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Water Utility Asset Management

A Guide for Development Practitioners

Asian Development Bank

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Abbreviations

DCWD	—	Davao City Water District
GIS	—	geographic information system
HPWSC	—	Hai Phong Water Supply Company
ISO	—	International Organization for Standardization
NWSDB	—	National Water Supply and Drainage Board
RWASA	—	Rawalpindi Water and Sanitation Agency

Background

Many of today's water utility managers face the challenge of cutting their unacceptably high levels of nonrevenue water. Aside from decreasing revenue, money for investment, productivity, and service delivery, nonrevenue water also increases the cost of the delivered water.

In addition to reducing nonrevenue water, water utility managers must (i) raise their service levels closer to 24 hours a day, 7 days a week, to meet the expectations of households, commerce, and industry; (ii) expand distribution networks to cope with population growth; (iii) finance the timely replacement and maintenance of existing assets; and (iv) treat heavily polluted water.

The way an organization manages its assets determines its success in addressing these challenges. A utility can improve and sustain the expected level of service, reduce water losses, cut unit costs, and fairly justify tariff rates if it knows what assets it has and needs, when and how to maintain or replace those assets, and how the assets should be operated.

This concept is easier stated than achieved. Policies, plans, practices, and systems need to be put in place and applied by skilled personnel who are committed to caring for assets and meeting service standards.

Better asset management is necessary because poor asset management leads to

- water losses that exceed industry good practice;
- less than 24/7 water supply service and frequent concerns over water quality;
- incomplete, inaccurate, and unreliable asset records;
- maintenance that mostly addresses breakdowns;
- minimal asset planning that is not based on sound analysis and records; and
- costs, and ultimately prices, that are higher than they should be.

There is no single rapid solution to remedy poor asset management. Although some short-term actions can be taken to reduce nonrevenue water, tackling the underlying issue of poor asset management requires a time frame of 3–7 years. It normally involves dealing with a considerable number of different assets, clearing a backlog of poor asset information, and effecting a change in system and attitudes.

A sequence of steps is needed to address poor asset management. First, the utility's commitment to improve and its degree of decision-making autonomy must be assessed. This may be gauged by observing evidence of other change activities and through discussions with management on the asset, staffing, or change decisions that require referral for approval to position holders outside the organization. Second, the utility's current asset management status needs to be established. There are a number of checklists and guidance manuals available to help undertake this step. Third, management buy-in for change must be obtained through workshops and senior management meetings to ensure that everyone shares the same way of thinking. Change plans will be developed at such workshops, based on the diagnosis, what is feasible within different time frames, and the need to build more and more support. Fourth, the utility should form a change team, usually engaging an outside expert to help guide the implementation process, which will deal with (i) asset inventory and records, (ii) computer-based systems including geographic information systems (GIS), (iii) asset policies including acquisition and disposal, (iv) decision rules to address asset criticality and risk, (v) asset planning, (iv) key performance indicators, and (v) operations and skills development.

Good asset management involves most people in the organization. They need to carry on with their daily work while also tackling a substantial change program. Despite these significant barriers, the change can and should be done to ensure utilities deliver promised services. Experience also shows that a strong external regulator that monitors service delivery for the community can help sustain good practices.

This guide focuses on medium-sized and large operators. It discusses techniques that apply to situations where asset types and conditions vary widely and in-house engineering and financial skills exist. The fundamentals, however, apply to all utilities. Asset management gives smaller utilities the opportunity to introduce good asset recording systems; ensure regular maintenance; identify critical assets; manage the risk of their breakdown; and measure asset performance, especially nonrevenue water, as an indicator of good asset management.

The guide aims to provide

- a brief overview of the concept, processes, and systems of asset management, including self-diagnosis to help utility managers and project designers identify change priorities (Chapter I);
- case studies about what utilities have done to manage their assets, including the results they achieved or did not achieve (Chapter II); and
- extra project-relevant information to Asian Development Bank (ADB) staff about existing asset management projects, a sample design and monitoring framework, draft terms of reference for consultants, and a one-page handout to inform clients about asset management (Chapter III).

Introduction to Asset Management

Asset management involves achieving the least cost and least risk of owning and operating assets over their life cycle while meeting service standards for customers. Consequently, utility managers need to put in place policies, plans, and strategies. They must also develop and implement a suite of processes that cover asset acquisition, operation, maintenance, overhaul, and disposal. Asset management also means applying tools that help make these processes effective, such as setting service levels, computing life-cycle asset costs, maintaining an asset register, monitoring asset condition and performance, and carrying out risk analysis of possible asset failure.

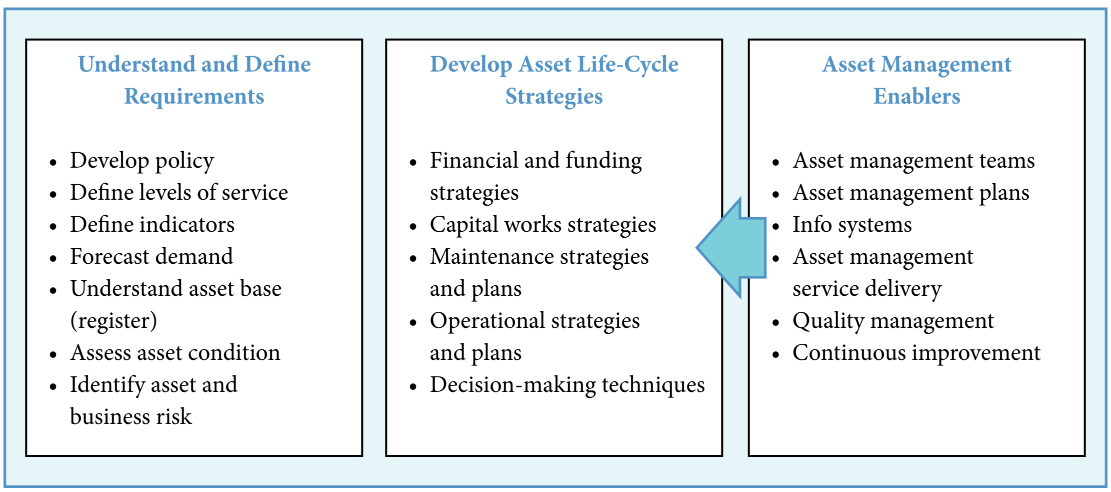
Asset management for water utilities is more complex than for most other sectors because of the number, variety, age, condition, and location of assets; the magnitude of asset investment; and the difficulty of inspecting and maintaining buried assets. This complexity is often compounded by lack of finance, information, and skills that can impede acquiring, commissioning, maintaining, overhauling, and replacing assets at the optimum time.

CHAPTER I

A Brief Overview of Asset Management

This guide uses the *International Infrastructure Management Manual* structure to explain the essentials of asset management (Figure 1).

Figure 1: Asset Management Explanation Structure



Source: The New Zealand Asset Management Support Group. 2011. *International Infrastructure Management Manual.* New Zealand. www.nams.org.nz/pages/273/international-infrastructure-management-manual-2011-edition.htm

A. Understand and Define Requirements

As a basis for effective asset management, utility managers need to (i) put in place an asset management policy, (ii) develop implementation and monitoring plans to achieve the targeted service levels and demand forecast, and (iii) obtain a good understanding of the condition of all their assets and identify the potential risks and consequences if they fail. This section presents an outline of these requirements.

1. Asset Policy

Utilities need to raise their organizations' awareness so everyone understands that asset management is important in achieving their service, financial, and sustainability goals. It should be high priority and considered by all while they go about everyday tasks. Crafting an asset management policy, later supported by plans and strategies, can raise this awareness (Box 1).

Box 1: Asset Policy Example

The organization will at all times practice the highest level of asset management including

- asset planning based on demand forecasts and targeted service levels;
- maintenance of reliable integrated asset records that facilitate good governance;
- maintenance, renewal, and replacement of assets based on life-cycle costing, condition monitoring, and risk assessment; and
- clear accountability for asset acquisition, security, operation, inspection, maintenance, and disposal.

Source: Asian Development Bank.

2. Service Levels

Establishing targets and monitoring achievements at various service levels: (i) informs the public, politicians, and the regulator of the utility's targeted and actual performance; (ii) enables managers decide on asset acquisition and management; (iii) allows the utility to compare its performance with that of others; and (iv) educates the staff on the links between top service-level indicators, strengthened asset performance indicators, and their own jobs.

For water the customer service level may be described in terms of availability (24/7) which may be judged by the number of interruptions or cumulative period of interruptions, quality (appearance and smell), pressure, number of supply interruptions and response times to supply interruptions.

Wastewater service levels are determined through (i) health and environmental conditions (such as final effluent discharges compliance with certain levels—Biochemical Oxygen Demand, suspended solids, and nitrogen); and (ii) system performance levels, such as the annual number of sewer overflows in the case of combined systems.

Customer service-level targets are set through consultation. The targets are reviewed occasionally or imposed through regulation. Cascading service levels throughout the organization requires indicators based on the SMART (specific, measurable, achievable, relevant, and time bound) criteria. This ensures that results are linked through all levels of the organization. The number of indicators increases as the organization level goes up (Table 1).

Table 1: Cascading of Service-Level Targets

Level	Service Level	Indicator	Value
1	24/7 service	Number of interruptions	Less than X times per year
2	System	Line breaks per 100 kilometers per year	Less than 10
3	Asset condition	Condition rating	3 or better
4	Asset monitoring	Inspection	Quarter 1
5	Maintenance crew	Inspections per crew	Number per crew

Source: Asian Development Bank.

3. Demand Forecast

Predicting demand is of key importance for asset management. It enables managers to plan what assets may be needed for system expansion or upgrades to sustain agreed levels of service.

Utility managers should have one or more demand forecasts based on different assumptions or scenarios. The challenge is to obtain reliable information on time and in sufficient detail for planning. Information to consider includes government records of building approvals, land releases that flag population growth, or repurposed buildings within an area that can lead to more demand for water and/or sewerage services.

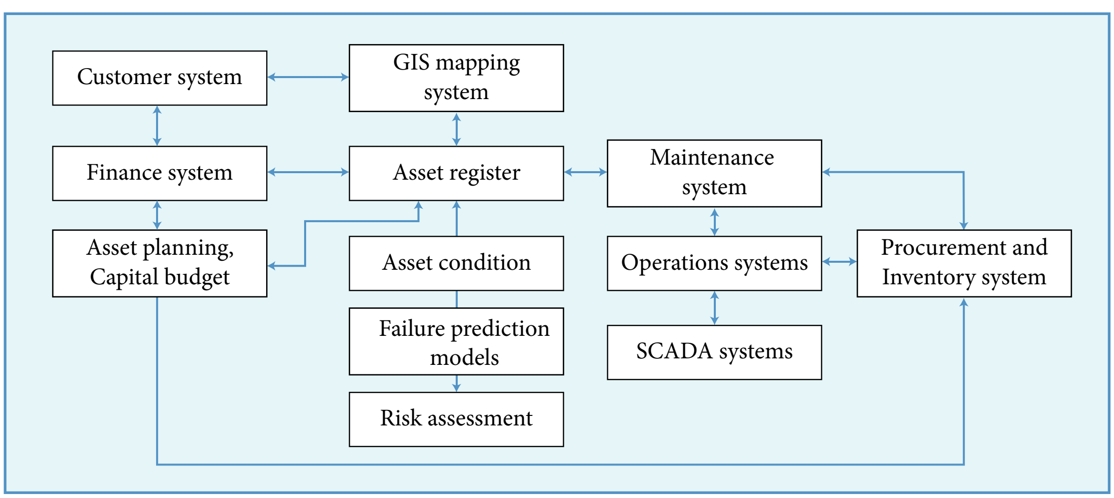
Without accurate forecasts, new assets to replace current assets under stress will not be acquired and commissioned on time or insufficient revenues will be generated to recoup the cost of the assets acquired.

4. Understanding Asset Base

Asset management is impossible without the support of good asset records (usually known as an asset register or asset database). This requires (i) investing in robust processes for consistently collating and recording information; (ii) gathering past data; (iii) establishing an asset classification method; and (iv) investing in a computer system that contains a number of key modules to allow, for example, planning and acquisition of assets, maintenance of records, and scheduling of asset replacement (Figure 2).

Asset record systems include card indexes, spreadsheets, customized software from major vendors, or computer applications developed in-house. Customized vendor systems may be the most cost- and time-efficient option. Vendors have invested considerable funds to develop their asset systems, which are integrated with other systems such as financial, customer services, maintenance, and GIS. Furthermore, vendor systems feature data security methods to maintain data quality. They also provide a range of standard reports to help managers monitor assets and make decisions. System processes include acquisition, operation, inspection, maintenance, renewal, and disposal. Asset systems in the more advanced utilities allow for inquiry and updating from portable computers or handheld devices. An extract from an IBM system is in Appendix 1.

Figure 2: Illustration of Asset Management System Modules



GIS = geographic information system, SCADA = supervisory control and data acquisition.

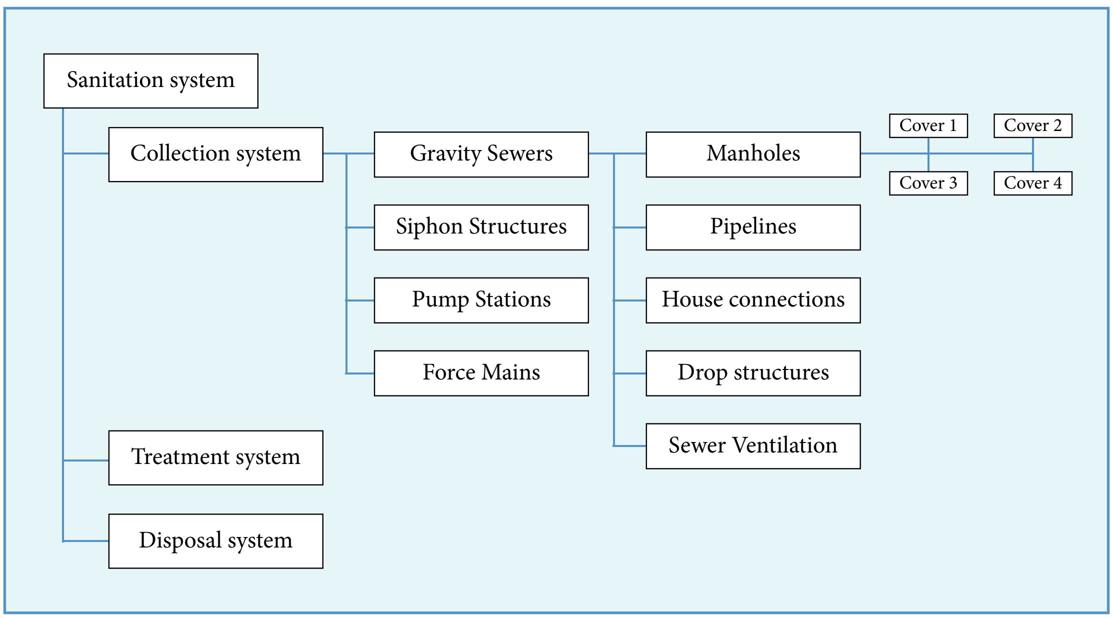
Source: Asian Development Bank.

Many utilities may not know what assets they have or where they are located. Utilities can remedy this by introducing a program to progressively develop the quality and coverage of their asset records. Typical information needed to do this includes the date of asset acquisition, description, maintenance history, original cost, current valuation, type, expected life, inspection frequency, risk rating, location (possibly tied to GIS), performance information, and unique identifier.

Asset records should be structured so they can be managed effectively. In Figure 3, the assets are classified in the following order: major function or process, sub-function, type, and component.

Classification may also be done by asset type (pipes, pumps, etc.) or by area. Classification facilitates data collection, reporting, and comparative analyses. The structure of the classification and the level of detail should be agreed on by utility management. A utility's needs—whether for energy consumption management or asset maintenance, for example—will dictate the type of information that should be captured. This, in turn, will influence the structure and level of detail that utility management will agree on for classification.

Figure 3: Asset Hierarchy for Classifying Assets



Source: Adapted by consultant from GHD on Asset Management.

5. Asset Condition

Asset condition ranges from brand new, to worn out and failing (Figure 4). Timely maintenance can improve the condition of assets and prolong their useful life. If the condition is known or reasonably predictable, then maintenance, renewal, or replacement can be timed to minimize service delivery interruption and costs.

Condition monitoring allows utilities to predict when an asset needs repair and replacement. It can also gauge how much longer the asset can be used. One way to approach this is to establish condition classes (Table 2).

The defining and setting of class rules is specific to each utility. The final set of conditions and action rules is best decided by the utility's engineers based on information from suppliers, their

Figure 4: Illustration of Asset Condition

Pipe sediment buildup progressively constricts flow and reduces service.

Cleaning and relining restore service and extend usefulness by about 50 years.

Source: GHD Course on Asset Management.

collective experience, and published industry data; or analysis of the utility's maintenance records.

About 20% of assets cause about 80% of problems. Some assets can be easily identified as higher cost and higher risk. These assets justify more sophisticated condition classification techniques. Some utilities use more complex rating systems and may vary the system according to asset type (i.e., underground pipes versus above-ground pumps).

Table 2: Simple Condition Ranking

Condition Class	Action Required
1	Repair immediately
2	Repair within 1 year
3	Repair within 3 years
4	Repair within 7 years
5	Repair when convenient
6	No damage, repair unnecessary

Source: Adapted by consultant from GHD Course on Asset Management.

Condition monitoring can be carried out through analogue, digital, or visual methods. For example, in assessing sewerage systems, possible methods include smoke testing, dye testing, lamping, video inspection using closed-circuit television, sonar, and ground-penetrating radar. However, these techniques are costly, and are therefore may not be available to small or developing utilities. Condition ratings can also be established by tracking causes of failures.

6. Identify Asset Risk

The delivery of water and wastewater services involves risks. Utilities of all sizes should identify and manage asset risks to enable them to achieve and sustain their targeted service levels while operating within their budgets.

Risk is the probability of failure multiplied by the consequence of failure. If both probability and consequence are high, then the risk is too high and should be reduced to an acceptable level or eliminated. If both probability and consequence are low, the situation can be accepted and no action is necessary.

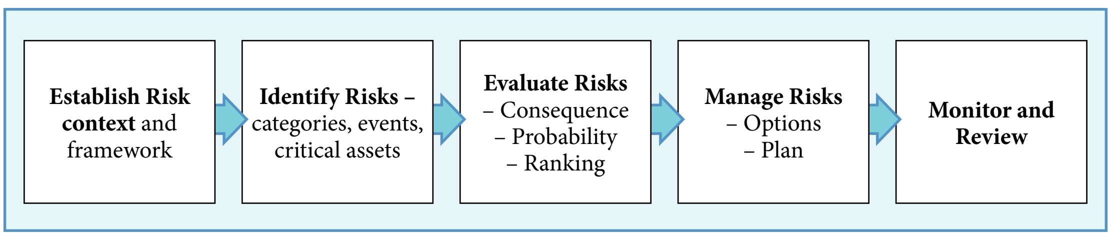
Utilities need to apply a risk management process following the steps in Figure 5.

Identification of risks is done through consultation among managers and recorded in a risk register. The risk is then rated to identify the degree of management needed to achieve an acceptable risk level. The rating system can range from simple to complex.

All assets can be rated. Assets with a very high consequence of failure and at least a moderate probability for failure are termed "critical assets." Critical assets would score within the shaded area in Table 3.

The management of critical assets requires a number of actions. For example, criticality may be measured for a water supply system through the number of customers and the length of time they may be affected by a failure. Actions to mitigate the risk posed by critical assets include having backup systems (such as alternative power supplies) and units on standby, or holding key spare parts. Managers should understand failure because it drives acquisition, maintenance, and renewal decisions. Managers should know that assets fail in different ways, and have different likelihoods and consequences of failure.

Figure 5: Risk Management Process



Source: Adapted by Consultant from *International Infrastructure Management Manual, 2011.*

Table 3: Example of Risk Ratings

		Consequence of Failure				
		Very Low	Low	Medium	High	Very High
Probability of Failure		1	2	3	4	5
Very Low	1	1	2	3	4	5
Low	2	2	4	6	8	10
Moderate	3	3	6	9	12	15
Quite Likely	4	4	8	12	16	20
High	5	5	10	15	20	25
Very High	6	6	12	18	24	30
Almost Certain	7	7	14	21	28	35

Source: Asian Development Bank.

The application of risk-mitigation and management strategies can be simplified. For example, each of the 35 cells in Table 3 may have its own group of actions, but grouping cells that have the same score could reduce the number of categories from 35 to 22, making the task more manageable. Qualitative grouping can further simplify the task into 3 or 4 risk categories, e.g., high, medium, and low.

B. Develop Asset Management Life-Cycle Strategies

Effective asset management requires tools to set service levels, compute whole-of-life asset costing, maintain an asset register, monitor asset condition and performance, and carry out risk analysis of possible asset failure. Useful tools or strategies include decision-making techniques, operational strategies and plans, maintenance strategies and plans, capital works strategies, and financial and funding strategies.

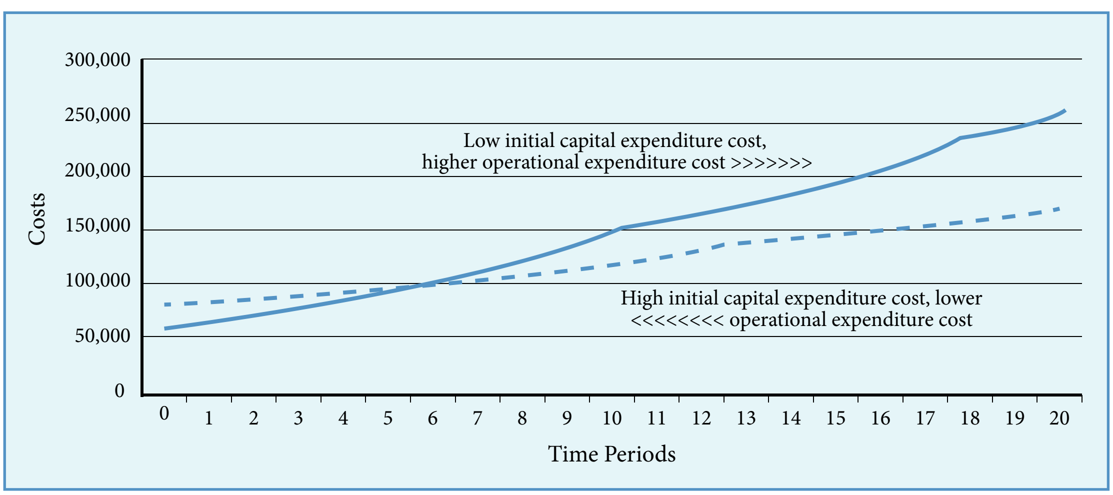
1. Decision-Making Techniques

Asset management requires a number of decisions such as what assets to acquire, when to renew or replace assets, and when to carry out maintenance. Decision making based on past experience, individual opinion, or faulty data can be avoided through life-cycle costing, a technique used to reduce the risk of making wrong decisions.

Life-cycle costing means getting the maximum service from an asset or groups of assets for the least cost during their lifetime. Initial acquisition costs, maintenance, refurbishment, and disposal costs are all part of the calculation. In Figure 6, two life-cycle cost trends are shown. The solid line is for an asset with initially low capital costs but higher operating costs over time. The dashed line is for an asset with initially high capital costs but lower operating costs over time. The cumulative cost lines show that the higher initial cost does not mean an asset has the highest life-cycle cost.

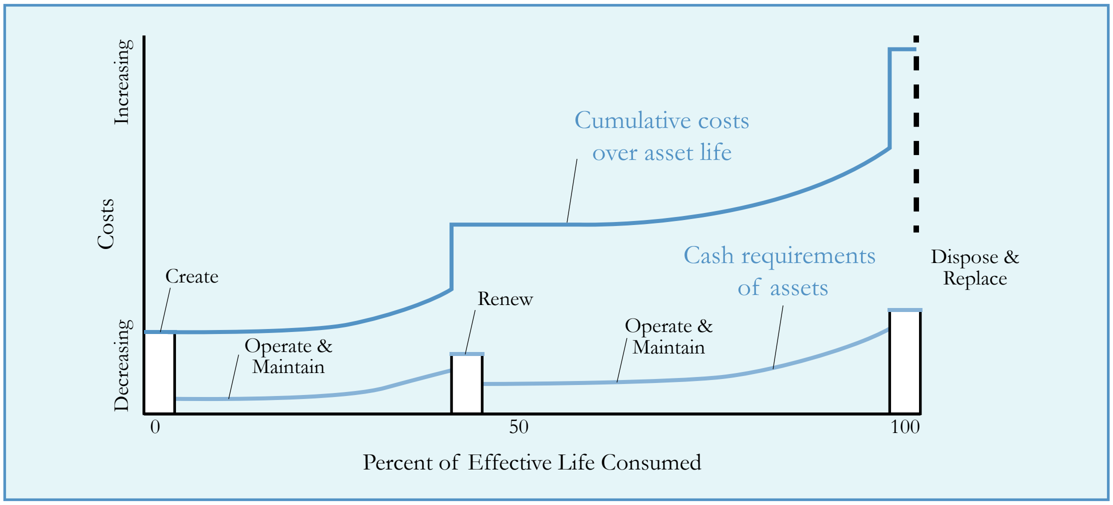
Figure 7 shows another way of illustrating life-cycle costs. Although operation and maintenance costs rise over time, they flatten out after asset renewal has taken place and maintenance costs are reduced. While the concept is easy to understand, it is much harder in practice to compute the costs accurately. Though the computations will not be exact, they are sufficient to help make an informed decision.

Figure 6: Comparative Life-Cycle Cumulative Costs



Source: Asian Development Bank.

Figure 7: Illustration of Life-Cycle Cost Pattern



Source: GHD Course on Asset Management.

To obtain the likely costs of maintenance, operation, renewal, disposal cost, and economic life, the starting point is supplier and bidding information; utility records; and utility management's experience, including that of engineering and finance staff. Estimated forecasts are sufficient to avoid a timing error in maintenance, renewal, or replacement. Being 80%–85% confident that the estimated life-cycle costs are within plus or minus 10%, for example, would be sufficient to make decisions.

Regardless of the technique applied, there will always be uncertainty in a number of key factors such as demand forecasts, expected life of an asset, operational performance, and continuity of supplier and spare parts. Therefore, it is important to thoroughly assess the sensitivity of computed results to varying key assumptions. Different utility managers must work together when applying any decision-making technique. For example, design and maintenance engineers should work with accountants because asset management involves physical assets and their financial consequences.

2. Operational Strategies and Plans

In delivering agreed service levels, assets should also be fully utilized. Otherwise, their life-cycle unit costs will be higher than they should be. This means adopting operational strategies that seek to achieve effective asset utilization.

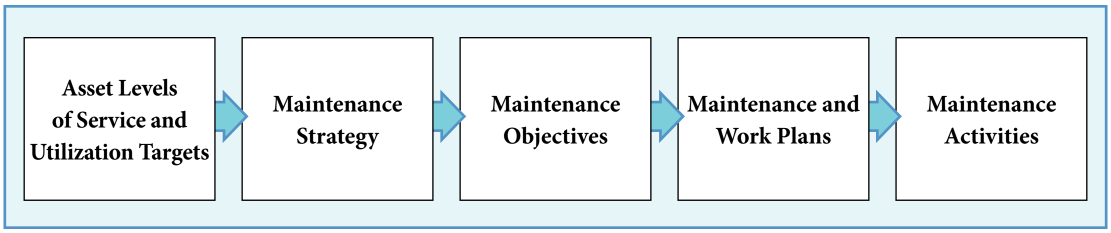
For water and wastewater services, the following is advised:

- Ensure asset utilization is not wasted. Examples of wasted asset utilization include pumping water and then losing the value of utilization through leakage, or processing more wastewater because of storm water seepage into the conveyance pipe system.
- Reduce demand for overused assets. This avoids the risk of failure or early replacement, which would then result in underuse.
- Establish a target range for asset utilization, then measure and report on actual performance against the target.
- Have emergency plans. This ensures service continuity in a possible crisis.
- Ensure operators are fully trained and aware of asset performance expectations. This ensures that they can contribute to asset monitoring and management.

3. Maintenance Strategies and Plans

The purpose of maintenance is to slow down asset deterioration and extend the period before rehabilitation and renewal is required. Engineers use a mix of preventive and breakdown maintenance (repairing unplanned faults). In some utilities, very little preventive maintenance is practiced. This translates into lower service performance and higher life-cycle costs. Experience shows that unplanned maintenance costs two to three times more than planned maintenance for the same task and is harder to manage. A proper maintenance management system translates the targeted asset service and utilization levels into maintenance activities (Figure 8).

Figure 8: Maintenance Management Overview



Source: Consultant adaptation of content in *International Infrastructure Management Manual, 2011.*

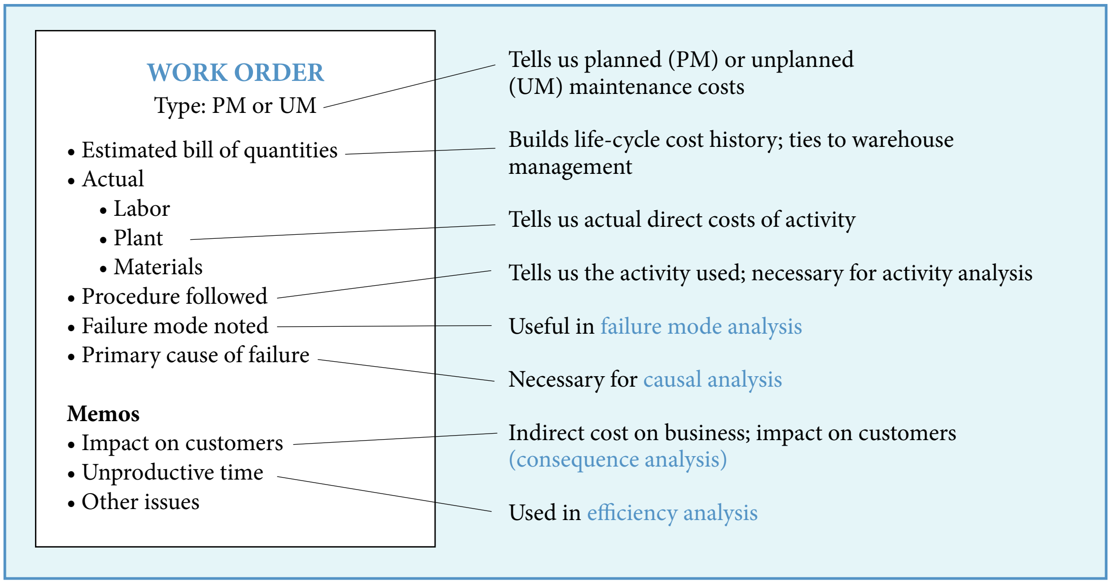
Maintenance strategy encompasses (i) how maintenance will be organized (skills-based or location-based), (ii) the choice of service delivery method (in-house or outsourced), (iii) expected functional asset performance, (iv) asset interaction with other assets, (v) information and records requirements, and (vi) maintenance prioritization. Objectives will include desired maintenance performances, such as response times, productivity, safety, and asset availability.

Maintenance plans or work plans will determine what standard operating procedures will be applied. They will also consider previously assessed risk rating, criticality, and condition. Finally, activities will take place such as inspections; planned remedial action; and unplanned work, such as dealing with breaks or overflows. Overall results are monitored, and performance will be judged against the set objectives.

Effective maintenance relies heavily on the quality of asset register information. Maintenance information should be embedded in the register or, at least, linked to the register. Maintenance will also rely on other information, such as operation and maintenance manuals, drawings, photos, manufacturer-recommended maintenance, and maintenance priority, to draw up its plans and procedures. Maintenance is also informed by knowing about asset failure modes. Asset failure modes refers to whether assets fail due to capacity overload, e.g due to operator mistake, or due to overall wear and tear.

The asset register, if computerized, can print out an inspection schedule based on a set of criteria. The system, once updated from inspection reports, can then generate work orders to inform the maintenance crew of the tasks they need to carry out and the materials needed (Figure 9).

Figure 9: Launching Maintenance



Source: GHD Course on Asset Management.

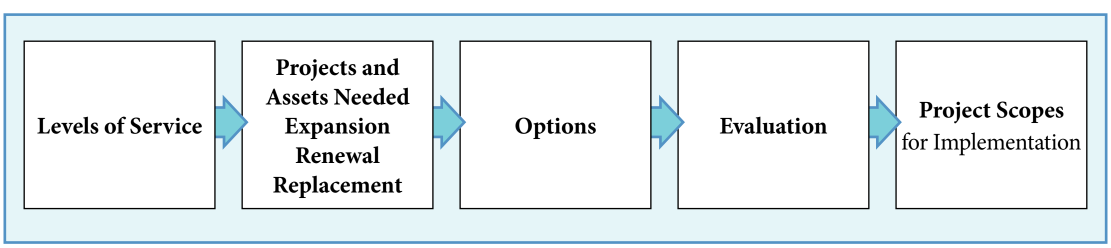
4. Capital Works Strategies

Budgeting of capital works (works that create or improve an asset) usually covers assets needed to (i) cope with growth, (ii) comply with new regulations, and (iii) renew or replace existing assets (planned or unplanned).[1] The process for capital works is in Figure 10.

Plans for capital works extend over 3-, 5-, 10-, or 20-year periods because of the different technical lifespan of the system's assets and the long lead time needed for some asset acquisition and works. In some countries, regulators set the planning period used, such as 10- and 20-year plans.

Levels of service, asset requirements, expansion, renewal, and replacements. Capital works planning begins with a demand forecast, knowledge of the existing asset base, and both the condition and expected level of service. External requirements may impose additional asset requirements to meet regulated standards for discharge, water pressure, or quality. Expansion, renewal, and replacement may be assigned different priorities if the utility cannot afford all proposed capital works.

Figure 10: Capital Works Overview



Source: Adapted from Author. 2011. *Infrastructure Management Manual*. Australia.

[1] Unplanned asset renewal or replacement results from unexpected failure.

Options. Options to consider include deferral, accepting a higher risk of failure, and design change. Service provision can also be considered as an operational cost rather than as a capital cost, such as leasing of assets owned and operated by others.

Evaluation. Next, options have to be evaluated using techniques such as risk analysis, cost–benefit analysis, and life-cycle costing before deciding on a preferred course of action. The objective is to achieve the optimum balance between capital costs, operating costs, affordability, risks, and service continuity.

Project scopes for implementation. Finally, approved projects should be described in detail for inclusion in the annual or more extended work program to enable all involved to fully understand the scope of the project, as well as its timing and expected results.

5. Financial and Funding Strategies

Proficient financial management expertise is essential to asset-intensive service businesses like water and wastewater utilities where physical assets make up at least 85% of their total assets. Annual expenses for new assets and asset renewal are significant, and most of the operating costs (for depreciation, energy, and maintenance) are driven by the asset base. Financial management is complicated when the lifespan of the assets is longer than typical borrowing periods and where revenues are dependent on asset valuations.

Utilities, therefore, need to

i. prepare long-term financial forecasts to better manage cash flows and timely asset acquisition and renewal,
ii. identify any shortfalls in funding to cover the capital works plan,
iii. negotiate borrowings based on the forecasts,
iv. test the impact of various revenue scenarios,
v. assess the consequences of using public–private partnerships for financing and operating assets (when possible), and
vi. judge the sensitivity of cash flows to varying assumptions and timings.

Assets, income, cash flow, and costs are interdependent. The forecasts have to be worked through repeatedly to get the most balanced and achievable result.

Financial management requires that the original costs of assets are recorded, along with their depreciated value, replacement value, and value as permitted by the regulator for computing a rate of return. Asset management is not restricted to engineering personnel. Financial staff have an important role to play in many aspects of asset management.

C. Asset Management Enablers

The factors that help asset management function effectively are teams, plans, systems, service delivery models, and quality management and continuous improvement. Teams and plans should be in place and supported; implementation systems should be operational; and achievements should be monitored, evaluated, and improved to achieve higher levels of effectiveness.

1. Teams

Asset management involves many skills and the entire utility staff, to some degree, so roles must be clearly defined. Clear accountability avoids duplication, confusion, or the risk of overlooking tasks. This is best stated in asset management policy and standard operating procedures. There is no best way to assign roles, although a number of organizations distinguish between asset owner, asset manager, and service delivery provider. Some centralize asset management, while others decentralize it. The competencies required for positions with asset management responsibilities should be clearly stated because they serve as basis for recruitment and staff development.

2. Plans

Document an asset management plan so everyone has a robust reference, especially given the scope of asset management, interdependencies, various skills and levels involved, risks, and financial and service consequences.

Again, there is no best template and the level of detail depends on the size of the utility. The asset management plan may be embedded in the entity's own annual or medium-term plan. It may only need additional sections for (i) revenue and tariffs, (ii) organization structure, (iii) personnel numbers, and (iv) a summary of operating costs and a balance sheet to convert the essential asset plan into the utility's business plan.

Asset management plans range from 30–50 pages to very detailed documents that can extend beyond 300 pages. If it is the utility's first time to document asset management, a simple version with a few pages should be produced as quickly as possible. This can be refined, improved, and expanded in subsequent years.

3. Systems

Integrated asset registers and supporting systems are important. Effective systems will aid decision making by (i) facilitating cost-effective asset management, (ii) helping achieve efficient customer service, (iii) enabling good management of contractors and outsourced services, and (iv) allowing for reliable reporting and analysis. A utility must invest in systems that leverage available technology and involved managers in their design if it wants to achieve superior performance.

4. Service Delivery Models

There are various options for service models and combinations: internal, outsourced (based on a schedule of rates), outsourced for a lump sum, some form of alliance or partnering, and public–private partnerships operating under build–operate–transfer or build–own–operate arrangements. A number of utilities opt not to carry out all the required tasks themselves. Some outsource maintenance, others outsource actual operations, while some outsource back-office support to service call centers.

Whichever service model is preferred, it is still very important to ensure (i) there is clarity on accountabilities and authority, (ii) risk sharing is understood, and (iii) there are backup plans if the other party fails to deliver. There should always be a thorough assessment of proposed service delivery arrangements. Some may consider producing earlier results, for example, by outsourcing to get around restrictions placed on a public utility. Although this might appear to be a good option, it can lead to expensive and unsustainable solutions.

5. Quality Management and Continuous Improvement

Water utilities usually have some form of asset management but recognize it could be improved. This performance gap is obvious through utility performance indicators, customer complaints, staff feedback, and simple observation.

One typical reaction is to rush into acquiring an all-encompassing computer system. However, without essential underpinning processes, data, and disciplines in place, the system will not work.

Steps to achieve improvements are shown in Figure 11, and can be categorized into the following broad phases:

- Identify the critical areas and assign priorities. It is not feasible to tackle a large amount of change and still sustain operations. A diagnostic framework can be used (Appendix 2).
- Assign and train a few teams to conduct the diagnosis (avoid immediate solution proposals), using proven tools to track process flows; get performance information, track causes, and identify improvement options.
- Ensure senior management buys into this process. Include it on the management agenda, promptly deal with team resourcing or barriers, and have change proposals considered and decided on quickly.
- Assign implementation to line management (not to the solutions development team), so there is ownership. Monitor the situation to confirm that expected results are achieved.
- Broadcast success, duly acknowledge recognition, and lock improved methods into place to avoid repeating old mistakes. Then begin with the next few priorities.

Along the way, the utility should gather benchmarking information. See Appendix 3 for further benchmarking comments.

Figure 11: Steps to Achieve Improvements

Conduct a high-level **diagnostic** to identify areas needing improvement and set priorities.

Set up a **continuous improvement (CI) process** and improvement **teams**.

Assign areas of improvement to teams and improvement targets.

Ensure teams are trained to apply detailed analysis and solution development **CI** tools.

Facilitate and coach teams to complete assigned improvement projects.

Benchmark processes and performance as part of each improvement project.

Management oversight of the CI process to coordinate plans and implementation.

Consideration of improvement options and approval of specific change proposals.

Implementation of improvements including staff training and systems integration.

Post evaluation to check if expected results of improvements were achieved.

Lock in new methods and approaches through standard operating practices.

Celebrate and reward improvement team achievements.

D. Conclusion

Asset management is a long-term commitment. Leading utilities that set benchmarks for others recognize that asset management is crucial to their results. Consequently, they have invested in improvements to systems and practices over many years, and have fostered an asset management attitude in their workforce.

Asset management is for all. Utilities of all sizes will have some form of asset management in place. Many utility managers will also be aware of inadequacies in their systems. However, they may be unaware of the scope and influence of sound asset management and how to improve their present policies, systems, practices, and attitudes.

Make it real. This guide will have achieved its objective if utility managers start to improve asset management by checking the status of present practices. Utility managers should then develop and implement a remedial plan that recognizes that some solutions and targeted results may take years to achieve, while others can be implemented in much less time. Utility managers can seek help to improve asset management from system providers, consultants, leading utilities, utility associations, and development agencies such as ADB.

Service matters. The customer is king. The ultimate beneficiaries of better asset management are the utilities' customers. Timely delivery and availability of quality water and wastewater services enables customers to enjoy a better quality of life and livelihood.

CHAPTER II

Asset Management Case Histories

A. Rawalpindi Water and Sanitation Agency, Rawalpindi, Pakistan

The city of Rawalpindi has a population of more than 5 million. Its water and sanitation utility, Rawalpindi Water and Sanitation Agency (RWASA), is a large urban utility structured as a government department.[2] It operates one treatment plant and about 1,150 kilometers of distribution pipelines. It delivers about 59,000 cubic meters per day through 93,000 water connections to about 1 million people. It also provides sewerage services.

Although it is considered a progressive utility in Pakistan, the RWASA still needs plenty of improvements to achieve good asset management practices.

Planning. The RWASA plans to implement asset management based on a planning horizon of more than 10 years, service standards, and whole-of-life costing. However, water supply is not metered, so the possibility of customer demand analysis is limited.

Acquisition. An acquisition policy is in place. When asset purchases are evaluated, the technical lifespan of the assets, availability of spare parts, maintenance needs, and compatibility with existing assets are frequently considered.

Asset records. While there is an asset classification system, the underlying system is not computerized. It is not regularly updated and lacks much of the information required to apply good practices.

Commissioning and operations. When commissioning new assets into operation, the RWASA ensures the process is formal, operators are trained by suppliers, and standard operating procedures are prepared. Operators are frequently given additional training but are not asked to get involved in equipment performance monitoring and reporting.

Maintenance. The RWASA relies mainly on breakdown maintenance. It does not base its maintenance schedules on asset criticality or condition monitoring. However, when breakdowns are frequent, the utility assesses whether to repair or retire the asset.

[2] For more information on the RWASA, visit www.wasa.rda.gov.pk/

Accountability. Asset management involves many different parts of the organization, so it is good practice to have clear accountability. The RWASA has not clearly defined roles and accountability, but plans to do so. Similarly they have not established a culture of caring for assets and have not drawn up a set of performance indicators against which to judge asset management performance.

Financial management. The RWASA needs to improve its asset financial management. While assets are recorded in financial statements, they are not depreciated. Maintenance costs are not tracked to specific assets, and there are problems with asset identification and insurance. Furthermore, reconciliation of physical and financial asset records seldom takes place, and aging asset reports are not available.

Overall, the RWASA rates its asset management practices as "passable" and believes it is still in an adaptation phase. It was founded in 1998, but took over assets put in place as early as 1920. This makes it difficult to identify assets and build a reliable asset register. Nevertheless, the RWASA has been computerizing its asset records from scratch and plans to acquire an asset management system and link it with a geographic information system (GIS).

B. Davao City Water District, Davao, Philippines

Davao is a medium-sized city with a population of about 1.5 million in 2010. Its water utility, Davao City Water District (DCWD) is expected to service both the city and its surrounding areas. The utility has 179,000 connections.

Planning. The DCWD includes in its planning all its treatment and distribution physical assets, whether for expansion or for upgrades to meet new standards. However, it seldom considers renewals, retirements, or major overhauls. It needs to develop an investment plan with a time horizon of 10 years or more. Most planning is constrained by funding availability, while top priority is given to major failure response. The DCWD seldom bases its planning on a set of system service standards, compliance with the standards of the International Organization for Standardization (ISO), or cost–benefit analysis. It does not refer to predetermined asset economic life and asset condition monitoring, but it intends to enhance its planning to do so soon. As part of asset planning improvement, the DCWD is considering reflecting asset plans in short- and long-term cash forecasts, and assessing the impacts of asset plans on future tariff levels and targeted service levels.

Acquisition. The DCWD has weak acquisition policies, but it has plans to improve them. However, asset proposal evaluations frequently consider whole-of-life-cycle costs and compatibility with present equipment. They seldom include maintenance and spare parts in evaluations.

Asset records. Although asset records contain key information, such as location linked to GIS, information on units of measure and the type of material remain incomplete. There is a partial asset classification system. Dates of acquisition are not always recorded, records are seldom used for maintenance scheduling and do not hold useful-life data, and there is no asset criticality rating or linked information on maintenance history.

Asset records are neither fully computerized nor integrated with other systems, and they are not audited to verify accuracy. Perhaps as a consequence, they are seldom used in asset and maintenance planning, as they are not considered comprehensive and reliable. They are, however, partially used in computing tariff levels. Physical records are reconciled with financial records.

Commissioning and operations. When commissioning new assets, the DCWD frequently implements formal procedures but seldom obtains staff training from suppliers, initiates formal operator training, or prepares standard operating procedures. Operators, therefore, rarely conduct equipment monitoring and reporting.

Maintenance. Like other utilities in developing countries, the DCWD places much greater reliance on breakdown maintenance than on preventive maintenance. Maintenance is rarely based on asset criticality and condition monitoring. Any existing planned maintenance does not rely on advice from suppliers or set inspection intervals. Even when breakdown maintenance occurs, it does not automatically trigger an assessment to repair or retire the asset.

Accountability. While there is clear accountability for asset acquisition, this does not apply to other key asset management processes such as planning or asset renewal. Although responsibility for asset records is in place, there is a need for clear accountability for operation and maintenance, and investigating new technologies. The importance of asset management is not widely understood, and there is no culture of caring for assets.

Given the mixed picture on accountability, the use of indicators exhibits a similar pattern. For example, the DCWD rarely tracks asset-driven items with high operating costs, such as planned versus actual maintenance and planned versus actual energy usage. Still, nonrevenue water, meter accuracy, and system breakdowns and failures are tracked and reported.

Financial management. The DCWD performs much more strongly on financial management. Physical and financial asset records are reconciled, key assets are identified and insured, assets are recorded in a balance sheet, and the cost of maintenance is attributed to specific assets. A report on asset aging is also available. Operating costs, however, do not include the cost of asset usage (depreciation), so they are still not comprehensive.

Overall, the DCWD understands that its asset management can be considerably improved to overcome present program fragmentation and enhance its operating practices. In 2008 it started with a program to improve its service delivery coverage, reliability, and efficiency. Actions have included a preventive meter maintenance program, an electronic government accounting system, a mainline replacement program, a mainline extension program, a change meter program, and GIS updates. A number of these initiatives would be relevant to other developing utilities.

Several clear challenges remain to be addressed, such as internal system deficiencies (centralized records, intranet, and GIS); downward communication flow; insufficient and nonintegrated software; and lack of system and operational manuals. The DCWD continues to acknowledge that there is a "lack of documented policies, archiving, training, property accountability, financial management manuals, and, generally, a lack of asset management knowledge and expertise."

An important observation by the DCWD is that the lag in asset management evolution led to compromises on data reliability and comprehensiveness, partly due to changes in software applications. It plans to fully integrate GIS into its asset record systems. Clear accountability for asset management or its components is expected to also drive further enhancements.

Good points. An ADB-supported program of continuous improvement led to better asset management. Other utilities would be interested in a number of these programs, such as the preventive meter maintenance program.

C. Barwon Water, State of Victoria, Australia

The Barwon Region Water Corporation is a large regional utility that services a number of regional towns and rural areas in the State of Victoria. It is the largest water corporation outside the Melbourne Metropolitan Area, providing high-standard water and sewerage services to about 300,000 customers. The number of customers rises sharply to about 500,000 in the peak summer season with the influx of tourists to the coastal towns and villages. Area served extends over 8,000 square kilometers. Assets are valued at A$1 billion, and include 5,000 kilometers of pipe, 10 major reservoirs, 10 water treatment plants, and 9 water reclamation facilities. The utility employs about 423 people and has an average annual capital expenditure of A$100 million.

Planning. Barwon Water prepares a detailed 5-year plan to accord with the 5-year tariff-setting period and performance standards set by the regulator. It also has a 10-year capital expenditure plan that covers both system renewal and expansion and upgrades stemming from changes in standards, including water recycling.

To determine pipeline replacement, Barwon Water engages the Commonwealth Scientific and Industrial Research Organization, the national science agency, to run the Pipeline Asset and Risk Management System—a simulation program that seeks to determine the best balance between affordable asset investment and preventing asset failure with consequent adverse impacts on service levels and meeting regulatory standards.

Acquisition. Within the context of the planning cycle, asset proposals are subject to a business case evaluation. While maintenance and spare parts form part of the evaluation, whole-of-life-cycle costing is currently not computed.

Asset records. Asset records are divided into aboveground and underground (pipeline) assets. Only pipes are linked to the GIS. Barwon Water plans to link more assets to make full use of GIS technology. Expressions of interest are being sought to provide a more comprehensive, computer-based asset recording and maintenance system.

The Maintenance Management System holds information on asset types; maintenance schedules; maintenance history; and, to some extent, expected useful lives. The financial system also records assets, resulting in duplication. The source of information for both systems is usually the same.

Asset records are continuously updated as transactions occur. Records are fully computerized, and are used to develop asset and maintenance plans. They are also an essential part of the tariff-setting process.

Commissioning and operations. Barwon Water gets the most from its assets by ensuring there are formal commissioning procedures, including training by equipment suppliers. Standard operating procedures are put in place and adhered to. Operators conduct equipment monitoring and reporting.

Maintenance. Maintenance is time based, following pre-set servicing intervals and not based on condition monitoring and asset claification. The utility determines maintenance scheduling based on information from equipment suppliers and in-house maintenance experiences.

Maintenance activities are divided equally between planned and breakdown maintenance. When breakdowns occur, the general practice is to replace like with like, but sometimes the opportunity is taken to make a major change.

There is a rolling water meter assessment and replacement program, and a leak minimization program. Pressure-reducing valves are installed in areas with high pressure that causes pipe bursts.

Accountability. Barwon Water has clear accountabilities for the different aspects of asset management, planning, acquisition, operation, maintenance, records, and renewals. However, while progress is being made, there is not yet a widespread and embedded culture of caring for assets.

A set of indicators is used to judge asset performance, some of which are obligations imposed by the regulator. However, the utility relies more on tracking actual performance and trends, such as energy usage, actual maintenance, and nonrevenue water, than on comparing planned with actual results.

Financial management. In line with water sector regulation in Victoria, Barwon Water has its assets valued and recorded in its balance sheet. Depreciation is charged to its operating statement. Currently 15% of the water production is unaccounted for. There is a view that reducing it may be difficult and may not be economically viable given the nature of the territory served.

Good points. Barwon Water considers its asset management practices to be in line with best practice, although it is looking to improve its underlying asset computer system and recording of pipeline assets. Two good points are as follows:

i. Barwon uses laptops and personal digital assistants to record and upload information from the field personnel into the shared asset-maintenance system.
ii. Its sewer infrastructure management system helps it generate a maintenance program to prevent breakdowns, lowering breakdown maintenance, sewer blockages, and costs. The sewer infrastructure system makes financial calculations to compute the costs of preventative maintenance versus the costs of blockages and service interruptions.

D. National Water Supply and Drainage Board, Sri Lanka

Sri Lanka's water authority, the National Water Supply and Drainage Board (NWSDB), is independent and responsible for its revenues, costs, and capital expenditures. It is a country-wide utility serving a number of independent regions comprising towns and villages, with the biggest region covering the capital, Colombo. There are 26 water treatment plants, 2,870 kilometers of distribution pipelines, and 180,000 metered properties and businesses. The daily volume of treated water is 143,000 cubic meters. The NWSDB also handles a much smaller wastewater treatment system.

Planning. The NWSDB practices long-term planning (10 years or more) and covers the treatment and distribution assets, renewals, retirements, and system expansion. It plans to incorporate more upgrades to meet new standards in its planning processes. Asset planning is based on condition monitoring; cost–benefit analysis; and, to a lesser extent, reaction to major failures. There is no planning based on a set of system service standards, compliance with ISO standards, or predetermined economic life.

Acquisition. The NWSDB has policies in place to cover asset acquisition. Compatibility with present equipment, maintenance, and spare parts are evaluation factors. However, whole-of-life-cycle costing is not mentioned as a feature of the acquisition process.

Asset records. The NWSDB relies on GIS as part of its asset records to establish asset location. Its asset records frequently record the date of acquisition, quantity, maintenance schedule, type of material, and financial information. However, they lack criticality rating, which ties in with frequency of maintenance, renewal timing, and expected useful life. Nevertheless, asset records are fully computerized, comprehensive and reliable, audited to verify accuracy, and used for asset and maintenance planning. Records are updated monthly.

Commissioning and operations. There are formal commissioning procedures for new assets, and the NWSDB ensures that staff are trained by equipment suppliers, standard operating practices are developed, and operator training occurs. Operators are also expected to monitor equipment and regularly report on its condition.

Maintenance. The NWSDB regularly conducts planned maintenance based on asset criticality and condition monitoring. It also relies on advice from suppliers on maintenance frequency when scheduling inspections and maintenance.

Accountability. Asset accountability at the NWSDB is strong, with clear responsibilities and authorities for planning, acquisition, operation, maintenance, renewal and retirement, and records. The utility has a process for investigating new technologies and a culture of caring for assets. However, it seldom recognizes the importance of asset management.

Asset accountability is facilitated by a set of indicators that are used to judge asset performance at various points of asset ownership, including for system breakdowns and failures, planned versus actual energy usage, planned versus actual maintenance, and nonrevenue water. There are also indicators for judging meter accuracy.

Financial management. Physical assets are recorded in financial terms in the NWSDB balance sheet, costs of maintaining assets are recorded, and the specific assets are depreciated with charges booked against revenue for asset usage. However, there is still room for improvement. Financial and physical asset records are seldom reconciled against one another; key assets are not identified and insured; and asset aging reports, which help reveal the likely pattern of future replacement and maintenance, are not available from the accounting records.

Good points. Although the NWSDB is doing many things right on asset management, it knows it can do more. Therefore, it rates itself as “passable” in terms of good asset practice management. Since 2008, it has invested in establishing better asset registers, organizing asset management training, and making asset management a part of maintenance attitude and processes.

The NWSDB’s challenge is to keep trained staff engaged in the asset management process. As an authority that operates under government employment conditions, job rotation and internal movements in the NWSDB sometimes work against training and retaining a skilled workforce for certain functions.

The NWSDB also lacks access to a pool of asset management experts and a network to improve asset management. This problem is shared by other utilities that are also dependent on their own resources and contacts. This type of problem presents an opportunity for international development agencies to become more deeply engaged.

E. Hai Phong Water Supply Company, Hai Phong, Viet Nam

The Hai Phong Water Supply Company (HPWSC) is a government-owned utility that provides Hai Phong City with potable water. It has approximately 200,000 connections and treats an average 163.715 cubic meters of water per day.

Planning. The HPWSC's asset planning covers all treatment and distribution assets, upgrades, system expansion, scheduled renewals, retirements, and major overhauls. Often, it is based on a set of system standards, predetermined asset economic life, condition monitoring, and reaction to major failures. Like many utilities, it is also impacted by the availability of funds. Financial justification needs strengthening as cost–benefit analysis is seldom the basis for asset planning. There is little attempt to apply ISO standards as part of the planning process.

Much of the focus is on short-term planning (1 year), with less attention to medium-term (5 years) and longer-term (10 years or more) planning, so it is difficult to assess asset planning impacts on the tariff level and trend. Nevertheless, targeted service levels are frequently considered during asset planning.

Acquisition. The HPWSC has had to continually expand services to serve its customer base and, therefore, has reliable asset acquisition practices in place. It has asset acquisition policies and considers whole-of-life-cycle costing when evaluating offers, maintenance and spare parts, and compatibility with existing equipment.

Asset records. While there is a comprehensive asset classification system and the records frequently contain key information such as acquisition date, criticality, maintenance schedule, maintenance history, and expected useful life, the HPWSC may have some challenges with location information and records that are not linked to GIS. The expected useful life is seldom recorded. The utility intends to update its asset records monthly, but does not always do so. Nevertheless, records are computerized, frequently integrated with other systems, and used to develop asset and maintenance plans.

Commissioning and operations. The HPWSC approaches commissioning and operations thoroughly. It ensures that (i) there are formal commissioning procedures, (ii) equipment training is conducted for staff by suppliers, (iii) standard operating practices are prepared, and (iv) operators are given formal training. Operators are also expected to monitor equipment performance and report as needed.

Maintenance. While there is frequently more breakdown maintenance than planned maintenance, the HPWSC puts considerable effort into maintenance practices. Frequently, maintenance planning is based on asset criticality, condition monitoring, and advice by suppliers. When breakdowns occur, the HPWSC assesses whether to repair, retire, or replace the asset.

Accountability. The HPWSC considers it has clear accountabilities established for asset planning, acquisition, operation, and maintenance. Furthermore, this view also applies to asset records and investigating new technologies. There is a reasonably well-developed culture of caring for assets and recognizing the importance of asset management.

To support accountability, the HPWSC has a set of indicators to judge asset performance, including reports on system breakdowns and failures, planned versus actual energy usage, planned versus actual maintenance, nonrevenue water, and meter accuracy.

Financial management. In well-run utilities like the HPWSC, it is important that the assets are recorded in a balance sheet and depreciated as used. Financial and physical assets are frequently reconciled, and the costs of maintenance are attributed to specific assets. An asset-aging report, which is useful for assessing replacement expenditures, is often available. However, key assets are rarely identified and insured.

Good points. Since 2008, the HPWSC has improved its performance in many areas by focusing on factors such as (i) developing its short- and longer-term investment planning, (ii) assigning responsibilities to units for specific assets, (iii) improving asset management skills, (iv) planning asset maintenance, (v) monitoring asset management activities, and (vi) undertaking an annual asset inventory.

The organization's major challenges are (i) obtaining sufficient finance to help sustain asset condition and service performance, (ii) upgrading the skills of some of the workforce, (iii) revising outdated methods, and (iv) remedying slow feedback within departments. To address some of these issues, the HPWSC intends to (i) improve its medium- and long-range cash forecasting, (ii) assess the impact of assets over the longer term on tariff levels, and (iii) record the useful life of assets.

The HPWSC would advise other utility managers to (i) ensure that investment in new assets is compatible with existing assets (e.g., investing in a high-capacity new pump is useless if the pipe system is too old); (ii) invest in people skills, as this improves performance; (iii) match assets to the service area's geographical conditions (e.g., using polyethylene pipes suits the saline nature of HPWSC's service area); and (iv) ensure overall financial capacity exists to be able to afford new and replacement assets.

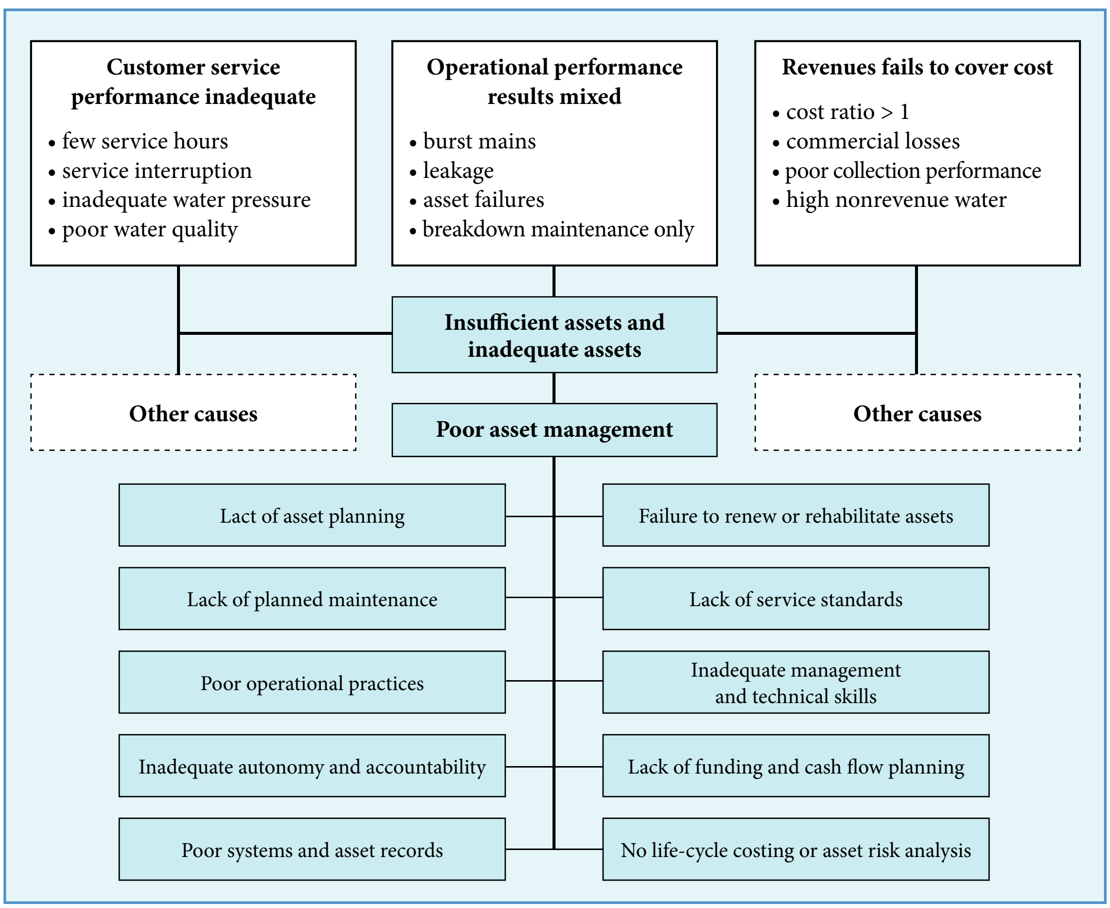
The HPWSC would appreciate external help to involve its technology, management practices, and financial sources.

CHAPTER III
ADB Perspectives

Through engagement with utilities in DMCs, ADB's staff is regularly confronted with the consequences of inadequate asset management—such as lack of customer coverage, poor service delivery, high nonrevenue water and high levels of costly breakdown maintenance.

Lending for new infrastructure and to replace existing worn-out assets would yield some immediate benefits, but sustainability will not be assured and the full benefits will not be realized unless better asset management to raise utility performance is also part of the solution. The problem tree in Figure 12 illustrates factors that contribute to poor asset management.

Figure 12: Asset Management Problem Analysis



Source: Asian Development Bank.

The problem tree is translated into a logical framework, or design and monitoring framework, tailored to the proposed project. Figure 13 provides an indicative design and monitoring framework for water utility asset management.

Figure 13: Indicative Design and Monitoring Framework

Design Summary	Performance Targets/ Indicators	Indicator Sources	Assumptions and Risk
Impact: Utility meets its service obligations on a financially sustainability basis	Coverage: X% population Service hours at least X/day Service Interruptions < X	Utility management information	**Assumption** Finance is available to fund planned infrastructure investment.
Outcome: Improved utility asset management	Improvement in selected asset indicators over 2012 baseline (International Water Association defined indicators) e.g., • water losses per connection (cubic meters/connection/ year) • pump failures (days/pump/year) • main failures (number/100 kilometers/ year) • Hydrant failures (number/1,000 hydrants/ year)	Utility records	**Assumption** Utility management fully implements asset management modules.
Outputs: Asset management diagnostic guide Asset improvement recommendations Asset management modules in place • Organization • Asset policies and plans • Asset inventory • Asset registers and systems • Asset skills • Maintenance system • Risk matrix and classification • Standard operating practices • Performance indicators • Cash flow forecasts	Completed by (date) Completed by (date) Complete by (date)	Project reports Project reports Project reports	**Assumption** Priorities of the utility do not change. **Risk** Key utility management and staff may change.
Activities with Milestones 1. Mobilize asset management team by (month year) 2. Develop implementation plan by (month year) 3. Recruit expert advisers by (month year) 4. Carry out work program (month–month year) 5. Train utility staff (month–month year)			**Inputs:** **ADB: $’000** Utility personnel: $’000 Consultants: $’000 Software: $’000 Training: $’000

Source: Asian Development Bank.

ADB usually assists a utility by initially financing a utility asset management diagnostic study, either through capacity development technical assistance or as part of project preparatory technical assistance. The study will use a diagnostic guide (similar to the one described in Chapter I) developed by the consultants (Box 2).

Box 2: Indicative Terms of Reference for Consultants to Assist in an Asset Management Improvement Project

Objective. To improve the asset management practices and performance of utility X so that it can sustainably meet its regulated service standards (or, in the absence of regulated standards, those that represent good practice as reported in regional benchmarking studies).

Outputs. The consultant will provide

- a project work plan;
- a diagnostic report of utility X's current asset management policies, plans, and practices;
- identification of key performance indicators and baselines, and agreement on targets (level and time frame);
- recommendation of priority actions based upon the diagnostic findings and taking into consideration the (i) capacity of the organization to initiate and absorb change, (ii) need to achieve the maximum performance benefits as early as possible, (iii) importance of building internal commitment, (iv) interdependencies of the asset management modules, and (v) estimated costs and resources involved in achieving change;
- an implementation timetable based on approved recommendations;
- asset management modules required by the implementation plan, including conducting awareness training for selected management and staff; and
- inception, progress, and completion reports in accordance with the agreed implementation plan with comment on expected and actual asset management performance results.

Detailed tasks. Detailed tasks are embedded in the work plan and project implementation plans.

Caveats. The consultant's outputs are dependent upon the utility providing an implementation team and sustaining the team for the duration of the implementation period. They also depend on the acquisition of new software or modification of existing software needed to underpin reliable asset registers and the asset management modules referred to in the implementation plan. As an alternative to a full technical assistance project, a pilot study could be conducted to provide at least a diagnostic report, which could then be used to frame a more substantive assistance project.

Source: Asian Development Bank.

A thorough diagnostic study will assure ADB staff that their project has a sound basis for deciding the best sequencing of remedial actions. This ensures that they will achieve better utility results over a realistic time frame. Management might be tempted to obtain quick results by moving directly from the observed poor indicator, such as nonrevenue losses, to an immediate action. In one case, management wanted to prioritize hydraulic modeling and pipe infrastructure replacement. However, more experienced managers prioritized actions toward sustainable benefits, such as building the capacity of management to implement and sustain change programs.

Box 3: Asset Management Issues and Proposed Solutions

	Issue	Solution
(i)	Unclear organization and responsibility for Asset Management Policy (AMP) within National Water Supply and Drainage Board (NWSDB)	Establishing Head Office (HO) and Regional Service Center (RSC) level organization structures and clarifying the role and scope of HO and RSC teams in the delivery of Asset Management (AM) services;
(ii)	No clear definition of strategy and policy for AMP	Preparation of policy and process and an implementation plan for asset condition assessment, network mapping, etc.;
(iii)	Lack of a comprehensive asset management system which tracks assets condition and performance	Evaluation and implementation of a comprehensive asset management system including a technical review of the existing asset recording system and evaluating how these could be integrated;
(iv)	Duplicate information systems for asset register and asset management purposes—Oracle database that currently holds the Asset register, and the Enterprise Solution Software which is not yet implemented. Linkages between the two systems are unclear.	Preparation of a strategic information system (IS) which provides details for the required functionality within NWSDB asset management IS. This required functionality should be mapped against currently available functionality gaps. This may involve upgrading of existing software or it may entail purchasing additional software and integrating it with current systems. NWSDB needs to make a decision on this.
(v)	Asset Register only partially complete	Survey of all assets to establish asset baseline;
(vi)	Lack of detailed network plans and maps	Comprehensive mapping of existing assets (use of GIS and linking to selected AM system);
(vii)	Limited understanding of asset condition	Condition assessment of all assets;
(viii)	Limited understanding of asset performance	Asset performance monitoring e.g. network modeling to assets the performance and capacity of pipelines as they age; condition-based maintenance where maintenance decisions are made based on accurate analysis of the condition of the asset as pumps and motors.

Source: ADB. 2010. *Technical Assistance to Sri Lanka for Institutional Strengthening for Decentralized Service Delivery in the Water Sector.* Manila (TA 7078-SRI).

In June 2010, under the Institutional Strengthening for Decentralized Service Delivery in the Water Sector Project, a report was prepared on asset management planning for the National Water Supply and Drainage Board (NWSDB) of Sri Lanka.[3] The problems relating to asset management were summarized in the consultant's report with suggested solutions (Box 3). This example provides a reference case for ADB staff.

[3] ADB. 2010. *Technical Assistance to Sri Lanka for Institutional Strengthening for Decentralized Service Delivery in the Water Sector.* Manila (TA 7078-SRI).

Among the issues described in this technical assistance project are (i) asset and investment planning, (ii) asset register management, (iii) maintenance management, and (iv) asset performance monitoring and evaluation.

The consultants were asked to produce 5-year asset plans. However, according to their assessment, the state of the records and the quality of the inventory of existing assets, including their condition, was insufficient to fulfill the planning request within the time frame. This barrier to better planning is not unusual, but the consultants were able to offer a number of change proposals that will lead to better planning over time. The utility kept asset records primarily for accounting rather than for engineering purposes, when they should serve both purposes. Engineering needs comprehensive asset records to help management determine asset renewal investment and maintenance.

The key issue is deciding on the sequencing of solutions, as some problems may take considerable time and effort to remedy, such as obtaining an accurate inventory of assets. Recommendations for improved asset planning must be based on extensive background information. Gathering this information requires a great deal of effort and can only be realistically achieved over several years. The information needs include

- population, service coverage, and demand analysis;
- analysis of current (start of plan period) levels of service;
- statement of maintenance strategy and incorporation of maintenance schedules;
- investment forecast for rehabilitation and new or augmentation initiatives; this should be linked to a forecast of levels of service improvement resulting from each investment or maintenance decision;
- a statement of measurement and monitoring strategies to be used during the plan period and associated investments; and
- a statement of the current asset register position, including asset condition analyses and criticality analyses for all assets.

The consultant's report contains asset[4] surveys for a number of the water schemes of the NWSDB of Sri Lanka. These provide another diagnostic guide (other than that provided in Chapter I) for other utilities. The report also mentions several actions to raise asset management performance, such as the use of training sessions to build asset management awareness and the setting up of an asset management team to oversee the implementation of the asset management improvement program.

[4] Appendix 2 of Volume 6: Asset Management Planning Report, of the Final Report.
URL: www.adb.org/sites/default/files/projdocs/2010/41679-01-sri-tacr-06.pdf

APPENDIX 1
Computer-Based Asset Management Systems

A computer-based system is needed because of the volume of data required for asset management and the need to access and share such information easily in different locations. Asset management is not a stand-alone system, because it impinges on many other aspects of utility operations such as maintenance, procurement, financial records of assets, and planning. Rather, it is a series of modules that are an integral part of the company-wide or enterprise-wide systems.

Typically, utilities acquire asset management systems provided by vendors as part of the vendor's enterprise systems, such as IBM's Maximo asset management software and SAP's Total Systems. There are other systems on offer. Each utility needs to select a system based on several critical factors apart from the system's features. This document does not advocate any one supplier's products, but merely uses a vendor's product to illustrate the modules involved and their capabilities.

Systems are available that suit both very large, complex businesses and much smaller enterprises, so it should not be assumed that only large utilities can afford computer-based asset systems. For larger utilities, the installation of computer systems costs more, takes longer to implement, and involves a culture change to ensure information is shared across departments. The experiences of Severn Trent Water, a water utility in the United Kingdom that employs about 5,500 staff, illustrate this point. In conjunction with IBM, the utility produced a video on their asset management systems expectations and experiences (see www.youtube.com/watch?v=p5z_c1F-vvY).

The IBM Maximo system has modules for work management, asset inventory, service management, and procurement. Each module provides a crucial part of the asset management system. For example, work management is concerned with the issuing of work orders for planned and unplanned maintenance based on information drawn from the asset management module. It tracks assets and holds details of their location, type, condition, criticality, and hierarchy. Asset inventory covers the tracking of parts needed to maintain assets and is related to the work management module that will indicate parts needed to carry out maintenance. Service management allows end users to submit service requests and manage open service requests. Procurement deals with tracking vendors and placing purchase orders for inventory replenishment.

The system has features that allow managers to plan, anticipate, and act before asset breakdowns occur, and to share information as the modules rely on a number of common databases.[1]

It is not necessary for all modules to be in place before the system is useful. The asset and work order modules will come first, followed by inventory and procurement. The system's web interface makes it easily available from a number of locations or to staff on the move, such as the maintenance crew. It can also be sited on a single computer for a small to medium-sized organization or scaled-up to service the largest of enterprises.

[1] See www.youtube.com/watch?v=oguxv7XHqHI&feature=related for a brief visual explanation of this type of software system.

APPENDIX 2

Asset Management Self-Diagnostic Guide

Table A2 provides an indicative diagnostic guide to determine the quality and comprehensiveness of a utility's asset management practices.[1]

Table A2: Asset Management Self-Diagnostic Guide

Asset Management Aspect	Minimum	Core	Intermediate	Advanced
Policy	Corporate expectations are expressed informally and simply: all departments must update asset plans every 3 years.	Policy statements are defined for all significant activities. There is a clear link to corporate goals, and action plans and accountabilities are stated.	All policy and strategies are reviewed and adopted by executive team each year. Detailed plans, resources, responsibilities, and time frames are in place.	Asset management policy and strategy are integrated into the organization's business processes and subject to audit, review, and updating procedures.
Demand forecast	Demand forecasts are based on experienced staff predictions. Past demand trends and likely future growth patterns are considered.	Demand forecasts are based on robust projections. Risks associated with demand change are broadly understood and documented.	Demand forecasts are based on mathematical analysis of past trends and primary factors. A range of scenarios is developed.	Demand forecast includes risk assessment of different demand scenarios with identified mitigation actions.
Levels of service	Asset's contribution to the organization's objectives and some basic levels of service have been defined.	Customer groups have been defined and requirements informally understood. Levels of service and performance measures are in place covering a range of service attributes. There is annual reporting against service targets.	Customer group needs are analyzed. Costs to deliver alternative levels of service are assessed. Customers are consulted on significant service levels and options.	Levels of service consultation strategy is developed and implemented. Technical and customer levels of service are integral to decision making and business planning.

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[1] The New Zealand Asset Management Support Group. 2011. *International Infrastructure Management Manual*. New Zealand. www.nams.org.nz/pages/273/international-infrastructure-management-manual-2011-edition.htm

Table continued

Asset Management Aspect	Minimum	Core	Intermediate	Advanced
Asset register	Basic physical information is recorded in a spreadsheet or similar (location, size, type), but may be based on broad assumptions or may be incomplete.	There is sufficient information to complete asset valuation (same as for minimum level, plus replacement cost and asset age life). Asset hierarchy, asset identification, and asset attribute systems are documented.	A reliable register of physical and financial attributes is recorded in an information system with data analysis and reporting functionality. A systematic and documented data collection process is in place. There is a high level of confidence in critical asset data.	Information on work history type and cost, condition, performance, etc., is recorded at the asset component level. There is a systematic and fully optimized data collection program. There is a complete database for critical assets and minimal assumptions for noncritical assets.
Asset condition assessment	Condition assessment is conducted at asset group level (top down). This supports minimum requirements for managing critical assets and statutory requirements (e.g., safety).	Condition assessment program is in place for major asset types prioritized based on asset risk. Data supports asset life assessment. Data management standards and processes are documented. A program for data improvement is developed.	Condition assessment program is derived from cost–benefit analysis of options. A good range of condition data for all asset types may be sampling based. Data management processes are fully integrated into business processes. Data validation process is in place.	The quality and completeness of condition information supports risk management. Life-cycle decision making and financial performance reporting are done. Periodic reviews of program suitability are carried out.
Risk management	Critical assets are understood by staff involved in maintenance and renewal decisions.	A risk framework is developed. Critical assets and high risks are identified. Risk management strategies are documented for critical assets and high risks.	Systematic risk analysis assists key decision making. Risk register is regularly monitored and reported on. Risk is managed consistently across the organization.	A formal risk management policy is in place. Risk is quantified and risk mitigation options are evaluated. Risk is integrated into all aspects of decision making.
Decision making	All decisions are based largely on staff judgment and agreed corporate priorities.	Formal decision-making techniques (cost–benefit analysis, multicriteria analysis) are applied to major projects and programs.	Formal decision-making and prioritization techniques are applied to all operational and capital asset programs within each main budget category. Critical assumptions and estimates are tested for sensitivity to results.	The same as for intermediate, plus the framework enables projects and programs to be optimized across all activity areas. Formal risk-based sensitivity analysis is carried out.

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Table continued

Asset Management Aspect	Minimum	Core	Intermediate	Advanced
Operational planning	Operational responses are understood by key staff, but plans may not be well documented and are mainly reactive in nature. Asset utilization is measured for some key assets but is not routinely analyzed.	Emergency response plan is developed. Demand management is considered in major asset planning. Asset utilization is measured for critical asset groups and is routinely analyzed.	Emergency response plans and business continuity plans are routinely developed and tested. Demand management is a component of all operational decision making. Asset utilization is measured and analyzed for most asset groups.	Operational plans are routinely analyzed, tested, and improved. Formal debriefs occur after incidents. Asset utilization is measured in real time and effectiveness is analyzed across all asset groups. Operational programs are optimized using cost–benefit and risk analysis.
Maintenance planning	Organizational objectives and how asset functions support these are understood. Maintenance planning is compliant with legislation and regulation. Maintenance records are maintained.	Asset criticality is considered in response processes, fault tracking, and closure process. Strategy for prescriptive versus performance-based maintenance is developed. Key maintenance objectives are established and measured.	There are contingency plans for all maintenance activities. Asset failure mode is understood. The frequency of preventive maintenance is optimized using cost–benefit analysis. Maintenance management software is implemented.	Forensic root cause analysis is used for major faults. Optimization of all reactive and planned programs alongside renewal planning. Procurement models are fully explored.
Capital works planning	There is a schedule of proposed capital projects and associated costs based on staff judgment of future requirements.	Projects have been collated from a wide range of sources such as hydraulic models, operational staff, and risk processes. Capital projects for the next 3 years are fully scoped and estimated.	Same as for core level, plus formal options analysis and business case development has been completed for major projects in the 3–5 year period. Major capital projects for the next 10–20 years are conceptually identified and broad cost estimates are available.	Long-term capital investment programs are developed using advanced decision-making techniques such as predictive renewal modeling.
Financial management	Assets are valued in compliance with accounting standards and 10-year forecasts, and are generally based on extrapolation of past expenditures.	10-year forecasts are based on asset management data including expected life, renewals, and service levels. Clear underpinning assumptions are stated. Expenditures are classified according to asset management categories.	Asset valuations and revaluations have a high level of confidence. Financial forecasts are tied exclusively to asset management systems.	All financial data have a very high level of confidence. Financial modeling is used to simulate various capital expenditure scenarios and impacts on life-cycle costs and service delivery.

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Table continued

Asset Management Aspect	Minimum	Core	Intermediate	Advanced
Asset management teams capability	Asset management is allocated primarily to one or two people who have asset management experience.	Coordination occurs through a steering group or committee. Asset management training occurs for primary staff. The executive team has considered options for asset management functions and structures.	All staff in the organization understand their role in asset management, it is defined in their job descriptions, and they receive supportive training aligned to that role. A person on the executive team has responsibility for delivering the asset management policy and strategy.	A formal asset management capability-building program is in place and routinely monitored. The asset management structure has been formally reviewed with consideration of the costs and benefits of options.
Asset management plans	Asset management plan contains basic information on assets, service levels, planned works and financial forecasts (5-10 years), and future improvements.	In addition, the plan contains an executive summary, description of services and key critical assets, top-down condition and performance description, future demand forecasts, description of supporting asset management processes, 10-year financial forecasts, and 3-year asset management improvement plan.	In addition, the plan contains an analysis of asset condition and performance trends, (past and future) customer engagement in setting levels of service, and risk techniques applied to major programs.	In addition, the plan contains evidence of programs driven by comprehensive Object Database Management techniques, risk management programs, and level of service versus cost trade-off analysis. Improvement program is largely complete with a focus on ongoing maintenance of current practice.
Information systems	Asset resister can record core asset attributes—size, material, etc. Asset information reports can be manually generated for asset management plan input.	Asset register enables hierarchical reporting (at components to facility level). Customer request tracking and planned maintenance functionality is enabled. System manual reports to be generated for valuation and renewal forecasting.	There is more automated analysis reporting on a wide range of information. Key operations, unplanned maintenance, and condition and performance information is held.	Financial asset and customer service systems are integrated and all advanced asset management functions are enabled.
Service delivery mechanisms	Service delivery roles are clearly allocated (internal and external) generally following historic approaches.	Contracts are in place for external service provision. Core functions are defined.	Internal service level agreements are in place with internal providers. Contracting approaches are reviewed to identify the best delivery mechanism. Tendering and contracting policy is in place. Competitive tendering practices are applied.	All potential service delivery mechanisms are reviewed and formal analysis is carried out. Risks, benefits, and costs of various outsourcing options are considered.

APPENDIX 3
Benchmarking

In Australia, a repeat study on asset management was completed in 2008 following an earlier study in 2004, and a new study was undertaken in 2012. The 2004 and 2008 studies covered 42 utilities from Australia, New Zealand, the Middle East, Asia, and North America. The same methodology was used on both occasions. The studies concluded that the project

> provides a substantial body of knowledge for building improvements in asset management. Irrespective of the history and context of each utility in terms of region, function, size, ownership, or form of regulation, participants were keen to improve their asset management processes and, by inference, their performance for customers, shareholders, staff, and other stakeholders.

The studies found that the best water utilities take three additional and clear actions. First, they invest in demonstrable leadership of the change initiative. Effective asset management is enabled by the active support of the most senior executives, and is in turn supported by a detailed bottom-up commitment to specific, targeted improvement initiatives. Second, they regard asset management as an integrated whole and create initiatives that lead to improvement as part of a cohesive plan. Working in silos is avoided. Third, they appreciate that building a strong asset management capability takes years—they see it as a journey, and no matter what other issues they confront, they stay focused on the core asset management improvement tasks.

Water Utility Asset Management
A Guide for Development Practitioners

Experiences of the Asian Development Bank (ADB) in the water supply sector show the consequences of inadequate asset management, such as lack of customer coverage and high nonrevenue water ratios. One response is lending to allow for new infrastructure. Some immediate benefits may be evident, but sustainability is at risk unless better asset management is part of the solution. This guide provides ADB's perspective on asset management, as well as an overview of the concept, processes, and systems of asset management, followed by a presentation of case studies about what utilities have done to manage their assets, including the results achieved.

About the Asian Development Bank

ADB's vision is an Asia and Pacific region free of poverty. Its mission is to help its developing member countries reduce poverty and improve the quality of life of their people. Despite the region's many successes, it remains home to two-thirds of the world's poor: 1.7 billion people who live on less than $2 a day, with 828 million struggling on less than $1.25 a day. ADB is committed to reducing poverty through inclusive economic growth, environmentally sustainable growth, and regional integration.

Based in Manila, ADB is owned by 67 members, including 48 from the region. Its main instruments for helping its developing member countries are policy dialogue, loans, equity investments, guarantees, grants, and technical assistance.

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