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The art of the possible: smart management of assets in the water sector

Policy paper on infrastructure

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Contents

Foreword

Water is essential for sustaining life. Together, sanitation and clean drinking water play a vital role in maintaining public health, securing economies and protecting the environment.

Unfortunately, universal access to clean water and wastewater services remains a challenge across many economies where the EBRD invests. A large funding gap constrains these countries as they strive to meet the United Nation's Sustainable Development Goals (SDGs) by 2030. For SDG number 6 – clean water and sanitation – the sheer scale of capital-intensive infrastructure that is needed for new water and wastewater networks, and to refurbish older assets, is enormous.

Furthermore, this gap has been magnified by the impact of unplanned urbanisation (for example, due to conflicts) and the projected long-term impact of climate change. Moreover, in many countries in the EBRD regions the funding gap in the water sector is not only about catching up (providing access to water and wastewater services) but also about meeting predicted growth and more demanding legislative requirements.

In a number of these countries, the level of asset care is often insufficient to sustain service quality. Consequently, service provision can be unreliable and refurbishment can be reactive and costly. But more careful investment and maintenance choices will depend on understanding budget constraints, infrastructure performance and risk appetites.

This paper proposes the adoption of advanced asset management practices that could help water and wastewater utility operators to improve their competitiveness and become more sustainable in operational terms. In addition, it highlights how the private sector could potentially facilitate this change by introducing new ideas and disciplines.

This publication is part of a series of policy papers financed through the EBRD's Infrastructure Policy Preparation Facility (IPPF). While this document focuses on the water and wastewater sector, the principles and benefits of sound asset management that are presented here are equally relevant to other infrastructure-intensive sectors. In order to achieve

successful reform in these sectors, the EBRD looks forward to further dialogue on asset management with the authorities and with Bank clients in the economies where it operates.

The authors would like to thank the country and organisational representatives, banking colleagues and consultants whose experience has contributed to the preparation of this paper.

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Executive summary

Growing fiscal constraints mean that many government departments and agencies, as well as private sector owners, are now being asked to manage water and wastewater infrastructure with fewer resources.

Effective asset management is vital for institutions that seek to provide a sustainable standard of service in the face of competing demands. This policy paper aims to encourage dialogue between the EBRD and its clients to deepen understanding of how to manage physical assets in the water and wastewater sector.

The sector is asset-rich, hence an appreciation of modern asset management practices is essential for efficiency in the organisations that own and/or operate this infrastructure. It is also vital when considering where and when to invest. But the benefits of efficient asset management can only be realised fully when there is commitment at the national, regional, local and institutional levels to developing the required capabilities.

This paper reviews why asset management is a journey worth embarking on and explores current practices and their applicability to the sector in economies where the EBRD invests. Additional content for this paper was provided by delegates at a workshop on asset management, held in London during November 2017, and through conversations with EBRD clients.

The research conducted for this publication, and discussions at the workshop, revealed that organisations have widely varying levels of maturity in terms of their asset management. When compared with the UK water sector, it is clear that many organisations in these countries face multiple regulatory, environmental and financial challenges. A lack of sufficient and predictable long-term funding – whether from customers or public budgets – is the most significant barrier to the implementation of asset management.

This policy paper identifies examples of best practice in asset management, exploring the "art of the possible" in the water sector. Through case studies it demonstrates how other organisations have developed, and continue to evolve, their asset management capability.

Lastly, this paper makes policy recommendations for the development of asset management among EBRD clients. These recommendations cover the different stages of asset management maturity, according to whether an organisation's capacity in this area is emerging, developing or mature. The EBRD will use this policy guidance to benchmark and advise current and future clients on how to best develop their asset management capabilities.

1. Introduction

This paper was prepared as a joint initiative between departments in the EBRD to encourage dialogue with various stakeholders – principally institutions – on the reform of asset management policy in the water and wastewater sector.

It reviews current asset management practices in the sector, with additional content provided by delegates at a workshop, "The Art of the Possible", which took place in London during November 2017. The paper shows how asset management capability develops through ongoing experience and understanding of asset behaviour, and is built on increasing use of data, management tools and techniques, which can then be used to invest effectively in future, to minimise whole-life costs and to maximise financial and operational outcomes.

- Section 1 explains how asset management can benefit the water sector and introduces the concept of the "asset management anatomy".
- Section 2 explores the core components of this framework, examining the challenges that organisations face in adopting asset management practices.
- Section 3 summarises how organisations can start and progress infrastructure asset management in the water sector.
- Section 4 recommends policy dialogue activities, including the potential involvement of the private sector.

1.1. Setting the scene

Water companies need a wide range of infrastructure assets to provide their water and wastewater services to customers. These assets include intakes, pumps, valves, pipes, reservoirs, treatment plants and so on. Each has a different function, operational life and characteristics, all of which impact service levels in different ways when they fail or reach the end of their life cycles. Some assets are relatively short-lived, such as chemical dosing pumps, and if they fail, are unlikely to be detrimental to service levels. By contrast, long-life assets such as impound reservoirs (dam structures) could have catastrophic consequences were they to fail.

Organisations that truly understand their assets are able to plan in advance how they will intervene in the event that any asset fails entirely. They can decide whether to repair or replace assets, thus helping to provide their customers with resilient services for longer periods. In addition, this asset intelligence helps the organisations to develop well-informed, evidence-based programmes to replace infrastructure. Those entities that lack insight into their infrastructure assets tend to adopt wholly reactive approaches to investment planning, fixing assets after they fail, which is a very disruptive and cost-inefficient way to manage services.

This paper shows that becoming a competent manager of infrastructure assets – and realising the cost-efficiency and service benefits of a more intelligent approach – requires the creation and exploitation of asset knowledge. Given the numerous infrastructure assets in the EBRD regions, and the varied nature of the asset base – a mix of new and old, of buried assets, different materials, varying standards of construction, operating conditions and maintenance expenditure – it is clear that effective asset management can appear to be an overwhelming task. In economies where the EBRD invests, some industry experts consider the task possibly beyond the reach of smaller and less mature utility operators. However – as will be shown – the adoption of the most basic asset management practices can help all water and wastewater operators to improve their businesses.

Box 1.1.1 (and similar boxes throughout this paper) outline the findings of discussions with participants during the November 2017 EBRD workshop, "The Art of the Possible".

Box 1.1.1. Workshop findings

- In the EBRD regions, many organisations in the water sector struggle to secure the funding they need to maintain service levels for customers. Often, the revenue they collect from customers is insufficient to cover the day-to-day costs of running the business, and organisations are highly dependent on subsidies to bridge this gap.
- Uncertainty about future funding is cited as a key reason for the short-term and reactive approach seen in some organisations, which could improve if funding levels were made clear and stable over a number of years.
- Some organisations comment that large one-off investments – to bridge periodic shortfalls in investment – create so-called "lumpy" (in other words, inefficient) spending profiles.
- Organisations recognise that having better knowledge of their future investment needs would improve their planning and make it smoother.

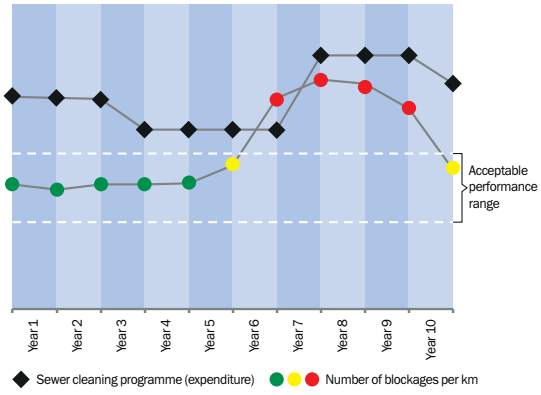
Why do assets owners and operators find themselves maintaining assets in a mostly reactive manner, unable to progress to a planned approach that is more systematic and cost-efficient?

There is no one-size-fits-all answer to this question, but the EBRD is aware that for many water and wastewater operators the combination of past underspending (due to rising costs and competing short-term fiscal demands) and a possible under-appreciation of the importance of water and wastewater services often leads to inevitable decline.

Often, a lack of financing means that water or wastewater providers are unable to apply sufficient asset care and consequently offer poor services. In times of austerity, reducing spend in the water sector may seem appealing to budget holders because certain assets can tolerate occasional periods of under-maintenance. Indeed, it may take years for the consequence of cost-cutting to fully manifest itself, at which point it can be very difficult to reverse. For most operators that reach this point the situation becomes irretrievable unless substantial financial investment is available.

Figure 1.1.1 illustrates this point. For example, reducing expenditure on routine sewer cleaning in years 4 to 6 is unlikely to cause an immediate increase in sewer blockages or their effects, such as sewer flooding and pollution, provided that known "hot spots" are maintained. Even delaying capital-intensive activities, such as the planned replacement of assets, might be possible without unduly affecting performance, provided that the assets are not at imminent risk of failure. As it can take two to three years before the outcome of short-term investment decisions can be seen, a false sense of service stability prevails. And if assets are left underfunded for too long, deterioration becomes unavoidable despite any attempts to over-compensate financially. This "lumpy" approach to financing the water sector is widely observed in many economies where the EBRD invests.

Figure 1.1.1. Reduction in sewer expenditure



Source: EBRD.

Note: Figure 1.1.1 is a stylised representation in which ◆ denotes the programme of expenditure on cleaning, with a reduction in years 4 to 6 and a delay in the observed shortfall in performance (denoted by the red dots), which is rarely recovered quickly, even with compensatory uplifts in spending from Year 7 onwards.

For many asset operators the need to make room for other investment priorities in their annual budgets is very real, because emergencies do happen. But too often, a well-intended, temporary cost cut becomes the budgetary norm, which in time leads inevitably to service failure and large cost inefficiencies in order to address the resulting backlog in service. In this kind of situation, organisations are often unable to cope with the burden of capital maintenance for their existing infrastructure, let alone any requirements for new assets.

Adopting good asset management practices will not prevent unforeseeable budget cuts or volatility in expenditure but it can:

- help all stakeholders (politicians, operators and managers) to understand the inextricable trade-off between investment, service delivery and risk, over the short term, medium term and long term
- create, institutionalise and capitalise knowledge about the asset base
- increase the efficiency and effectiveness of the limited investment that is available, thus creating financial strength
- when feasible, extend the service life of existing assets instead of requiring the construction of new ones
- aid in the preparation of sound investment programmes, defending budgetary levels
- underpin a more sustainable approach to asset care, ensuring that future infrastructure projects will also be well managed and maintained
- better protect staff, customers and the environment
- increase the accountability and reputation of the operator, and
- facilitate private sector participation.

1.2. What is asset management?

Asset management is the term that describes a set of disciplines and methods for delivering a desired level of service to customers at the lowest whole-life cost while managing risk at an acceptable level.

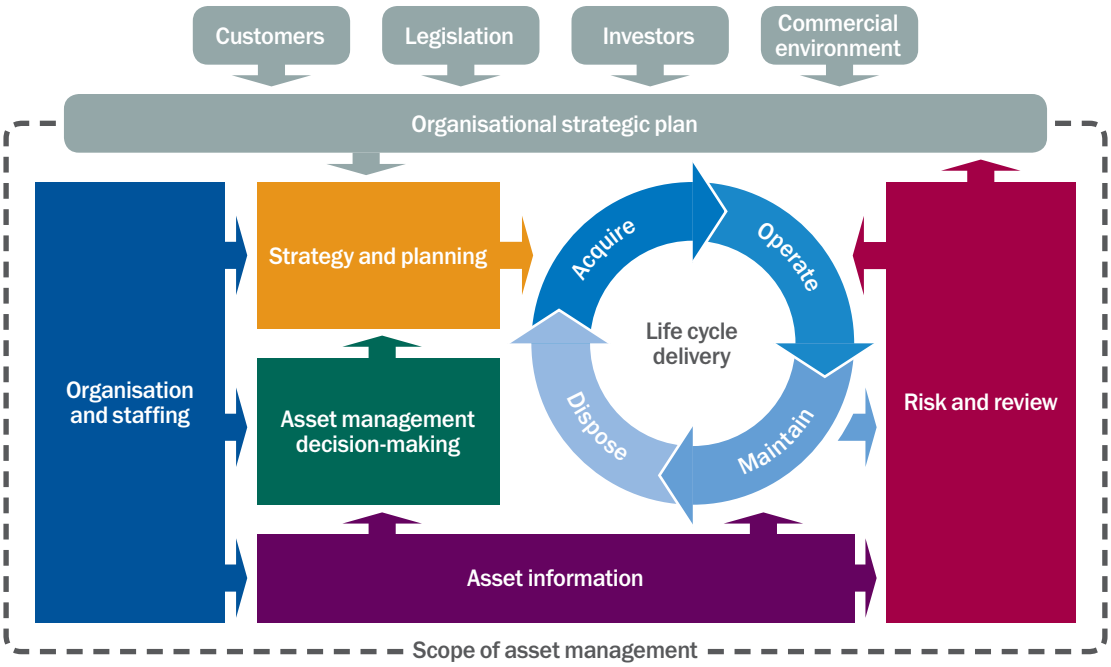
It is widely used by infrastructure-intensive organisations in the water, transport and energy sectors. Asset management aims to address unreliable service provision – which is often compounded by asset deterioration – through better use of the limited budgets that are available. It is a process of continuous learning, improvement and refinement of the organisations' approach to investment, maintenance and renewal. It helps organisations to manage their assets in line with their institutional objectives.

1.3. The "asset management anatomy"

Adopting an asset management approach offers utilities a way to make better decisions about budgets and investment in assets and to run their organisations more efficiently.

Several associations have published standards, manuals and guidelines dealing with municipal infrastructure asset management. *"Asset Management – an anatomy"* (version 3), published in December 2015 by the Institute of Asset Management (IAM), is widely regarded as describing asset management in its most comprehensive form because it shows how the external environment may influence and shape an internally led process of asset management. Figure 1.3.1 illustrates this configuration.

Figure 1.3.1. IAM scope of asset management



Source: Adapted from *"Asset Management – an anatomy"*, © 2015, Institute of Asset Management (www.theIAM.org/ama).

The IAM "anatomy" is often used to gauge the understanding and development of effective asset management in an organisation. It contains six core components, each of which looks in detail at specific asset management practices. The six core components of this asset management approach include:

1. strategy and planning
2. asset data and information
3. risk and review
4. asset management decision-making
5. life cycle delivery
6. organisation and staffing

According to the IAM, the strength of an organisation's asset management capability and the benefits it realises from that depend on how well-developed the core components are and how many specific asset management practices are in use. The IAM anatomy deliberately shows interrelationships and dependencies between the various core components. Although its design and language may look complex the IAM document recognises the diversity of practitioners and the approach can be scaled to suit an organisation's size, character, capacity and asset management ambition.

1.4. Benefits of asset management

Organisations with effective approaches to asset management will have better understanding of how assets behave over their lifetimes, including how the risk of failure changes over time or under certain conditions, and the likely consequences of the asset failing in service. Having this insight benefits an organisation, allowing it to better target and time its investment and maintenance programmes. Consequently, investment and maintenance choices are based an objective assessments and not simply on past spending or misplaced preferences.

By focusing their investment, organisations also reduce costs through implementing better balanced maintenance and operational activities. Indeed, where largely reactive expenditure programmes have been transformed into mostly planned preventive programmes, the water sector has typically delivered whole-life cost savings of around 30 per cent.

Organisations that use data-driven asset investment models also benefit from being able to relate investment to risk. This can be particularly useful for asset management teams when an organisation has to prioritise the investments that have the greatest impact.

Accurate forecasting of future financial requirements is important to all organisations and particularly vital to those that are responsible for the stewardship of physical assets in the water and wastewater sector. Organisations that capture their future investment requirements in well-founded asset management plans develop a more strategic outlook than those whose approach is purely based on a tactical, annualised budget-setting process.

Those organisations that are able to link investment needs to risk will also be able to model and clearly communicate the impact of any budget variations on their strategic objectives, including financial outcomes. When an organisation is competing for funds with other organisations, its ability to communicate the value of investments will secure an advantage over a competitor that lacks this capability.

Effective asset management has a positive impact on safety, too. Organisations that have embraced asset management have an increased understanding of the physical risks associated with asset deterioration, of common asset-failure modes, and of what triggers catastrophic asset failures which could cause harm. Once this level of understanding has been developed it allows organisations to better protect their staff and customers, by initiating specific investment programmes to identify, analyse, evaluate, treat and review known safety issues.

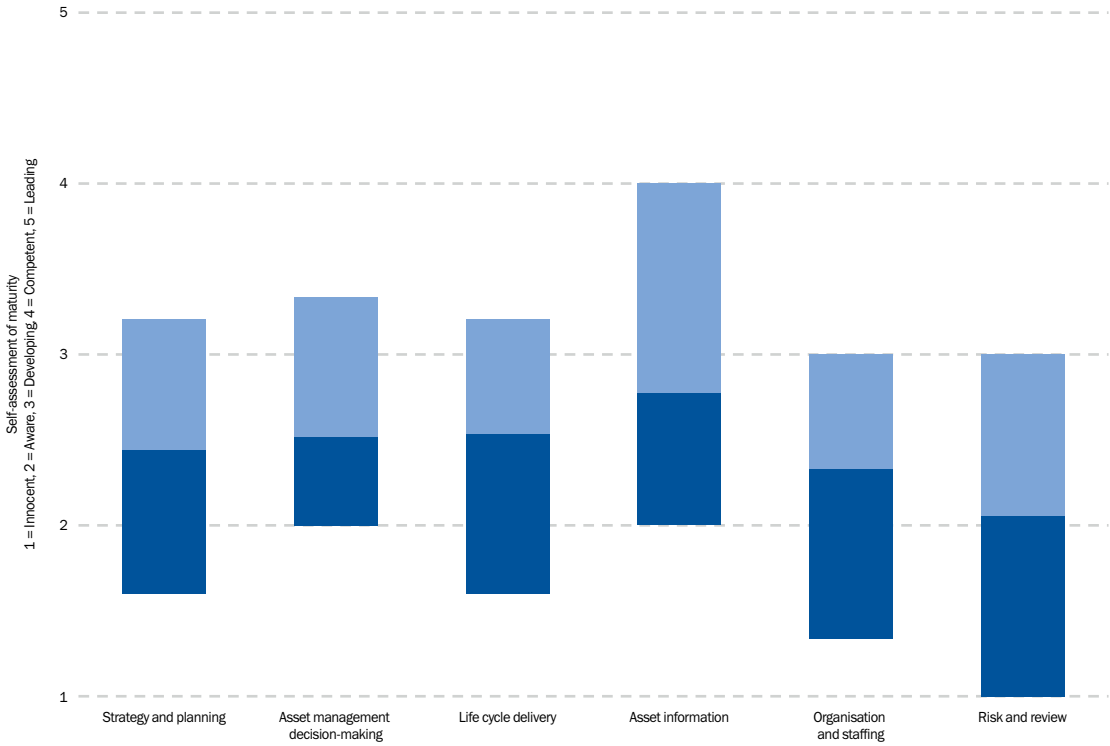
An organisation with an accurate understanding of its asset base is also better prepared for private sector involvement. Potential concessionaires or other investors need to know the quality of the assets they will be responsible for or plan to acquire.

Lastly, effective asset management also provides intangible benefits. More reliable assets and fewer service outages can improve the organisation's reputation with customers, regulators, municipalities, partners and investors. An improved external reputation has been linked to higher morale among staff, with employees feeling valued, proud to work for their organisation, and clearly understanding how they contribute to its success. In the best examples of this reputational benefit the organisation becomes the employer of choice, attracting and retaining talented workers.

1.5. The EBRD regions

Political, regulatory and customer factors affect the adoption of asset management in different ways, which are specific to organisations and to countries. At the EBRD workshop in 2017, the authors of this paper conducted a high-level analysis of the current maturity of some of the EBRD's client organisations against the six core components of the IAM's asset management anatomy. The results showed wide variation, as Figure 1.5.1 illustrates.

Figure 1.5.1. EBRD workshop delegates' self-assessment of the asset management maturity of their organisations



Source: PA Consulting.

The results suggest that some water sector organisations in economies where the EBRD invests are more engaged with asset management practices than others but that all could benefit from its wider adoption and development, regardless of any regional differences. The next section of this paper sets out what is expected under each core theme of the IAM framework and how the most advanced organisations have built competencies in these areas.

2. Asset management strategy

Achieving asset management competence is not a straightforward path. Indeed, the barriers to adoption of good asset management practices have been investigated widely. Workshop participants at the November 2017 EBRD event were vocal in sharing their views on this point. This section of the paper introduces the six core themes of the IAM asset management framework and the findings from our discussions with water sector organisations at the workshop.

2.1. Component 1: Strategy and planning

An asset management strategy often begins with what an organisation commits to doing in order to manage its infrastructure assets – in other words, its mission, corporate goals and timelines for achieving results (or "asset management objectives").

The organisations with the most effective asset management practices are those that have taken sufficient time to gain commitment from their senior executives to these objectives, which may well be informed by historic performance, regulatory directions and customer choices and are typically refined through continuous reflection and engagement.

The best organisations are then able to demonstrate application of their high-level strategic objectives to their operational performance and infrastructure investment. Having this "line-of-sight" transparency makes it possible to understand how each tier of an organisation's hierarchy contributes to successful, fully integrated asset management that meets the organisation's needs. Unless its objectives, priorities and approach are aligned, an organisation could make ineffective use of assets, staff time and financial resources.

Communication of these objectives, priorities and approaches often takes the form of an asset management policy. A policy of this kind outlines broadly the principles of asset management and guides its development, implementation and the systematic monitoring of its success across the organisation, consistent with the organisation's plans. It normally includes the organisation's approach to asset renewal and financing. Often, it also includes corporate goals and objectives.

Box 2.1.1. Workshop findings

- Justifying to governing bodies and regulators the time required to achieve the benefits of asset management is often an impediment. However, this is less relevant to better informed organisations and to participants in the EBRD's workshop.
- Indeed, organisations with better engagement at the executive level tend to be more advanced in their asset management compared to those that struggle to achieve the same level of engagement.
- For some of the delegates, strategic objectives change frequently. They indicate that this makes developing a "line of sight" and associated performance indicators difficult. Furthermore, they note that internal and external factors influence these changes, with external factors being harder to manage.

Proven success in the development and implementation of asset management processes relies on a strong corporate alignment to the approach and commitment to continuous improvement. When beginning to implement asset management, people tend to have varying perspectives on current practices and on priorities for improvement. Firm leadership, objective business intelligence and effective communication are vital throughout asset management.

Indeed, for asset management to be at its most effective, the process and structure should be fully integrated into the organisation's objectives for each management function. Full engagement and implementation across the breadth of the organisation, from finance, human resources, IT, regulation and engineering teams, requires a multi-departmental approach. Section 2 contains further discussion of organisation and staffing.

2.2. Component 2: Asset data and information

Ageing infrastructure is a significant concern for those entities responsible for operating and maintaining water and wastewater systems. Many utility operators struggle to operate, maintain, and improve systems and infrastructure assets that were installed decades ago. Uncertainty about the location and condition of infrastructure assets and a lack of comprehensive planning contribute to the reactive approach to maintenance that the EBRD commonly observes.

Conversely, demonstrating an understanding of the asset base, knowledge about its condition and how this will deteriorate over time is exactly what good asset managers do. This capability is enhanced when an organisation understands how asset deterioration might affect the levels of service it provides to customers and the financial and reputational impact this would have.

Typically, the best public and private utility operators develop and implement formal asset management plans (AMPs), which aim to address system needs and reduce overall costs, using asset data and information. The most advanced organisations formulate their AMPs based on robust predictions of asset deterioration, optimal programmes that consider the best balance between cost, risk and performance. Comprehensive AMPs commonly identify:

- the asset stock, its operational performance and condition, possibly including the remaining asset life
- investment expenditure and assessment of outcomes
- gaps between the current and desired levels of service
- internal and external risks to service delivery
- practices, projects and investment programmes required to meet organisational asset management objectives, to manage risks and to achieve the desired level of service in the most cost-effective way
- a timeline for implementation
- resources required, and
- future improvements to the plan.

Underpinning a competent AMP are sound asset-related data and information. Asset data is the record of key asset attributes – for instance, the make and model of a pump, the date it was installed, its duty, its maintenance and repair history, and so on. For buried pipes this basic data is likely to include the pipe use, diameter, the material it is made from, the date it was laid, its location, depth and so on.

Asset data may be captured in separate asset inventories or in geographical information systems. There may also be additional technical information about the condition and performance of an asset. For example, a sewer inspection may have identified the location of physical discontinuities – pipe wall fractures, pipe joint misalignment, partial collapses, blockages, ingress of water and so on. Or, for instance, the hydraulic performance of a sewer may have been established by recording past flooding events at properties or by using network models, validated using data on flow and spill frequency. Financial information could include details such as the cost of repairing a sewer, or compensation payments made for pollution incidents linked to the sewer.

In addition, analytics make it possible to translate this data into information that can be used in management decisions and to deliver organisational value. There are four types of analytics, each with a particular purpose, as Table 2.2.1 illustrates. The progression from left to right in the table is sometimes referred to as the asset management "journey" and is reflected in the strength of an organisation's decision-making capability and its value to the business.

Table 2.2.1. The four types of data analytics

Type	Descriptive	Diagnostic	Predictive	Prescriptive
	What happened historically (or is happening now, based on incoming data)?	Why did it happen?	What will happen next?	What should we do?
Definition	Typically looks at data about past events and analyses these to uncover patterns suggesting how to approach future events	Understanding how an infrastructure failure occurred (not just what happened and when) further expands the insights	Used to predict asset deterioration and when an operator should intervene	Suggests actions based on various predictions and shows the decision-maker the implications of each option
How the information is used	• To increase asset reliability • To report on performance • To create business intelligence • To reduce operational costs		• To predict infrastructure failures	• To increase asset utilisation • To optimise available resources
What analysis makes this possible	Alerts, key performance indicators, trends, data mining, frequency of events, cost of operations, and root cause of failures		Trends of time-series data, correlations, statistical analyses, sophisticated mathematics	Characterised by sets of rules, "what-if" scenarios, complex analyses of data (including its uncertainty), use of artificial intelligence

Each method of analytics shown in Table 2.2.1 builds on the method shown in the previous column, with descriptive analytics being the most common method and prescriptive analytics the most advanced.

Given that different types of analytics provide different insights it is important for managers to understand the information that each type can yield.

- **Descriptive analytics**
  Typically, descriptive analytics looks at data about past events and analyses them to uncover patterns that suggest how to approach future events. Data on past performance of assets – such as where a water main has bursts or a sewer has collapsed – as well as data about the impact of that failure on customers could, for instance, establish an indicative performance trend for the existing asset type. Even in its simplest form descriptive analytics could reveal, for example, that thin-walled PVC water mains fail more frequently than those made of HDPE materials, and thus predict the occurrence of future failures of similar PVC pipes.

- **Diagnostic analytics**
  Understanding how an infrastructure failure event occurred (not just what and when) expands the intelligence further. Collecting asset failure modes, for example, begins to build a richer picture. This type of analysis has shown, for example, that vitreous clay sewers are more likely to block than cast-iron alternatives, with PVC sewers the most resilient to blockages. Not only does this influence tactical sewer-jetting (blockage removal) programmes but also guides the choice of future materials to lower overall maintenance costs.

- **Predictive analytics**
  Data analytics can also be used to predict asset deterioration, thus suggesting when an operator should intervene. A basic assessment of the number of pump failures per year according to age, for example, is likely to reveal high failure rates during an initial bedding-in period after commissioning, followed by a period of more stable operation and, finally, assets failing much more frequently towards the end of their asset life – a typical "bathtub curve" With predictive analytics, an operator, knowing the age or duty of any pump, could estimate the remaining service life and when best to intervene.

  This level of analytics becomes significantly more powerful when other criteria are introduced, such as repair options and by how much each asset life was extended, ambient temperature and whether prolonged heat accelerated deterioration, and so on. The use of this type of sophisticated analysis can be developed to estimate the expected nature of deterioration over time. The most sophisticated predictive models can be used to forecast both asset performance and customer service.

Achieving a higher order of data analytics implies, of course, collecting or acquiring more data. In the water sector a prescriptive methodology can yield demonstrable savings of 10 to 50 per cent on capital and operational expenditure compared with a basic descriptive approach. The higher gains are likely to accrue to those organisations that have the lowest levels of maturity.

Box 2.2.1. Workshop findings

- Some of the workshop delegates believe that effective asset management relies wholly on complex analytical modelling, supported by complete data sets and sophisticated IT systems. Their view is that getting started could thus be an obstacle.
- In its most basic application, asset management can be applied using expert judgement and experience, which can be validated over time as asset data quality is improved. Indeed, various industry working groups and consultancies offer comparable ("surrogate") information which could also be used to address any shortfall in data.

Case study: Dunea (Netherlands)

Dunea is one of 10 water companies supplying drinking water to 1.3 million customers in the southern areas of the Netherlands. With a water network that, due to its advanced age, had little or no data associated with its pipe network, especially with regard to any history of pipe failures, Dunea needed to be armed with better information and data on their assets.

The firm employed a variety of techniques to overcome the gaps in asset data, which have led, during the past six years, not only to improved network performance, better targeting of pipe maintenance, mitigation of risk and greater certainty on outcomes, but also to improved capital investment.

The adoption of asset management practices is saving Dunea around €2 million every year – equivalent to more than 17 per cent of capex for the distribution mains.

Case study: Severn Trent Water (UK)

Severn Trent Water (STW) is a large, privately owned company providing water and wastewater services to 8.5 million people in a geographical area of around 21,000 km^2 in the United Kingdom.

Providing these services requires STW to operate and maintain nearly three million assets across multiple classes. As a result, determining which assets to invest in, and how and when, in order to maximise the return on investment, is a complex challenge. The firm must make its case for investment (and for the resulting tariff adjustments) to its Board and to the economic regulator for England and Wales, the Office of Water Services (Ofwat), every five years.

STW uses advanced analytics, modelling and optimisation to conduct complex asset-level modelling and inform its investment decision-making. The firm's methodology has twice been recognised by Ofwat as "industry-leading". Its transition to a largely proactive approach to investment planning has delivered cost efficiencies in excess of 15 per cent. Over the past 14 years, STW has also included sewer infrastructure in its models and significantly reduced the incidence of sewer collapses and internal sewer flooding through smarter investment, benefiting customers and the environment alike.

In economies where the EBRD invests, basic asset data and asset information is often unavailable or at best disparate in terms of its quality and completeness. Furthermore, the processes needed to support an advanced level of analytics may not be in place or may be underdeveloped. But that does not mean the organisation should delay data analytics.

An effective strategy should:

1. determine which types of assets1 to include in the AMP

2. match asset data and processes to the organisation's level of analytical maturity so that it can gain immediate insights

3. focus on the largest and most critical assets, followed by the gradual inclusion of less-critical facilities, and

4. select a meaningful problem and attack it on a scale that is small enough to deliver rapid results while also putting into place additional data collection, technologies and processes to support more complex analytics.

What is important at this stage is not a perfect outcome but a path to iterative results.

[1] Typically, the term "asset" refers to physical infrastructure - the capital-intensive water abstraction, treatment and distribution systems, wastewater collection, conveyance, treatment and sludge facilities that enable service delivery. The term also applies to other general items such as buildings, vehicles, IT and telemetry equipment, telephones and "tools" such as maintenance management systems or customer call software. It can include natural resources such as aquifers, rivers and so on that are not owned by the asset operator.

2.3. Component 3: Risk and review

Good asset plans use knowledge about the probable impact and likelihood of asset and service failures[2] because this helps the organisation to better understand its exposure to risk. In turn, this insight makes it possible to prioritise the investment actions required and to determine the expected level of risk reduction. Forming reliable intelligence on risk helps asset-rich organisations to move from blunt investment strategies based only on replacing ageing infrastructure (a common approach in the EBRD regions) to more rational approaches.

The complexity of the approach is also driven by the availability and quality of data, which will improve over time. Initially, organisations will use past performance to forecast the possibility of failures. However, mature organisations will realise that predicted service failures do not always align with the patterns of the past. Hence, they are likely to develop more sophisticated modelling, undertaking scenario analysis to see where future failures might differ from historic trends.

Box 2.3.1. Workshop findings

- Organisations whose asset management is rudimentary raise concerns about potential exposure to risk as a result of the transparent analysis typically used in asset management. The adoption of asset management and increased visibility could lead to the perception that they face higher financial and operational risks than actually exist.
- Most organisations attending the workshop assess their maturity as being "aware" and "developing" with regard to risk assessment – there are few misconceptions about risk visibility.
- However, some delegates believe that they currently lack the asset and costing data that are necessary to estimate fully the probability and consequences of failure.

[2] It should be understood that a functional failure of an asset does not necessarily lead to service failure, which will depend on how critical that asset is to service performance, the level of redundancy, and so on. For example, a two-pump sewage pumping station fitted with a duty and standby pump configuration is still able to operate fully if one pump fails, albeit at higher risk.

An understanding of the probability and consequences of asset and service failures requires additional information, as outlined below.

- **The probability of asset failure** is directly related to mechanical failures, such as impellor wear or the seizing of a pump motor. In these situations, data may be sourced, for example, from the experience of operational staff, from suppliers, company records of specific failures, alarm data (SCADA[3] systems) or information derived from maintenance management systems such as "mean time between failures".

- **The probability of service failure** is the likelihood that an asset failure will reduce the level of service that customers experience. For example, if a water main bursts there will be a high probability of service failure for customers in rural areas, where network resilience is lower and there are fewer configuration options compared to a mains burst on an interconnected network in an urban setting. Tools such as "failure mode effects analysis" (FMEA) help to reveal the links between asset and service failures.

- **The consequences of an asset or service failure** include the impact and scale of the failure. These consequences could include financial and economic impacts (penalties incurred, revenue lost, compensation payments made, and so on); organisational impacts (accident frequency rates); operational impacts (increased outages), social impacts (an increase in the number of complaints); environmental impacts (length of the body of water contaminated); service impacts (a reduction in water quality, an increase in sewer flooding and pollution); or reputational impacts (media interest).

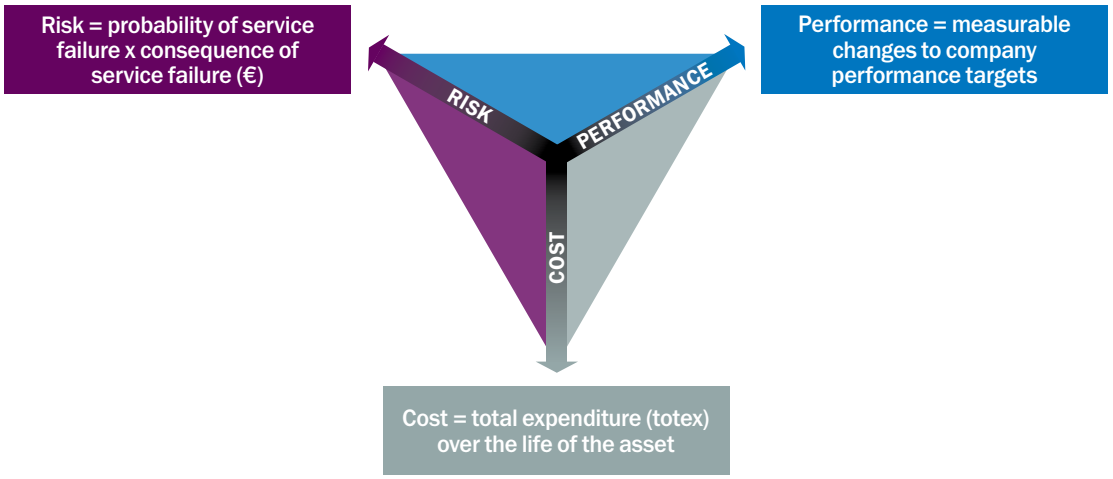
Organisations that embrace effective asset management will generally have an established mechanism for valuing the consequence of an asset and service failure that reflects its importance. One approach to valuation is to analyse the historic costs of such events. Some costs – such as guaranteed payments for service failures – do not reflect their true value, so the use of "willingness-to-pay" surveys (see Annex 1) can provide a more accurate representation of true costs. Some organisations may develop a points-based system instead of expressing the cost in monetary terms.

2.4. Component 4: Decision-making in asset management

For sustainable service delivery, the integration of asset management plans with long-term financial plans is vital. This integration identifies gaps between long-term potential costs and available funding, and includes a review of requirements for capital (renewal or growth), operations and maintenance. Integrating asset management plans with the financial planning process provides a basis for developing, reviewing, updating and implementing financial strategies for sustainability. This integration may identify a need to reduce costs (adjust service levels) or increase funding (raise revenue). Organisations that have consciously developed asset management functionality will be capable of understanding the delicate but inextricable balance between cost choices, risk and performance.

[3] Supervisory Control And Data Acquisition.

Figure 2.4.1. The tension between cost, risk and performance decisions



Source: PA Consulting.

Figure 2.4.1 shows the interconnections between decisions on cost, risk and performance. Risk-averse decisions, such as permanently eliminating sewer flooding, would require exemplary asset performance and a corresponding increase in cost to manage this enhanced level of service. Balancing the multiplicity of corporate ambitions for service levels against the available asset stock and budgets means finding an acceptable equilibrium between cost, risk and performance.

- **Cost:** Operational and management activities may often be too reactive, with weak cost accounting. But those organisations that have a greater breadth of planned work are also more likely to have a more accurate understanding of activity-based costs than their more reactive peers. They will also be capable of assessing the trade-offs between various options for operational and capital expenditure and of understanding the whole-life cost of alternative solutions.
- **Risk:** When assessing risks to service levels, organisations are likely to take different approaches; they may be based on their past experiences of the consequences of service failures, which are often linked to the resilience of the network. Most organisations will know which of their assets are the most critical to maintaining the desired service levels. However, determining the risk of service failure will depend on the maturity of the company's asset management. In organisations with higher levels of asset management maturity, risk is likely to be assessed using advanced predictive analytical models, with risk movements being forecast for specific points in time.
- **Performance:** At differing levels of granularity, most asset-intensive organisations will measure their levels of service performance, tracking and reviewing tactical performance indicators. Organisations with a high level of asset-management maturity are likely to have key performance indicators which feed into strategic management reporting systems that are automatically updated on a regular basis. The most mature organisations will also review their progress against each target and take steps to mitigate the risk of failing to meet the required target.

Almost all organisations attending the EBRD workshop have limited funding and are obliged to prioritise their investment activities. A traditional organisational approach to budgets is to set these priorities independently according to each specific activity: an organisation may define, for example, a budget to reduce leakage or to clean a reservoir. Experience shows that budgets based on past spending patterns are rarely good predictors of the true investment needed, although they may be a good starting point.

As asset management maturity evolves, organisations make more informed, value-based decisions using monetised risk and service performance to help prioritise their investment needs. Investment decisions previously based on cost alone become gradually informed by a better understanding of the value that the investment adds to the organisation. This concept is covered in Section 2.3, which shows that once an organisation has developed a formal approach to capturing the impact of its investments, linked to cost, risk and performance, it can make decisions based on value.

The most advanced organisations use a variety of techniques to optimise their asset management decision-making. These techniques start with the use of basic "triggers" (interventions based on reaching set-points), prioritisation methods, and linear to non-linear approaches (the latter using multiple constraints with whole-life costs to establish the most efficient intervention portfolio over time).

Box 2.4.1. Workshop findings

- The seminar identified a wide spectrum of decision-making maturity among the participating organisations, ranging from a 4 (the highest level of maturity among them) down to a 1 (the lowest level of maturity) in terms of both "capital investment decision-making" and also "operations and maintenance decision-making".

2.5. Component 5: Life cycle delivery

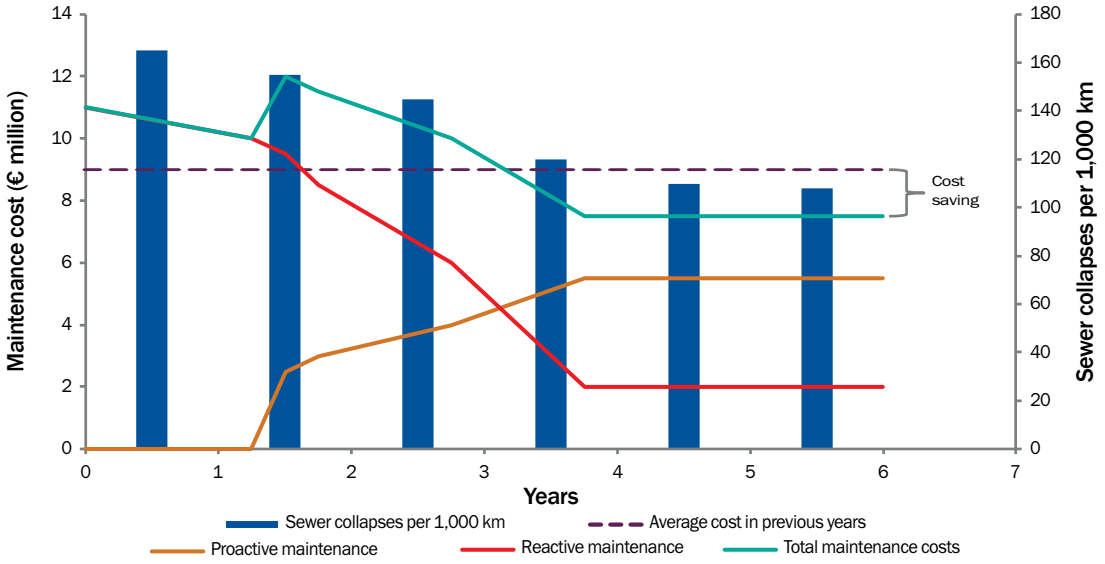
In addition to developing the overall asset management strategy, it is necessary to develop a strategy for each asset group, based on life cycle plans. Typically, these strategies will be based on attaining the desired standard to meet the strategic objective. They will be costed across the full life cycle of the asset and translated into an investment plan. It may include a sound understanding of the effectiveness of intervention activities and activity-based costing. A robust approach to managing this process is essential, with best practices for each of the three phases of asset life cycles, as follows.

- **Asset creation and acquisition:** This involves new assets being created in the asset register, which may include acquired assets that have a previous service life, such as pre-owned plant or assets that come to the organisation as a result of a new build, merger or acquisition. The greatest costs are incurred at asset creation and may include bringing acquired assets up to the required standard. On completion, the asset creation or acquisition, the outturn costs and realised outcomes should be compared to those presented in the business case. This exercise provides valuable feedback for future life cycle management planning

- **Asset operations and maintenance delivery:** Adopting a proper regime of asset operations and maintenance normally reduces costs, prolongs operational asset life and stabilises service resilience. The concept of reducing costs and improving performance is captured in Figure 2.5.1. It shows that a largely planned preventive regime with regard to sewer collapses is more cost efficient in the long run than an approach based solely on reactive[4] maintenance and past trends, and that over time asset performance becomes more reliable.

[4] For some assets a reactive, "run to fail" approach to maintenance is entirely legitimate, with downtime minimised through the provision of spare parts.

Figure 2.5.1. Cost savings and improved performance from adopting a mainly proactive maintenance strategy



Source: EBRD.

Note: In the example above, proactive maintenance is steadily introduced from Year 1. While total costs are initially high, these plateau to less than the average cost of using a reactive approach to maintenance. In addition, the rate of sewer collapses is reduced and stabilised.

Organisations that plan their management of maintenance and inspection activities and truly understand asset criticality, asset failure mechanisms, asset failure rates, and so on, can make objective and cost-efficient decisions about managing asset life cycles. Plans for the proper operation of each asset should be established at the start of each year and translated into budgets at the asset level. These budgets and operational targets should then be tracked throughout the year, with variations understood and managed. Periodic expected expenditures such as repairs, large-scale overhauls and full asset replacement need to be accounted for. There is a skill in identifying the right balance between reactive and proactive maintenance; more advanced asset management practitioners tend to achieve a balance of 25 per cent reactive maintenance to 75 per cent proactive.

- **Asset decommissioning and disposal:** This is the ongoing evaluation of whether assets are still effective or viable in their service delivery. The effectiveness or viability of an asset can change due to alterations in standards, legislation, market conditions or financial constraints, or simply due to obsolescence. For example, asbestos-cement and inferior PVC water pipes both have shorter asset lives than were originally expected.

Identifying activities and costs throughout the asset life cycle, for all groups of assets, allows organisations to prepare fully costed investment plans. The cost projections will also be required by the accounting and finance teams for the financial modelling used to explore the plan's short and longer-term financial performance. For example, if the proposed plan means a rise in customer bills, and runs counter to the feedback obtained from stakeholder engagement, it may be necessary to revisit the levels of spending outlined in the plan. The most advanced organisations use systems and processes that allow them to iterate their investment plans routinely, quickly and accurately.

In addition to operational costs, financial models are also used to make decisions regarding the draw-down of capital funding. The timing and sourcing of funds – be they debt or equity – is often a result of financial optimisation. Traditional life cycle management and financial planning approaches tend to treat operational expenditure (opex) and capital expenditure (capex) discretely but many utilities are increasingly adopting a total-expenditure (totex) view of their organisational expenditure. Indeed, in the United Kingdom, the regulatory framework for the water sector is driving the use of a total-expenditure view to encourage utility operators to focus on minimising the whole-life costs of assets. The totex view requires an understanding of the trade-off between operational and capital expenditure and financing models that are sufficiently flexible to allow organisations to optimise this balance, dynamically allocating funds between the two expenditure streams accordingly.

2.6. Component 6: Organisation and staffing

The importance of having the right people and processes cannot be overlooked. Organisations that successfully implement asset management have:

- effective leadership throughout the organisation, with senior champions who promote the vision of asset management policies
- staff who understand the need for – and benefits of – asset management, with a commitment to continuous improvement
- an asset management culture that values informed decision-making, is prepared to challenge, learn and develop
- diverse, skilled people, with asset managers and asset planners who have a broad cross-section of knowledge, practical experience and understanding in areas such as engineering, economics, regulation, asset operation and risk management.

The shape of an asset management team will vary from organisation to organisation and to a certain extent depends on the maturity of the asset management capability already developed by the organisation. An organisation that is currently in the development stage, collecting data before building asset deterioration models, is likely to have larger teams focusing on data capture and a smaller asset performance team.

Case study: EPCOR

EPCOR is a small public corporation, owned solely by the city of Edmonton in Canada, providing water, wastewater and distribution services to over one million people.

Over the past three years the organisation recognised that, despite robust quantities of data, its past method of investment planning method was limited. Projects were assessed in isolation, the system was spreadsheet-based with limited or no opportunity to assess multiple "what-if" scenarios and ask the right questions, and a view of reliability, risk, whole-life cost and forecast performance for each asset was impossible.

However, decision analytics, modelling and optimisation mean that EPCOR is now better able to meet the demands of regulation by providing multiple scenarios for how asset performance affects revenue requirements and completes the loop between assets, customers and funding.

Case study source: "A Compendium of Best Practices in Asset Management", edited by J. N. Bhagwan (2012), IWA Publishing, www.iwapublishing.com

Box 2.6.1. Workshop findings

- The EBRD workshop found that opinions vary as to what an asset management structure should look like. There is a general acceptance among participants that having dedicated resources focused on asset management enables an organisation to reach asset management maturity more rapidly.
- For most organisations, designing the structure around asset management is seen to be an area for further improvement.
- While some cite a lack of staff capacity as an initial impediment, wider research suggests that the ability of asset management practitioners to positively influence decisions – once the management process has been established – is widely recognised.
- Participants think that embracing the full possibilities of asset management requires expertise: competent, dedicated and specially trained people within and outside the organisation.
- Smaller organisations may not be able to realise the full benefits of asset management because of their inability to allocate resources to skilled asset managers, systems and processes.

Summary of Section 2

Effective asset management in the water sector can be transformational but requires a fundamental understanding of asset behaviour and of the appropriate actions to mitigate asset degradation. This is particularly important in view of the diverse asset bases commonly observed in the sector. This section shows that such understanding is supported by good data, sound information, effective processes, tools and knowledgeable people. It also requires the ability to prepare well-informed asset management plans that can be defended: improvement programmes that aim to deliver the organisation's required outcomes, including for the customers they serve. Section 3 suggests an asset management framework from which organisations could either start or advance their asset management capabilities.

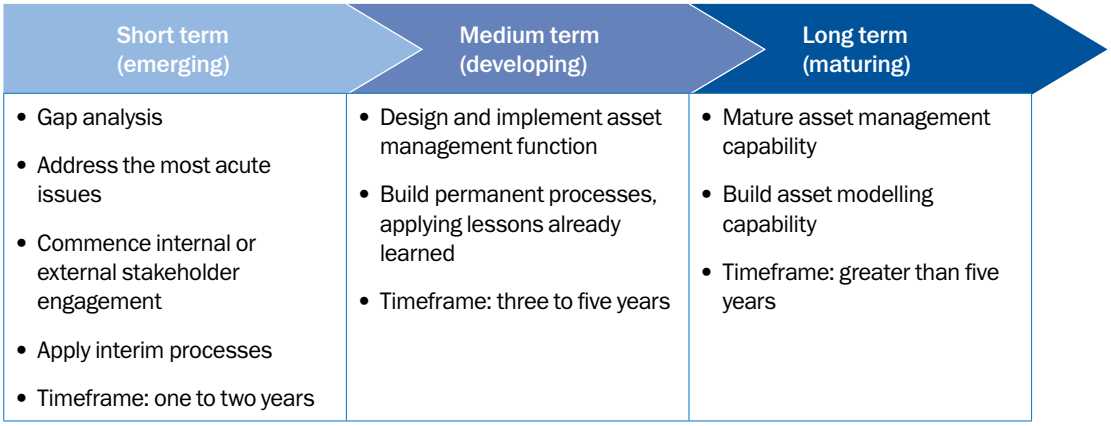
3. Implementing and enhancing asset management in the water sector

This section considers the next steps in asset management. There is no single authoritative approach to introducing, developing or maturing asset management systems and processes within an organisation. Embracing the "asset management anatomy" (and other approaches) can ensure full consideration and integration of the principles and methods within an organisation, but this may not suit all.

3.1. The pathway to better infrastructure management

Some organisations will be unsure about how to start the process and others may not know how to progress asset management. For many organisations in countries where the EBRD invests the fulfilment of the six core components of asset management will vary, as will the starting point, ambitions and pace. A typical progression to asset management maturity is shown in Figure 3.1.1.

Figure 3.1.1. The development of asset management



Source: PA Consulting.

Stage 1: Short term (emerging)

There is no correct place to start, but a pragmatic first step to adopting and/or improving asset management practices is to conduct an asset management diagnosis – a deep- examination of the current level of asset management maturity – guided by *"Asset Management – an anatomy"* (see page 6), or a similar approach. This should reveal existing asset management practices as well as organisational capacity and shortcomings, identifying what is being done well and where further improvement may be needed.

In addition, the EBRD recommends taking stock of assets and finances at this stage, assessing the asset inventory or registry and information (if available) about the condition of assets, to estimate the remaining life of those assets. This process can be integrated with available financial data on replacement costs, operational and maintenance costs, and allocations. All operators have a basic inventory or register of their assets which can serve as a starting point for collecting asset data. The asset data does not necessarily have to be digitised or entirely objective in order to be useful; subjective information and expert judgement can also prove to be extremely valuable. Furthermore, an organisation might consider recalibrating its own poor data by using datasets available from industry working groups and consultancies. At this early stage of developing asset management, it is advisable to record even poor data, assumptions or the use of surrogate data.

During the initial stages, some of these activities may progress quickly and use temporary approaches that are later refined and embedded. The general view of practitioners is that it is better to begin by taking on small, manageable goals of asset management development rather than to strive for perfection or overly ambitious programmes. By starting small with one asset class instead of all, it may be easier to build an understanding of the asset management processes and achieve quick results.

For some organisations there may be additional merit in organising at the outset asset management training for representatives from finance, operations and engineering teams to build capacity so that the organisation can make rapid progress. Additional support for change may be required to help less experienced (and less convinced) organisations to instil an asset management culture. Certainly, it is important to build a shared awareness of the current state of assets and finances, relative to long-term goals and objectives.

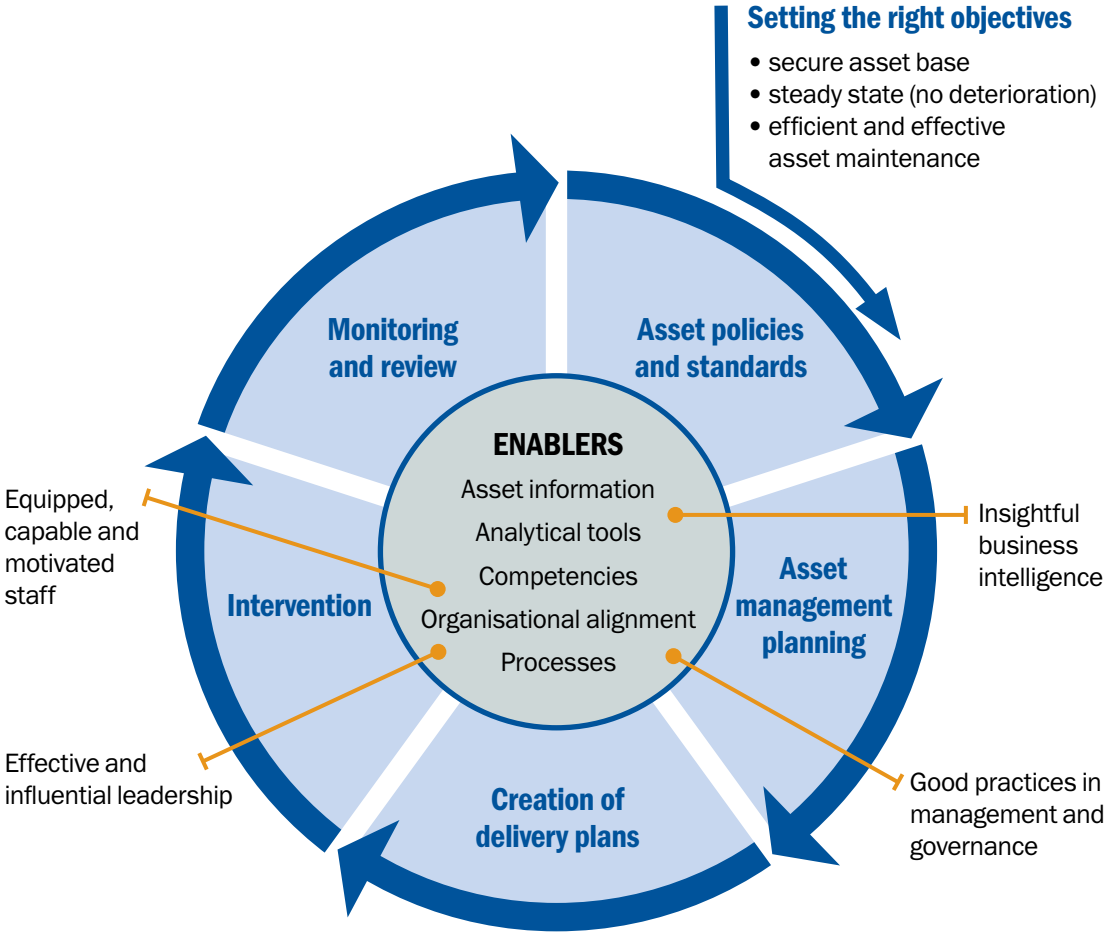
Visible communication and engagement – both within the organisation and externally – should be ongoing, embedded and central to asset management. Here, practitioners recommend developing a communication and engagement plan. This can provide a sense of inclusion and enable organisations to adopt asset management in the most effective manner possible.

Ultimately, these initial assessments pave the way for development of an asset management strategy and a defined plan of action. Of course, organisations have different strengths, weaknesses and priorities that need to be recognised before commencing the process of asset management.

Stage 2: Medium term (developing)

Once an organisation has established its current asset management capability and implemented any short-term mitigation it will then be in a position to start designing more permanent asset management practices. Any lessons learned from the initial short-term processes typically offer valuable insights when developing a permanent approach, which could take the form shown in Figure 3.1.2. Like the IAM asset management anatomy, this approach is based on the International Infrastructure Management Manual and the ISO 55000, ISO 55001 and ISO 55002 standards for asset management. It deliberately shows asset management as a cyclical process, reflecting the iterative nature of developing and embedding asset management all the way through to maturity. It brings together in a logical, continuous sequence the six components of the IAM asset management framework as set out in Section 2 and includes plan implementation and review stages.

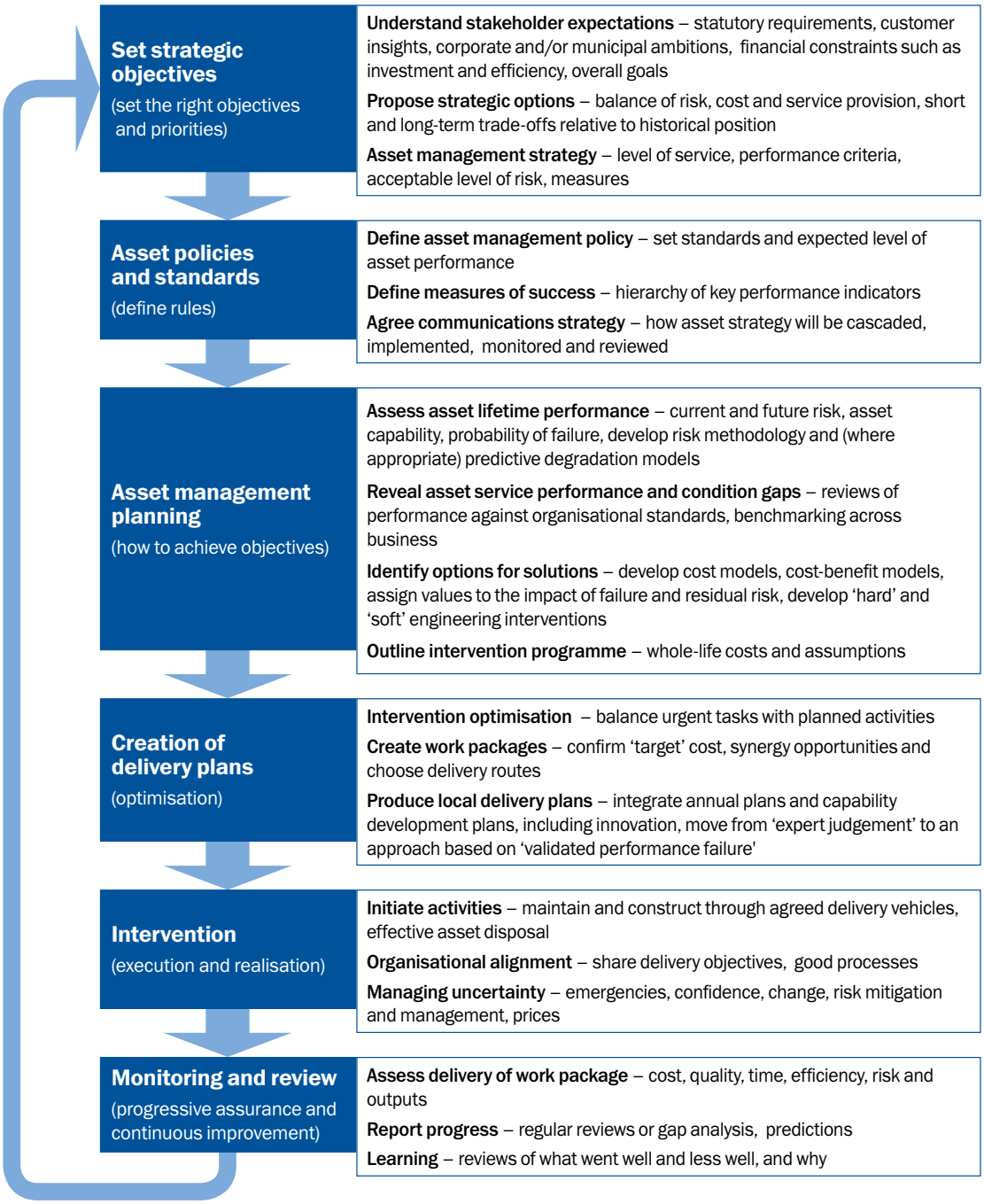
Figure 3.1.2. Embedding asset management



Source: EBRD.

Often during this medium-term stage of development the organisation is learning by trialling and testing various approaches to see what works best for them. Even so, a certain clarity and structure with regard to the asset management tools, methods and documentation should be developed by this stage. Figure 3.1.3 shows the typical features of asset management at this mid-development stage.

Figure 3.1.3. Features of medium-term asset management



Source: EBRD.

It is important to note that Figure 3.1.3 is not a blueprint of asset management because an approach that works well for one organisation may not work as well for another. For all organisations, the format and content of asset management practices will depend on many internal and external variables that influence the success of each stage. It may take three to five years from the start of the asset management cycle to reach the medium-term stage of definition

Fundamentally, the asset management function is created to manage the stewardship of the organisation's asset base. It is there to help management understand how assets behave over time and how this behaviour can inform their investment decisions. The asset management teams will also interact with regulatory teams and corporate strategy teams to understand the levels of service and performance that the organisation aspires to reach, within specified budgets and timescales. The asset management teams will then convert these aims into policies and standards that will guide operational teams. Asset management staff will also be responsible for deciding which assets to replace, refurbish, upgrade or mothball and which asset management practices require modification. They will then put these decisions into asset management plans and pass them to delivery teams for implementation.

Many of the early implementation tasks may be about updating information (such as improving information about asset condition and improving risk assessments). But they will also include the execution of the projects identified in the asset management plans to manage service delivery risks. It is clear that successful implementation depends on the competence of the people involved, asset performance,[5] data quality and the finances available. The organisations that benefit most from good asset management invest both in the infrastructure improvements identified through these structured processes and in asset management itself.

The implementation of asset management projects, programmes and practices is vitally important because this is where it is has the most impact. However, monitoring and reviewing the success of these initiatives is equally important for continuous improvement. Best practice involves regularly reporting on progress against the asset management objectives and outcomes identified in the asset management strategy and plan, including the key performance indicators selected. Over time sufficient feedback accumulates to make connections between cost, risk and service trends.

[5] Asset availability, reliability, operability, functionality and so on.

Stage 3: Long term (maturing)

After an organisation has put dedicated resources into the development of its asset management capability it is likely to be in a position where it can make its asset modelling capability more sophisticated. The organisation will have experienced resources and a good understanding of how to use data to make more informed investment and maintenance decisions. Realising the full potential of asset management takes many years and no single organisation has perfected its approach.

Typically, organisations at the higher end of maturity will exhibit the following attributes:

1. There is full organisational alignment, whereby the organisation's objectives – including ambitions for health and safety, the environment, customers and so on – are integrated into the asset management practices that each department delivers daily.
2. Assets are managed in a consistent and considered manner regardless of scale or heterogeneity.
3. There is an appropriate balance between cost, risk and reliability (in service and performance) which reflects the expectations of stakeholders.
4. The impact and value of asset interventions are understood, resulting in an optimal and sustainable approach to asset maintenance and replacement.
5. Information, tools, methods and processes are developed to support evidence-based, whole-life-cycle investment decisions.
6. Embedded asset management teams include individuals who are competent and motivated.
7. There is some form of continual learning and development: regular monitoring validates successes achieved and directs future actions.

The maturity matrix

The maturity matrix shown in Table 3.1.1 sets out examples of the capabilities to be demonstrated at each stage. An organisation's existing level of maturity, combined with its own drive to mature, will significantly influence the time it takes for an organisation to show full maturity.

Table 3.1.1. The asset management maturity matrix

	Area	Evolving	Developing	Mature
Asset management strategy	Documentation or engagement	Partial documentation exists but is not communicated	Document exists and is signed off by the executive management team	The document is signed off by the executive management team and supported by internal and external stakeholders
	Line of sight	Strategic objectives are partially defined	Strategic objectives, outcome and key performance indicators (KPIs) are defined but not fully communicated	Strategic objectives, outcomes and KPIs are defined, communicated and fully visible
	Benefits of asset management	Benefits are defined but not documented	Benefits are identified and documented	Benefits are quantified and the realisation process is documented and used across the organisation
Data information and analytics	**Area**	**Evolving**	**Developing**	**Mature**
	Analytics	Future trends are assumed to follow past trends	Predictive approach is developed, forecasting asset deterioration and identifying future risks	A prescriptive approach is used to optimise investments. "What-if" scenario analysis is widely used
	Asset data Quality	Use of third-party data is prevalent to fill data gaps	Data quality is partially measured and understood, in isolated pockets of knowledge	The data strategy and policy is documented. A dedicated data team is part of the organisational structure.
Decision-making	**Area**	**Evolving**	**Developing**	**Mature**
	Prioritisation and optimisation	Decisions are made based on expert judgement	Investment is consistently prioritised, supported by a decision-support tool	Investment is optimised across various investment drivers, using a common monetised currency
Risk	**Area**	**Evolving**	**Developing**	**Mature**
	Probability of service failure	Probability of failure is based on expert judgement and past trends	Probability of failure is analytically modelled for strategic asset classes	Probability of failure is analytically modelled for all asset classes
	Valuation of consequence	Valuation is based on expert judgement and past trends	Data-driven valuation exists for strategic asset classes	Data-driven valuation exists for all asset classes. Scenario analysis is undertaken.

	Area	Evolving	Developing	Mature
Life cycle management	Asset creation	Incomplete manual process exists for capturing newly created assets	A semi-automatic process exists for capturing newly created assets	A fully automated process exists for capturing newly created assets. Process is signed off by senior management and regularly audited
	Asset maintenance	Corrective	Time-based	Condition-based
	Whole-life cost	Whole-life cost has not been developed	Whole-life cost is applied to inform decision-making process for strategic assets	Whole-life costs are widely understood and applied to all asset classes
Staffing and organisation Decision-making	**Area**	**Evolving**	**Developing**	**Mature**
	Asset management function	Function has not been defined	The asset management function is incorporated into an existing function, without full definition of scope	Dedicated resources are available
	Asset management structure	The structure has been considered but not implemented	The structure has been implemented with limited resources	An asset manager director and dedicated teams are in place, covering defined asset management functions

Summary of Section 3

This section presents the asset management journey, showing how organisations can progressively build their management capabilities and realise the benefits. It reveals that a common approach involves first forming a central asset management team, developing common approaches and engaging with internal and external stakeholders, followed by embedding the asset management functions deeper into the organisation. Gaining greater insight into asset management allows for better decision-making, in a continuous process of reflection, planning and intervention. Section 4 of this paper considers policy recommendations in the economies where the EBRD invests, looking at key actors in the water sector.

4. Policy recommendations

Beyond the specific recommendations for organisational reform set out earlier in this paper, Section 4 looks at wider policy considerations that can further enable asset management in the water sector of countries where the EBRD invests.

4.1. Organisational reform

In the workshop discussions it became clear that for most organisations in the water sector, the motive for adopting asset management is well understood. Small organisations are likely to have less capacity to embrace asset management or to see the value in adopting it. In addition, small entities may lack basic asset data to support the simplest of analyses. Large and consolidated entities in the water sector would probably gain the most from formalising the full extent of asset management practices in their organisations.

Less well-versed organisations and administrations may require further convincing, through demonstration of the value of better investment planning and decision-making, for example improved infrastructure reliability and service to customers. Sharing experiences of these benefits can be persuasive, even for smaller operators. Smaller organisations may also consider merging with other operators in their region, creating larger and more capable organisations in the long term.

What is clear is that taking no action can lead all organisations into widening funding gaps or cause them to become accustomed to delivering poor service levels and using high-risk strategies.

Initiating and following an asset management journey is an enormous change that often requires organisational restructuring and personnel training throughout the development of asset management. Organisations must adapt, developing many new skill sets (statistical, analytical and so on) to complement their existing pool of skilled accountants, engineers, operators and scientists, and these changes are also perfect opportunities to rebalance any gender disparities in an organisation. The implementation of organisational and management changes should be both gradual and purposeful.

4.2. The role of regulatory and government bodies

Asset management is not a statutory requirement, but creates added value for an organisation, its customers and investors and for the natural environment. Where regulatory bodies can exercise influence in the water sector they should champion asset management, endorsing and even incentivising its use. In this regard, regulators and government bodies may choose to use a "carrot" or "stick" approach, or both.

Both approaches have been applied in the United Kingdom's water sector. The requirements of the independent UK economic regulators (Ofwat, WICS and NIUR)[6] to achieve greater cost efficiencies and performance levels indirectly stimulated companies' interest in asset management and its rapid development. The case study in Annex 1 describes the infancy of asset management in the water sector of England and Wales during the 1990s and its subsequent evolution to address competing demands. Ofwat, the water sector regulator in England and Wales, even chose to assess the relative strength of asset management adoption within organisations through the use of Asset Management Assessment scoring. Today, asset management is a core business competency, led largely by water companies seeking greater efficiency, improved performance and risk visibility. Asset management has enabled these companies to communicate objectively with their customers and stakeholders about the "what-if" scenarios of their investment choices.

In England and Wales, senior regulatory officials who support performance-based regulation – which focuses on assets and performance instead of on financial cost accounting – also promote the need for sound asset management practices.

[6] Office of Water Services (Ofwat), Water Industry Commission for Scotland (WICS) and the Northern Ireland Utility Regulator (NIUR).

4.3. Contractual arrangements

The development of a water and wastewater operator's asset management plan is important to better understand and communicate the optimal investment and maintenance programme. In order to ensure effective implementation of this kind of plan, stakeholders must provide adequate and predictable funding.

Regardless of whether this funding derives fully from end-users, the relevant political authorities must show a clear commitment to ensuring that the necessary funding is available and predictable in the long term. Politicised budget allocations tend to encourage unpredictable and short-term funding decisions. Efforts must therefore be made to depoliticise annual budget decisions for the water sector and to tie immediate funding and future adjustments to funding into the asset management plan, linked to a formula-based methodology.

Therefore, where suitable, sound governance of the sector should be backed by solid contractual arrangements that regulate the relationship between public authorities and autonomous legal operators in the sector, whether those operators are publicly or privately owned, and where such contracts clearly define the rights and obligations of the parties and the relevant processes involved.

4.4. Private sector participation

The private sector can facilitate the adoption of asset management – for example, firms that specialise in asset management architecture, training, integrated information management systems, models and data analytics. The case studies in Annex 1 show how private sector expertise in asset management enables asset-intensive organisations to develop their management capability. Private sector organisations often work across different sectors and are able to bring asset management insights which may be common across sectors.

Furthermore, some broad-based consulting organisations are able to provide a different skill set to address asset management challenges. For instance, an IT or online organisation could use a

technological solution. It is possible for an asset, or group of assets, to be modelled as a "digital twin", a method in which assets are represented by a digital operational model which simulates and tests various operational scenarios before the chosen scenario is implemented on the real assets. This approach allows the modelling and testing of extreme operational scenarios without the risk of asset failure and associated service interruptions.

A more traditional use of private sector companies lies in developing an independent view of an organisation's asset management maturity and capability. Private sector firms are often used in this more traditional client-support role, to provide services that develop an organisation's own internal asset management capability.

Organisations that already use the private sector recognise the benefits of this type of collaboration. While much of this private sector activity is likely to be conducted under basic service contracts,[7] such as the completion of an asset-condition survey, well-developed asset management can also reveal further opportunities for private sector participation.

An organisation with expert knowledge of its assets, risks, service trends and costs can contract out more confidently operational activities such as the operation and maintenance of sewage pumping stations, sewer cleaning and water mains repairs. If it has accurate knowledge of its asset base the organisation is also better prepared to initiate more comprehensive private sector involvement. This is vital because potential concessionaires or other investors need to know, with a certain degree of confidence, the quality of the assets for which they will be responsible for or the expected value of the assets they plan to acquire.

[7] The outsourcing of specific support services.

4.5. Conclusion

Infrastructure represents a significant investment for every organisation. A formal approach to the management of infrastructure assets in the water sector is essential to support informed decision-making, to provide services in the most cost-effective manner over the entire asset life cycle, and to demonstrate this stewardship to customers, investors and other stakeholders. Applying best practices in asset management ensures that infrastructure continues to provide sustainable and economically viable levels of service.

In order to achieve higher commercial performance in the water sector – whether measured in terms of revenue growth or customer satisfaction – organisations are adopting more sophisticated asset management approaches that make it possible to manage heterogeneous, widely dispersed assets.

Most organisations in countries where the EBRD invests recognise the potential benefits of asset management but are at different stages of maturity. All of them could progress by better understanding asset behaviours and preparing evidence-based investment programmes that take account of service expectations and risk. This would enable them to move from conducting relatively isolated budget-setting exercises to pursuing a more integrated and holistic approach to asset care and investment planning.

Taking this step requires a permanent commitment to data collation, information analytics, learning and continuous improvement. There are many ways to bridge gaps and to build the skills needed to become competent. While opinions vary on the shape that an asset management structure should take, participants in the EBRD infrastructure workshop generally acknowledge that having dedicated resources allocated to asset management, and working collaboratively with expertise provided from the private sector, can achieve the swiftest deployment of asset management capability.

For some organisations, their strategic objectives change far too frequently to develop a coherent or consistent mission. Although it is widely recognised that changes to strategic objectives influenced by external factors are harder to manage, there is a role for regulatory and government bodies to provide direction and certainty, promoting and even incentivising asset management practices.

Annex 1. The water sector in the United Kingdom

In the United Kingdom, almost every household has a continuous supply of very high-quality drinking water and is connected to a mains sewerage system. This infrastructure is complemented by rivers and coastal waters that meet increasingly stringent environmental standards. But this has not always been the case.

Prior to 1989, the country's water and wastewater networks had suffered from decades of underinvestment, a position in which many delegates to the EBRD's 2017 workshop on asset management find themselves today.

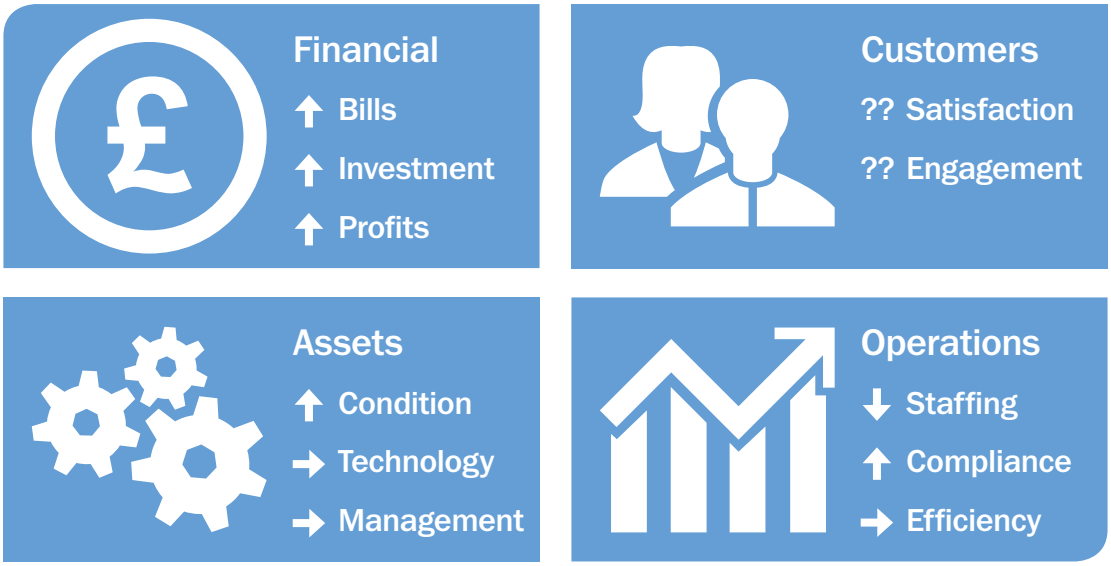
The turning point for the sector in England and Wales was the privatisation of water authorities in 1989. Scotland's water sector, however, remains under public ownership. The privatisation in England and Wales saw the transfer of personnel and physical assets from the ten former water authorities to privately owned limited companies. This process was supported by floating these firms on the London Stock Exchange in order to raise capital funding, thus writing off part of the UK's government debt.

Further restructuring took place with the aim of protecting customers and the environment. Three independent bodies were created to regulate the activities of the water and wastewater companies: the National Rivers Authority, which is now the Environment Agency (EA), the Drinking Water Inspectorate (DWI), and an economic regulator, the Office of Water Services (Ofwat).

In the 10 years after privatisation the water and wastewater companies borrowed and invested heavily in their asset base to improve compliance and the condition of assets. During this period, investment decisions were unsophisticated, with rudimentary decisions about costs or benefits being commonplace. Customer bills and company profits rose, arguably to an excessive degree, and consequently, the government imposed a windfall tax in 1997.

While the companies focused on assets and investment, their employees and customers enjoyed fewer rewards. There was significant downsizing and outsourcing of activities, reduced staff numbers, and customer service appeared to be a relatively low priority.

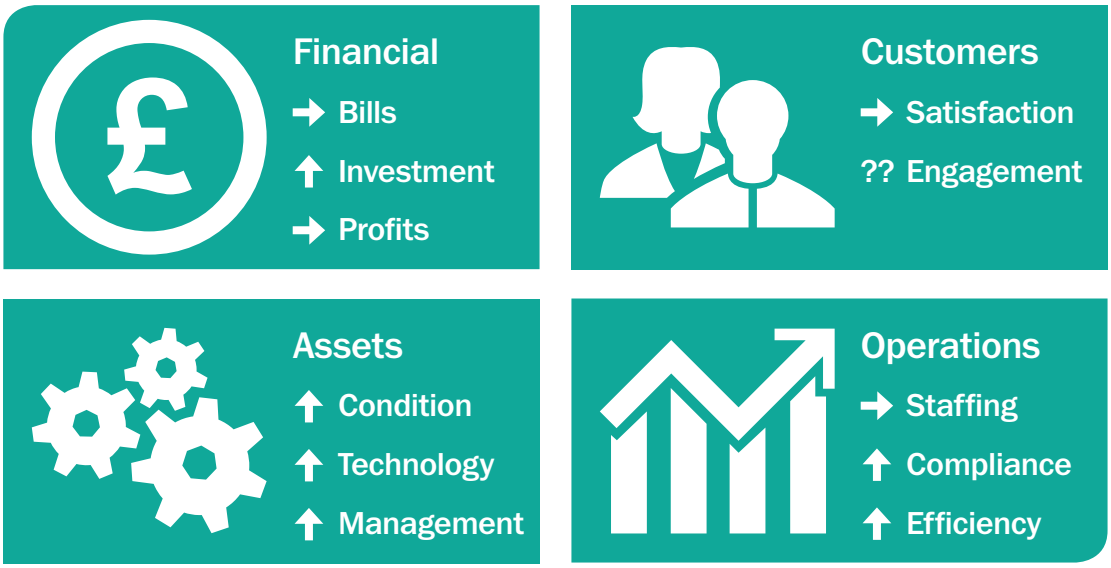
Figure A.1.1. Water sector in England and Wales (1989 to 2000)



Source: PA Consulting.

In the period from 2000 to 2010, the regulatory regime forced companies to change their approach. A need for comparative efficiency drove organisations to implement cost efficiency measures in their operations and investment. The adoption of asset management as a discipline created large asset management teams from what had previously been very separate teams in operational and capital delivery. One of the key changes during this period was Ofwat's growing expectation that companies should consult their customers, understand their priorities and reflect these in their business plans. Meanwhile, companies began to find innovative ways to create better value by adopting technology to manage and operate infrastructure, although this was not always done successfully. On the whole, the water and wastewater firms thrived and complied with the regulatory requirements, improving their efficiency and the condition of their assets.

Figure A.1.2. Water and wastewater sector in England and Wales (2000-10)



Source: PA Consulting.

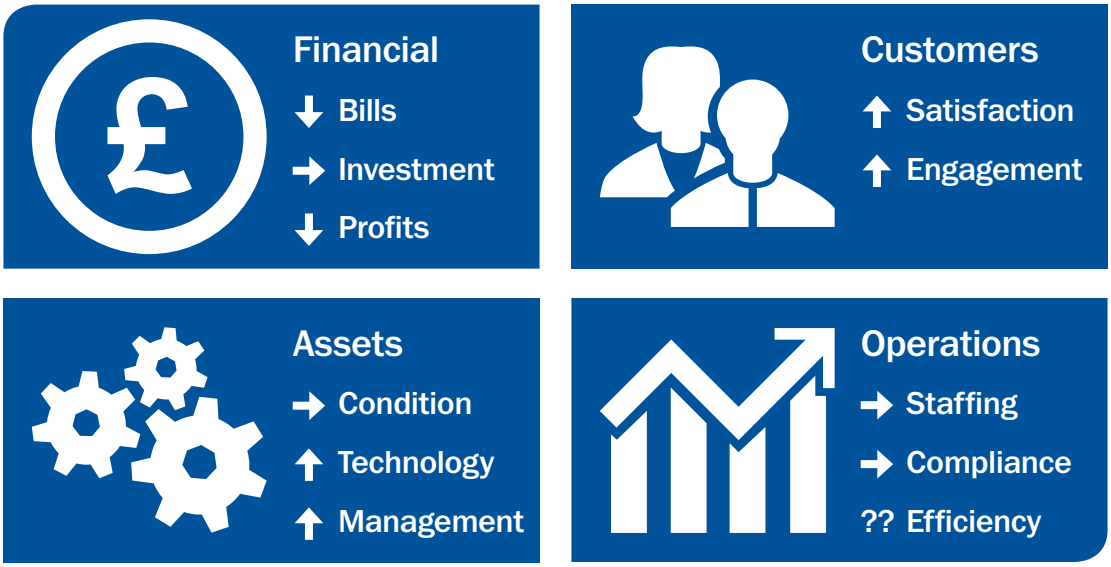
Since 2010, the sector has changed significantly compared to how it was in the period immediately after privatisation. The regulator adopted a tougher stance, with price reviews and customer bills remaining flat in real terms for most companies.

As a result of these constraints on finance, capital investment levelled out, with companies increasingly seeking new ways to maintain service for a lower lifetime cost (totex). The regulator significantly reduced the allowable return on capital investment but increased the scope of performance incentives, aiming to better reward companies that performed well but to penalise those that did not meet targets.

Thus, in order to sustain their previous levels of return on investment companies needed to achieve profits through better operational performance rather than by simply by matching the very generous cost-of-capital allowances they had enjoyed in the past. Asset management has evolved significantly since 2010, driven by the need to lower totex, with water companies commonly using predictive analytics to forecast asset deterioration and the associated investment levels required to maintain stable levels of service for customers.

Indeed, whereas in the early years after privatisation these organisations were internally focused and asset focused, the later years were more about service and customers, with the expectation that customers should actively participate in the development of company plans and that customer satisfaction with services should be improving.

Figure A.1.3. Water industry in England and Wales (2010-20)



Source: PA Consulting.

Ofwat increasingly expects water companies to engage more closely with their customers and to reflect customer preferences in their plans. Engagement with customers is now undertaken through face-to-face engagement at structured forums. Water companies organise independently chaired "customer challenge groups" to help generate high-quality business plans and reduce the need for regulatory intervention.

The mandating of these customer groups, the results of which are reported to Ofwat, was seen as one of the major successes of Ofwat's 2014 Price Review. Through close engagement with customers, water companies also undertake research into customers' willingness to pay for certain activities and this is seen as an important aid to investment decisions. After the water companies were awarded the Final Determinations by Ofwat the regulator challenged companies to keep customers engaged throughout the implementation of the next five-year business-planning process.

1055 Policy paper on infrastructure – The art of the possible: smart management of assets in the water sector

Photography: EBRD and iStock

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