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Building blocks for sustainability series

triple-s

Infrastructure asset management for rural water supply

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POINTS FOR ACTION

For Governments

- Develop a national strategy and guidelines for IAM in rural water supply and ensure financing to implement
- Develop templates for contracts between service authorities (usually local government) and service providers that ensure incentives for adopting IAM
- Provide technical support and training to service authorities and service providers in IAM

For NGOs

- Support local government to systematically inventory all assets in their jurisdiction
- Harmonise monitoring processes to align with government IAM systems
- Provide capacity support to local government in implementing national IAM guidelines

For Donors

- Provide technical and financial support to national governments for the development and implementation of IAM strategies and guidelines
- Ensure all donor supported WASH interventions are included in government asset inventories and that all relevant information is shared with national and local governments

Supporting water sanitation and hygiene services for life

Infrastructure Asset Management (IAM) is a series of systematic and coordinated management practices that help optimise performance while minimising costs and risk of asset failure.

There are few good examples of IAM from the rural water sub-sector of developing countries, although IAM is critical for sustaining services. Even in resource constrained environments, adoption of simplified IAM principles can increase cost-effectiveness and reduce interruptions in service.

Photo: Carmen da Silva-Wells, IRC

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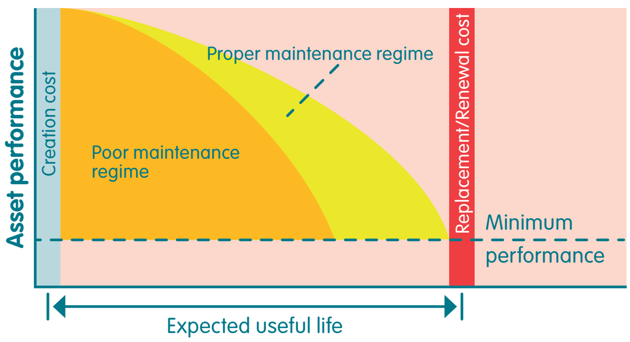
DEFINING INFRASTRUCTURE ASSET MANAGEMENT

Asset systems are ideally renewed through the incremental replacement of individual components, while the overall function of the system, and hence the services delivered, are maintained. As such, asset systems and the services provided have an indefinite lifetime, unlike the components of which the assets are composed.

In the water sector, assets refer to the physical components of water systems (e.g. pipes, pumps, meters, generators, storage tanks, valves) whilst their management refers to the processes and decisions that ensure services are maintained at agreed levels and that the value of the assets is maintained by ensuring the maximum functional life and optimum performance at the lowest possible cost. Well planned, resourced and implemented IAM helps avoid the large lump sum replacement and rehabilitation costs associated with premature failure and unplanned breakdowns. Figure 1 shows graphically how effective IAM can lead to the extended lifespan of an asset.

FIGURE 1 EXAMPLE IMPACT OF MAINTENANCE ON THE LIFESPAN OF AN ASSET



Source: DWAF, 2008

Effective IAM requires an alignment between strategic management objectives and the operational tasks performed. Such alignment requires an understanding of how the different maintenance regimes can impact the lifespan of an individual component and consequently, the trade-offs between performance of the component and of the system in which the component functions and the life-cycle costs of one maintenance approach for that component compared to another. Therefore effective IAM relies on three main pillars of competence: engineering, business management, and information management. In addition, the planning and decision making involved in IAM must be coordinated across all levels including: operational, tactical (i.e. medium term), and strategic (i.e. long term).

Photo: IRC

IMPORTANCE OF IAM FOR RURAL WATER SERVICES

Decreasing service levels over time as well as the premature failure of rural water infrastructure is well documented (Smits and Lockwood, 2011; RWSN, 2008). Effective IAM helps avoid these problems and can be particularly useful in rapidly developing countries where coverage rates have reached a significant level but sustainability is becoming the main issue. Emphasising IAM is a way to address sustainability since it focuses on understanding how existing assets should be managed for optimal performance and cost effectiveness. In practice IAM is about balancing priorities between extending coverage and sustaining service delivery or even increasing the level of existing services. The chosen balance depends on strategic choices related to levels of services provided to the population.

STAKEHOLDERS INVOLVED

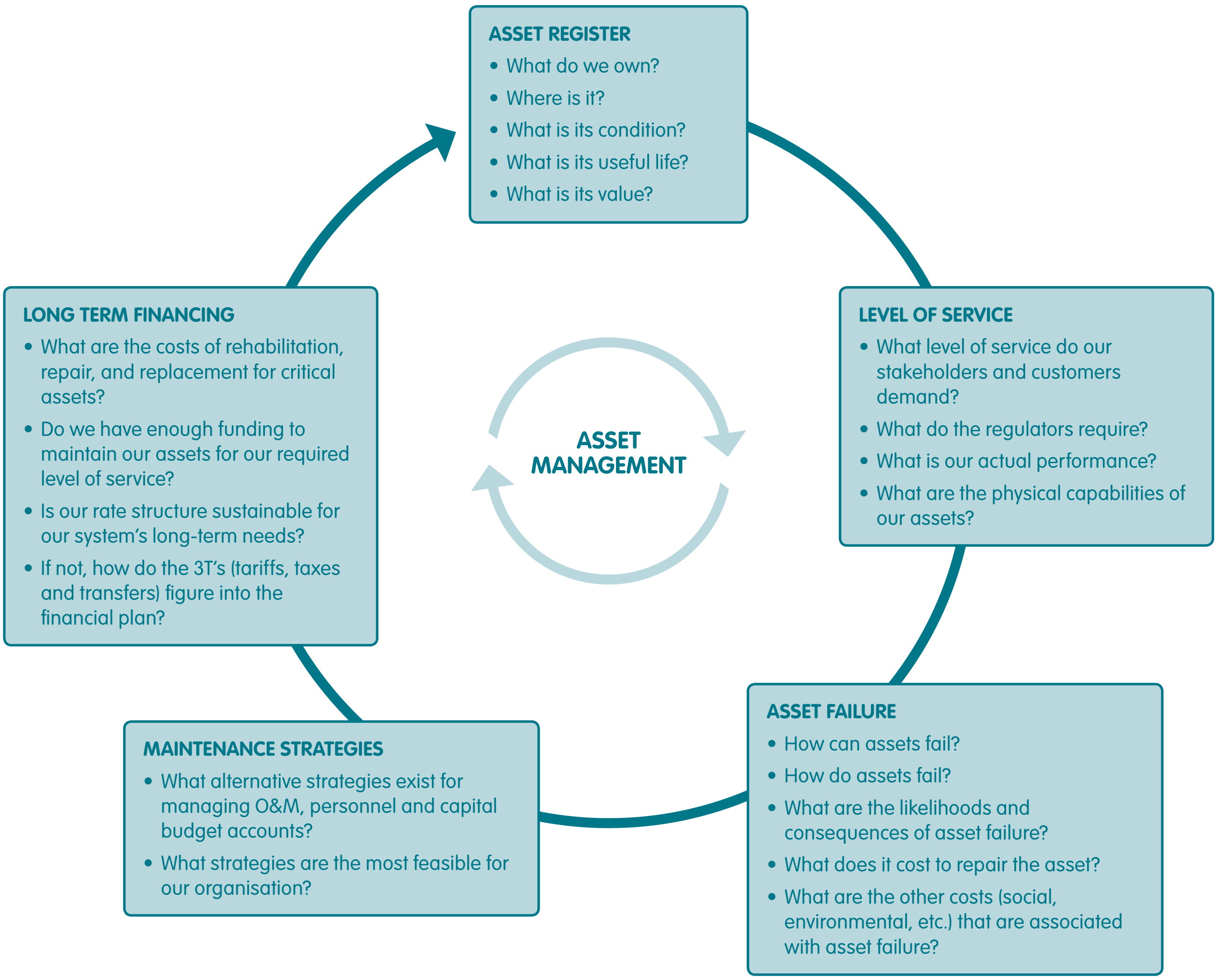
In the urban water sector, IAM is generally carried out by service providers, which could include private or public utilities. In the rural water sector, responsibility for IAM is typically more fragmented and distributed amongst a number of different stakeholders. In most cases, overall coordination is ensured by the service authority, usually local government, but the specific activities are often shared between the service authority and service providers. The precise balance of these activities will depend on the scale and complexity of technology included in the system(s), the contractual arrangement in place, the availability of financial and technical resources, and other factors, such as geographic characteristics and government capacity. For example in rural areas, regardless of their technical and human capacities, water committees will typically have the responsibility for maintaining water points, whilst service authorities will monitor the functionality of water points in their jurisdiction and take strategic decisions related to investment, rehabilitation and decommissioning of infrastructure.

Due to the wide range of stakeholders involved in IAM, there are many different perspectives and views of what constitutes IAM. Accountants and business managers may focus on financial planning and commercial risks and benefits, while engineers may be more concerned with performance optimisation, network analysis and design optimisation. Due to the low public visibility of water supply assets (e.g. buried pipes), politicians and elected officials may often be primarily concerned with IAM as it relates to coverage, service performance, and the affordability of services in the short term. As a result of these varying perspectives there is a tendency to reduce IAM to a one-size-fits-all set of solutions or to have a misconception that IAM can be reduced to a software package or a specific activity such as the development of an asset register or that it can be altogether outsourced (Alegre and Coelho, 2012).

CORE AREAS OF IAM

Up-to-date knowledge of the condition, performance and associated risk of failure for each asset or system is a key component (alongside financial resources and technical capacities) in the development of appropriate plans with regard to the operation, maintenance, and long-term financing to ensure the continuity of the services provided. Figure 2 introduces the five core areas and activities involved in IAM, which are described in more detail in the following paragraphs. It also provides examples of the types of questions that need to be answered throughout the IAM process.

FIGURE 2 FIVE CORE AREAS OF INFRASTRUCTURE ASSET MANAGEMENT



Source: Adapted from EPA, 2008

Developing an asset register

Accurate and detailed knowledge of assets constitutes an important component of IAM and often represents the first step that managers take when implementing IAM. The asset register includes both physical information (e.g. technical specifications, manufacturing and installation date, hierarchy in system, sub-components, location, and condition) and additional information to support accounting and financial modelling (e.g. expected useful life, current replacement cost). In the rural water sector, the development of asset registers will likely be linked to water point mapping activities. Such mapping activities can complement IAM, however to be effective these activities must involve detailed data collected on a continual basis.

Information regarding the condition, performance and value of the assets should be regularly collected and entered into the asset register. This information is collected through two principal activities:

1. **Asset condition and performance assessment** is carried out either through routine physical inspection or indirect monitoring (e.g. for underground assets). Tracking the condition of an asset over time allows for planning for the required routine maintenance. A simple condition performance score card, such as the one shown in Table 1, can be used to guide this activity.
2. **Asset valuation** can be determined using two different techniques. The first is aged-based depreciation, where each system asset is valued at purchase and assigned an estimated lifespan. The value of each asset is then depreciated by a defined percentage each year. The depreciation value is treated as an operating cost so that when an asset requires rehabilitation or replacement, sufficient resources are available. The second technique is condition-based management, in which the value of an asset is determined by its condition and performance, rather than by its age.

In the rural water sector, this step can be translated into the adoption of a simple mapping system, containing as much information about the assets as possible (location, year of construction, cost).

Defining the agreed service level

Meeting an agreed level of service in the most cost-effective manner is the primary objective of IAM. It is therefore crucial that the service levels are clearly defined, with agreed indicators and corresponding benchmarks (i.e. targets). In the rural water sector, the benchmarks will most likely be the national standard for basic services with indications of accepted distance, quality, quantity and reliability of service. Monitoring the performance of services provided in comparison with these indicators will provide insight into the effectiveness of the IAM practices.

TABLE 1 CONDITION PERFORMANCE SCORE CARD

Grade	Description	Condition description	Survey guide	Survey action
5	Very good	• New infrastructure • Completely refurbished • Exceptional preventive maintenance • State of the art technology	• Very clean environment • Asset in impressive condition	Record
4	Good	• Fully functional without problems • Well maintained (with full maintenance records) • Operating under good conditions	• Clean environment • Good condition • Provides required service	Record
3	Fair	• Infrequent break downs • Some record of maintenance • Some signs of deterioration	• Asset still operational • Provides reduced service	Record condition details
2	Poor	• Occasional breakdowns • Operational interruptions • Inadequate maintenance • Visible deterioration	• Noisy • Overheating • Visible component fatigue • Minor leaks	• Record condition details • Take close up photos • Measure decibel levels
1	Very Poor	• Frequent breakdowns • Frequent interruptions • Visible critical defects • Renewal required	• Excessive noise • Excessive heating • Visible cracks • Visibly broken parts • Excessive leaks	• Record condition details • Take close up photos • Measure decibel levels
0	No service	• Does not exist • Not applicable to this asset • Asset has been decommissioned		

Source: DWAF, 2008

Understanding modes of failure

This cornerstone of IAM requires in-depth technical knowledge of how each asset deteriorates and fails and what can and should be done to prevent this. In the water sector it is common to categorise assets into three groups: pipelines, civil structures and electrical/mechanical assets, each presenting different deterioration patterns and requiring different maintenance treatments.

- Pipelines deteriorate progressively, usually over a long period of time (e.g. calcification, corrosion, scoring). Preventive maintenance is often not possible and full reconstruction is the most common course of action.
- Civil structures also deteriorate progressively, however they can be maintained through regular preventative maintenance and repairs.
- Electrical and mechanical assets are prone to more abrupt failure due to the vulnerability of system function when individual sub-components fail (e.g. fuse, drive chain for motor). Minor maintenance and rehabilitation is possible, but often there is a limit to these actions before it is more economical to replace the asset entirely.

Determining the maintenance strategy

Once the modes of failure are understood, maintenance models and replacement strategies can be identified, which are dependent on the available budget. Maintenance models and replacement strategies include different tactics (Francois et al, 2014):

- **Perpetual light renewals** – appropriate when the asset's lifespan can be significantly extended through minor repairs.
- **Light renewals alternating with full replacements** combines regular maintenance with full replacements.
- **Run to failure and fully replace** at the end of the asset's lifetime – must be supported by an effective inspection programme to detect the failure as quickly as possible and replace the asset.
- **Run to failure and do nothing** is the default when insufficient funds are available to carry out any kind of maintenance on the assets or replace the failed assets.

In the rural water sector, the maintenance strategy is often constrained by limited capacity – financial or human resource, or both. As a result a 'run to failure and do nothing' approach is common.

Developing a long term financial plan

To create a realistic plan, the service authority must understand the costs of: the asset system and its components over their full life-cycle and the chosen maintenance strategy. In addition it is important to understand the extent to which tariffs can be used to cover those costs and the extent (if any) to which locally generated taxes or government transfers will be required.

BOX 1 RESOURCES FOR IAM IN SOUTH AFRICA

In South Africa, IAM is recognised both at national and municipal level as an important pillar of the delivery of WASH services. This recognition is seen in the financial, human and technical resources allocated to incorporate the appropriate IAM practices. For example, in the municipality of Amathole in the Eastern Cape, 14 staff members of the finance division have been appointed to manage the $US 400 million worth of water supply assets, which supply roughly 58,000 urban users and 106,000 rural. The municipality has developed a comprehensive asset register and updates it on a tri-annual basis, according to the national accounting requirement. Operations and maintenance are the responsibility of a specific division, with 900 members of staff and a dedicated annual budget, which amounted to $35,600,000 in 2013. A comprehensive case study has been developed describing the uptake of IAM practices in Amathole and the municipality of Chris Hani in the Eastern Cape of South Africa (see Boulenouar and Gibson, 2015).

WHERE TO START WITH RURAL IAM?

Each service authority must find the appropriate level of IAM practices to suit the infrastructure profile and human and financial capacities in its jurisdiction. It may not be possible or appropriate to systematically adopt the advanced practices of IAM. For example in South Africa, national guidelines recognise an asset management ladder with three categories: basic IAM, intermediate IAM and advanced IAM. Table 2 (p. 6) presents an overview of these three categories and corresponding activities.

Infrastructure asset management is a dynamic process and is inherently context specific. For example, the complexity of an IAM plan should be related to the complexity of the system or systems to be managed. Complex systems may require asset management plans that include elaborate computer software linked with geographical information systems and modern sensors that collect data in real time. However these are not necessary conditions for effective IAM. In fact an overemphasis on software, technology, or any 'tools' may detract from the process and objectives of IAM. For the rural water sector IAM can include the development of asset registers in coordination with water point mapping, however IAM is much than a one-off mapping exercise.

IAM needs to include a clear understanding of the service level objectives, sufficient detail directed towards the development of maintenance strategies and priorities, and the commitment to obtain the data required to make informed decisions that are consistent with the established management plan. Therefore IAM in the rural water sector, like the urban sector, is as much about the knowledge created by the iterative management processes described above as it is about the development of registers, inventories, or other management tools.

Service authorities can begin IAM by improving their technical capacities to understand the modes of asset failure and the maintenance options available to address them at the lowest possible cost. Even if the resources to carry out replacements are not immediately available, this knowledge and skill set is very beneficial. These capacities of 'technical detectives' are often lacking at the district level and even regional level. When these skills are not found amongst service providers or at the local level, 'technical detectives' should be located within the service authorities or made available by central government through technical support mechanisms.

TABLE 2 IAM MANAGEMENT LADDER

IAM Category	Functions	Activities
Basic	Project planning	Standard project planning for specified service levels and demands for the next 20 years
	Project implementation	Project implementation in accordance with South African National Standards (SANS) and the Municipal Infrastructure Grant (MIG) process
	Operation and Maintenance	Basic O&M skills and capacity to maintain service delivery
	Accounting	Compliance to minimum accounting standards to obtain approval of the Auditor General
	Monitoring	Identification of the most critical assets and their related risk management requirements
	Billing & cost recovery	Billing systems and cost recovery to maintain financial viability for the service delivery
Intermediate	Project planning	Comprehensive feasibility studies to project service level developments and water demands
	Project implementation	Project implementation in accordance with SANS standards and MIG process
	Operation and Maintenance	Skills training and capacity building to improve O&M efficiency (e.g. reduce water losses to best practices level)
	Accounting	Compliance to improved accounting standards to demonstrate progression to the Auditor General
	Monitoring	Compilations of a comprehensive risk register utilising asset criticality, likelihood of risk events and the impact thereof, resulting in a first-order risk management action plan with priorities and intervention strategies
	Billing & cost recovery	Enhanced financial management practices to improve viability for the service delivery
Advanced	Project planning	Real-time monitoring of water demands and losses combined with predictive modelling for future service levels and demands based on socio-economic development indicators
	Project implementation	Project implementation in accordance with SANS standards and the MIG process
	Operation and Maintenance	Advanced O&M control and monitoring systems to inform operational actions
	Accounting	Advanced accounting standards to be rewarded above average efficiency and productivity ratings by the Auditor General
	Monitoring	Comprehensive risk management developing and utilising a risk response register where all risk events are rated (e.g. impact, likelihood, risk exposure) and countered with a series of risk treatments to maintain acceptable risk levels for the level of assurance specified for the water services being delivered
	Billing & cost recovery	Financial management practices that achieve profitability and economic growth using sophisticated billing and cost recovery systems

Source: DWAF, 2008

HOW HAS IAM BEEN PROMOTED?

In general, IAM practices have been successfully adopted in rural areas where there is significant public funding available at the local level (e.g. locally generated taxes or transfers from the national government) and where other incentive mechanisms are in place. These incentive mechanisms include financial support, training and capacity building support, and tax incentives to private service providers. In most cases these incentives are funded by the national or state government through low or no interest loans, grants, and direct subsidies. Box 2 provides a description of support for the adoption of IAM in rural areas of the United States and Australia. In both countries public and private operators are provided with incentives for adopting IAM and also disincentives for failing to integrate IAM into their management practices.

IAM is only effective if there are adequate resources (i.e. financial and human resources) available to support the strategies, knowledge and capacity development, and practices which make up IAM. Service providers and service authorities in the rural water sector often face significant shortfalls in resources and as a result IAM practices are not occurring or are not effective in achieving desired objectives.

BOX 2 SUPPORT FOR IAM ADOPTION IN TWO COUNTRIES

Australia: Since the 1980s the government of Australia has been a leader in promoting IAM in the rural water sector. Currently there are various organisations involved in promoting IAM: the National Asset Management Steering Group, Asset Management Quarterly International, and the Institute of Public Works Engineering Australasia (IPWEA). IPWEA provides a suite of online tools and resources to help small, rural, or remote communities with less than 5,000 people develop a ten year asset management plan and expenditure projections for long term financial planning. Tools (e.g. expenditure modelling and risk management planning templates) are designed to feed into a national assessment framework used to monitor each local government's progress towards financial sustainability. See: www.ipwea.org

United States: The US Environmental Protection Agency (EPA) has consolidated resources on IAM including publications, software, training materials, and links to organisations running workshops and supporting IAM. It has also developed software such as the Check-Up Program for Small Systems (CUPSS), which helps small drinking water or wastewater utilities manage their physical assets, track maintenance and replacement, plan annual budgets, and provide an overall management plan. CUPSS is open source and currently has over 3,000 users from each of the 50 US states as well as over 40 international users. The federal government (EPA and US Department of Agriculture) also provides grants to the National Rural Water Association (NRWA) which, through its state affiliates, provides technical support and trouble-shooting free of charge to the rural systems (typically classified as less than 10,000 people). See: water.epa.gov/infrastructure/sustain/index.cfm

Recommendations

IAM requires human, technical and financial resources to: enable regular inspection and monitoring of assets, gain and retain in-depth technical knowledge of the systems and their modes of failure, and develop the capacity for creating and implementing a long term management strategy.

In areas where IAM concepts and practices are new, the starting point should be the development of basic asset registers that include only the major assets of the systems. It is important to understand what assets exist and what the remaining lifespans of these assets are. Introducing IAM in rural areas will likely require the support of development partners and will likely occur at the level of the service authority, in most cases the local government. The incentives for adopting the basic principles of IAM should be clear to service authorities, however community based service providers may need to be motivated to assist in the development and updating of asset registers and other basic IAM tasks.

In urban and peri-urban areas where water systems are more complex and the service providers have greater management capacities (e.g. private operators or public utilities), the more advanced aspects of IAM can be introduced. These aspects include detailed asset registers and maintenance plans, rigorous monitoring regimens, and advanced financial management practices. For these service providers the commercial benefits of IAM should be very clear.

In general IAM is an important step in the professionalisation of service provision in the water sector and should be considered a backbone to adopting a service delivery approach.

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Photo: Ton Schouten, IRC

About IRC

IRC is an international think-and-do tank that works with governments, NGOs, businesses and people around the world to find long-term solutions to the global crisis in water, sanitation and hygiene services. At the heart of its mission is the aim to move from short-term interventions to sustainable water, sanitation and hygiene services.

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About the Building Blocks for Sustainability series

This briefing series was developed under IRC's Triple-S project. It is intended as a resource for people who make decisions about rural water supply – financing, policy and programme design and implementation. It outlines the basic building blocks for sustainable delivery of water services – such as indicators and targets, aid harmonisation, and professionalisation of community management – and provides evidence and examples from actual practice.

For more publications in this series, go to: www.ircwash.org/buildingblockbriefings

About this Brief

This brief was authored by Julia Boulenouar and Ryan Schweitzer of Aguaconsult. Findings and recommendations are based on the results of a multi-country study carried out by Triple-S and a review of broader sector examples and research.

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