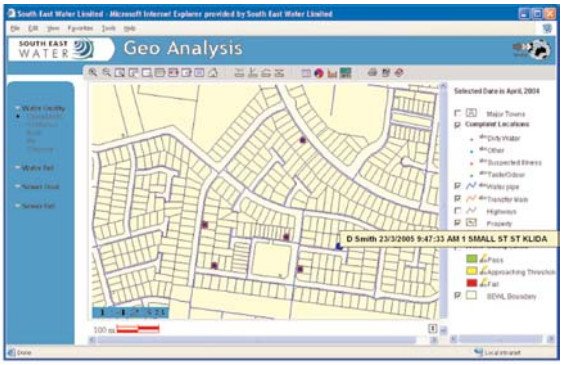

Figure 5
Selecting the map pin top left corner displays the selected records with mapbase and water network. The close cluster indicates that these are all to do with the same event.

The data warehousing solution

South East Water needed an IT system that would make information accessible to users across the business and provide the tools to ensure consistent reporting. The system needed to free up time otherwise spent generating and formatting monthly reports. This would allow more in-depth data analysis, to better support decision-making and preventative planning.

In 2002, South East Water began to investigate the creation of a data warehouse for asset information. The strategy building process took three years. Consultants were brought in to examine outputs, perform a situation analysis and estimate a return on investment. Their report predicted that South East Water's current and future business requirements would challenge the capabilities of the existing system.

How it works: A systems architecture approach

A systems architecture approach extracts data from a company's source operational systems, transforms it into one consistent format, then loads it into a single data warehouse for storage. The information is then extracted from the warehouse, and transformed for consistency once again, then loaded into a series of 'data marts'. Reporting and analysis tools are used to extract and transform the information once again, turning it into reports.

Reports created using a data warehouse are automatically generated and formatted. The automated reporting, plus the incorporation of one central information source, makes reporting both faster and more accurate.

A unique achievement: combining geographic information systems with business intelligence tools

The water industry is unique in that it is very spatial – all data relates to a specific geographical location where something has occurred. The standard business intelligence tools used for data warehousing, which have no spatial element, were not appropriate to meet South East Water's needs.

The company uses a geospatial system with the ability to combine data, but this system also had problems with information being segmented and potentially inconsistent.

Research found very little precedent for integrating spatial facts into a data warehouse, with the exception of one US report, which found that this approach offered a number of potential benefits, including increased accuracy of forecasting, optimised planning and resource allocation, and the ability to proactively fix problems.

Based on extensive research into costs and benefits and an identified lack of existing options, South East Water took the innovative approach of developing its own system. The company adapted their unique system with assistance from its long-standing vendors in the geographic information system community.

The system geographically maps and automatically cross-references all information contained within the warehouse. For example, events such as water bursts are cross-referenced with data about water quality in each region. This information can be pinpointed to its exact location, making it simple to analyse relationships and accurately identify the causes behind complaints or events.

The improved quality and readability of the reporting using the new data warehouse has the added advantage of making it easier to communicate information such as causes behind events to non-operational staff and outside parties.

Piloting the system

A 12-month pilot program was developed to test the architecture, beginning with water quality data.

The system has now been running live for over three months. Initial reviews have been positive, with users finding the system simple to use and analysis much easier to perform. Combining water quality data with events, such as bursts, allows instant cross-referencing, leading to swifter sourcing of any problems.

The review also found that the pilot objectives had been met, strategic and tactical aims achieved, and the architecture assembled functioned well.

Cost savings have been identified through reduced effort in maintaining the range of existing reporting databases, reduced laboratory reporting costs, and enhanced reporting leading to improved diagnosis and response to complaints. Significant reductions in time spent on report preparation are another major advantage.

The system delivered better business intelligence, easier access to data, and reporting and analysis that is repeatable, auditable and consistent. All of these benefits will lead to improved decision-making for South East Water.

The system is currently being extended to cover data on water reliability, then sewer quality.

User response

Users within South East Water find the system easy to use and immediately helpful as a time-saving device and a source of accurate, comprehensive information.

Reports which had taken approximately one week to assemble

are now created instantly, allowing more time for analysis. Whereas gathering data once took up 90% of a reporting job, with 10% left over for analysis, the new system allows the opposite to happen.

General comments include that tools and data access are simple and effective and that the average user can easily use the system to analyse and map information.

Several further opportunities to use the system have been identified, with many of these suggestions being progressively incorporated into the system.

A learning curve

The major issue identified with assembling the warehouse was the importance of ensuring the data quality of the operational source systems before incorporating them into the warehouse.

Data that perfectly suits a company's operational needs can sometimes be impossible to use for the reporting purposes of the warehouse. For example, fields that don't need to be filled in for operational uses can be crucial to the generating of reports.

The source systems need to be able to support the warehouse's reporting requirements for the system to function smoothly.

In hindsight, the creators of the data warehouse at South East Water have realised that it saves time and effort to run data profiling to clean up the source systems before incorporating them into a data warehouse, rather than fixing up the data along the way.

The good news is that assembling a data warehouse is a great way to clean up a company's operational systems so that they can be used for multiple purposes.

Future applications

The system is currently being extended to cover data on water reliability, then sewer quality. It will continue to be extended throughout the company, with possible future uses including limited customer access to the system.

South East Water staff members involved in building the data warehouse believe that the process will only get easier as time goes on, and as the company's business knowledge grows.

The water quality system will continue to be refined as users find more applications for it and discover potential improvements through day-to-day use.

South East Water's data warehousing pilot sets a new precedent for the water industry. All water companies have similar issues in effectively managing their assets and reliably reporting to regulators and the central issue of combining geographic and non-geographic data to support decision-making is a common one.

Conclusion

South East Water's significant investment in creating a data warehouse for its assets has been rewarded with excellent results after a short time, and continued potential for improvement.

Enthusiastic user response to the system has been matched by measurable improvements in data analysis, reporting, productivity and diagnosis and response to complaints.

The benefits for South East Water and the community are obvious, as are the environmental advantages of reduced customer complaints and increased capability to address issues before they occur. ●

AM UPDATES

Diary

A listing of upcoming asset management-related events and conferences. Send details of your events to WAMI for inclusion.

Water Loss Reduction Speciality Conference
12-14 September 2005, Halifax, Canada
As Specialised Conference of the IWA Water Loss Task Force, this event is intended to present the latest developments, strategies, techniques and application of the international best practices in water loss management, auditing and control.

The conference will provide three days of technical presentations and discussion forums that will review the international approach to water auditing, strategies for water loss reduction, performance measurement, real and apparent loss control, international benchmarking, success stories from utility application of IWA strategies, new technology and discussion forums.
www.leakage2005.com

Public Stakeholder event of the Water Supply and Sanitation Technology Platform (WSSTP)
17 October 2005, Budapest, Hungary
This first ever all-stakeholder event on the future of the European water sector will be a public consultation addressing: the vision of the sector for the short, medium and long term; the common strategic research agenda; and the implementation plan to make the necessary research funded and implemented.

The target audience for this event is all those involved in water management, drinking water supply, waste water collection and treatment, industry, agriculture, regulation and policy making, sustainable technology development and supply (especially SMEs), finance, NGO's, who want to contribute to the strengthening of the European water sector in the world market, and believe that collaboration between all stakeholders involved in water is the best way forward.

For more information please email Bianca van der Wolf:
Bianca.van.der.wolf@kiwa.nl

WSAA 2006 benchmarking programme
The Water Services Association of Australia (WSAA) conducts a rolling programme of process benchmarking for its Members and other interested water utilities. Commencing early 2006, the next programme will benchmark maintenance practices of key mechanical and electrical assets. Utilities interested in participating in the 2006 project are invited to attend the best practice workshop for civil asset maintenance practices in Australia in August 2005. For details, please contact Andrew Foley (Project Director) at:
andrew.foley@wsaa.asn.au

The Adam Smith Institute's 4th Annual Conference: Infrastructure Asset Management
7-8 November 2005, London, UK
Faced with increasing demands on service levels and efficiency, the management of a company's physical infrastructure can have a huge impact on safety, predictability and performance. Clear asset management strategies are crucial for the effective maintenance and enhancement programmes required to meet obligations and surpass targets.

This conference acts as a forum for debate pulling together important figures, spanning industries that all face the challenge of managing a vitally important asset base. Key topics will include:

- Embedding Asset management practices across the company
- Collaboration and partnerships for successful projects
- Optimising asset use through risk management and understanding asset life-cycles
- The role of regulation in driving infrastructure improvements
- Analysis of best practice models

Among the speakers confirmed is Bill Emery, Director of Costs and Performance & Chief Engineer, Ofwat. For more information and to register, visit:
www.marketforce.eu.com/index.cfm?obj=conferences.overview&confid=68