MINISTRY OF FOREIGN AFFAIRS
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Mykolaiv
city on the wave

Assistance to the Development of the Mykolaiv Masterplan

Water Supply and Sanitation

Asset Management, Report

Final

February, 2024

COWI

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List of Abbreviations

AMPs	Asset Management Plans
AMPL	Asset Management Program Leader
DANVA	Danish Water Association
DMA	District Metered Area
EBRD	European Bank of Reconstruction and Development
GIS	Geographical Information System
GFA	GFA Consulting Group
HACCP	Hazard Analysis and Critical Control Points
IAM	Institute of Asset Management
LCC	Life Cycle Cost
MVK	Mykolaivvodokanal
O&M	Operation and Maintenance
PIP	Priority Investment programme
RCM	Reliability Centered Maintenance
SAMP	Strategic Asset Management Plan
SCADA	Supervisory Control and Data Acquisition
TCO	Total Cost Ownership
VCS	VandCenter Syd (in English: Water Centre South)

1 Introduction

This report has been developed within the framework of the project “Technical advice to the Danish Ministry of Foreign Affairs regarding Mykolaiv - Denmark partnership” financed by the Danish Ministry of Foreign Affairs (MFA). COWI has been entrusted the development of contributions to the masterplan regarding water, energy and solid waste. The masterplan concerns the Mykolaiv City and its development in the period till 2050 (throughout this report Mykolaiv City and Mykolaiv as well as City of Mykolaiv are used synonymously).

Mykolaiv Masterplan, which has been requested by the Mayor of Mykolaiv City, has a time horizon till 2050. It provides a compass for actions to be taken by the Mykolaiv City to ensure that it will develop into a thriving city attractive to its citizens and business community.

COWI and One Works assist Mykolaiv City Administration in developing the masterplan. In this work, COWI focuses on three sectors:

- Water and wastewater,
- Energy, including power, district heating and renewable energy sources.
- Solid waste management.

Mykolaiv City Administration meets every week with COWI and One Works to ensure proper coordination.

COWI has established a project organization consisting of a project management team and three sector teams of professionals, each headed by a Discipline Leader. Three sectoral Focal Points are responsible for monitoring cross-cutting activities, ensuring coordination between the parties and maintaining consistency in the deliverables.

To enhance transparency in the development of the Mykolaiv Masterplan, given its significant public interest and exposure, COWI has established three sector-specific Sounding Boards inviting all potentially interested parties to take part in these.

Box 1-1: COWI’s contribution to the Mykolaiv Masterplan.

The report focuses on provision of the detailed information about asset management that should be an integrated part of any company providing utility services. As MVK has been interviewed and based on the previous analysis of the existing situation at the company, the structure and approaches towards organizing the asset management systems is provided within this report. In the view of the future investments into the water supply and wastewater treatment in Mykolaiv and it is of a high importance to introduce and efficient

Some specific recommendations are given to MVK along with examples from VCS and based on the European practices and experience.

The present report consists of six chapter, including the current introduction and appendices.

Chapter 2 provides the general description of the notion of asset management and how it is defined by some organizations like EBRD or Institute of Asset Management.

Chapter 3 gives the objective and reason for performing asset management at the utility service companies and explains the importance, specially referring to the providers of utility service.

Chapter 4 focuses on the details on the areas that are to be kept under management and assessed with the view on how it effects the running of business every day and in long run.

Chapter 5 explains what steps to be taken in order to organizer the work of efficient system of asset management. Chapter also provides the approaches at the point when the system is already set as well as organigrams.

Chapter 6 provides recommendations in the view of arrangement of asset management for MVK.

Appendices provide the references and information about the company VCS in Denmark along with the cases and examples of how asset management is organized at the utility company in Denmark.

2 What is Asset Management

Asset Management is an integrated process, bringing together skills, expertise, and activities of people with information about physical assets and finances of the utility, allowing informed decisions supporting sustainable service delivery to be conducted.

The above definition is the introduction to the asset management policy at VCS Denmark and clearly identifies people as an essential factor in good asset management. The definition also clearly states that asset management is not a system, but a mind-set.

The focus of the asset management process will vary from utility to utility and will most likely shift over time, depending on how well the utility know and have register of the assets. If the utility does not have an overview of the assets including the quality of assets both investment planning and maintenance planning will be difficult.

There are many perspectives on asset management, and various international best practices identifies their own specific definition for asset management. While these definitions are each unique in their formulations, they share some clear and important messages:

- Asset management is an ongoing, iterative process or approach, not a one-off project,
- Asset management is holistic and integrated,
- Asset management is about generating value and sustainable service delivery.

Regardless of whether a water utility chooses to embrace one of the provided definitions of asset management, or to develop its own to align with their own culture and terminology, the definition should include consistent messaging.

The three following quotes all say the same thing but in different ways – the approach to asset management can be different but with the same goal of being more professional and efficient in delivering the desired level of services.

ISO 55000 defines asset management as: *Asset management is a coordinated activity of an organization to realize value from assets. Realization of value will normally involve a balancing of costs, risks, opportunities, and performance benefits.*

The Institute of Asset Management (IAM) defines asset management as: *Asset management is the art and science of making the right decisions and optimizing the delivery of value. A common objective is to minimize the whole life cost of assets but there may be other critical factors such as risk or business continuity to be considered objectively in this decision making. (The IAM, 2019).*

European Bank for Reconstruction and Development (EBRD) defines asset management as: *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. (EBRD, 2018, p.6)*

To take the understanding of the process of asset management in a utility context a bit further, some basic principles can be outlined.

- Infrastructure assets exist for the purpose of delivering valuable services to the customers,
- Service delivery needs should at a utility be met in a socially, economically and environmentally responsible manner that does not compromise the ability of future generations to meet their own needs,
- Sustainable service delivery requires assets, people and financial resources,
- Asset management supports utilities in managing the risks that threaten delivery of service, achieving and demonstrating stewardship of both assets and finances,
- Utilities are diverse and local conditions matter. Asset management uses best practices that are scalable and adaptable to unique circumstances in each utility,
- Asset management is a process of continuous review and development,
- Leadership and the integration of asset management into organisational culture are critical.

The asset management processes are illustrated in Figure 2-1.

It illustrates that there are many components in asset management, and provides a circular, continuous pathway to link all elements of the process. The circular nature emphasises that the process is on-going and requires continuous review and improvement.

Figure 2-1: Asset Management Process

Source: (Asset Management, British Columbia/ Asset Management Framework in Romania, EBRD/Ramboll/BDO/VCS)

3 Why do we do Asset Management?

All utilities are services, where assets represent high monetary values, normally established over several generations, and often without a proper maintenance strategy, this due to lack of funding, due to lack of overview of the assets and recognition of the consequences of neglect of actions of maintenance.

MVK and other utilities in Ukraine is in a different and unique situation after the war where usual maintenance practices might have been disrupted. Further, a need for large investments is recognised and will primarily depend on foreign investments. To assure the best conditions for receiving these investments, well designed asset management procedures will be important.

Utilities build and maintain infrastructure to provide water services. These services support the quality of life, protect health and safety, and promote social, economic and environmental well-being. Failure to maintain infrastructure, manage natural resources and protect the services provided by nature, entails a risk of degrading - or even losing – the services that customers expect, and future generations will rely on.

Sound asset management practices support sustainable water service delivery by integrating customers' needs, values, and an informed understanding of the trade-offs between costs, risks and levels of service.

Water and wastewater infrastructure represents significant investments for every utility. A formal approach to the management of infrastructure assets is essential to support management in making informed decisions, 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 asset management best practices ensures that infrastructure continues to provide sustainable and economically viable levels of service.

These best practices illustrate the following achievements:

- Properly built and effectively maintained infrastructure supports public health and safety along with potential adverse environmental impacts of society.

- Financial sustainability requires strong connections between long-term infrastructure investment needs, long-term funding plans and financial performance measures to track progress over time.

- Well informed decisions contribute to achieving the goals of the utility, while balancing the financial capacity of current and future generations.

With the help from a well-organized asset management system, MVK will be able to:

- Enhance transparency concerning assets. It will be easier to see which assets are of the most importance in your system and must be held in better condition than others,

- Focus on long-term planning. One of the most important issues in asset management is to create space for the long-term planning to foresee any major reinvestments in good time,

- Focus on whole lifetime / life cost. All investments and reinvestments should be made with respect to choose the best solution regarding the balance between cost of establishing, costs of operation, and costs of maintenance. In some cases, it is better to choose a higher quality from start and in that way reduce operation and maintenance costs in the long run,

- Take risks into account in decisions. Another important main issue in asset management is the risk management or risk assessment. A systematic and professional risk management is a tool for avoiding situations where assets are not performing at desired level,

- Introduce better prioritizations. In some cases, one must choose between different solutions or prioritize between different options. Using assets management in the right manner contains some tools to make better decisions,

- Improve efficiency. Based on having the (more) correct asset-data, you can do the right things in the right order at the right times – this will of course improve the efficiency and effectiveness; and

- Improve holistic thinking about assets. The holistic view of your assets relates to the enhanced transparency of the asset portfolio. By holistic thinking means clearness and knowledge about how the assets are related directly or indirectly to the delivered value to the customers.

Sustainable service delivery means that current water utility services are delivered in a social, economic, and environmentally responsible manner that does not compromise the ability of future generations to meet their own needs.

4 Key Features of Asset Management - Areas to Focus On

People, information, assets, and finances are considered to be the core elements of asset management, as illustrated at Figure 2-1, Chapter 2. Each of these elements is necessary to ensure sustainable service delivery. Success requires the integration of these four elements throughout the process of asset management.

These four core elements can be thought of as the four key features needed to support the process of asset management, and they are equally necessary for ensuring sustainable service delivery.

Assets
Assets are the physical infrastructure owned by water utilities to enable service delivery. Assets include, but are not limited to, water and wastewater systems, and drainage and flood protection systems. It is important to include both existing and new assets, and to consider future assets in utility planning. Assets may also include natural resources and the essential ecological functions nature provides.

Finances
A holistic understanding of the infrastructure required to deliver services and associated long-term costs, including capital, operating and maintenance costs, is critical to asset management. Technical and financial information must be linked to inform long-term decision-making. Proactive asset management will yield fewer service disruptions, more predictable results, and lower total lifecycle costs than a reactive approach to repairs and replacement.

The balance between revenue generation, debt and maintenance and operation costs should be acknowledged and controlled. Debt can either be a useful tool for a water utility, or a burden or even a significant risk. In general terms, the correct amount of debt is subjective and context specific. Holistic and strategic use of debt is best when it augments progress toward steady replacement of existing assets.

People
Asset management is a corporate responsibility, and the importance of having the right people and the right processes cannot be overstated. Utilities that successfully implement asset management have:

- Staff who understand the need for, and benefits of, asset management and the importance of committing to continuous improvement,
- Clear corporate priorities and asset management objectives,
- Effective leadership throughout the organisation, including top management, that creates and promotes the vision and values reflected in an asset management policy,
- Culture that fosters teamwork and integration across departments, throughout the organisation,
- Culture that values informed decision-making,
- Staff that understand the need for lifelong learning to develop their knowledge, experience and capacity.

Information

Information is needed to support decisions that are cost effective, manage risks, and support long-term service delivery. The quality of information, as well as its collection and dissemination can evolve over time to strengthen informed decision-making. Answering the following questions provides much of the information needed:

- What assets do you own and where are they located?
- What is the depreciated value of your assets?
- What are the conditions (physical, demand/capacity and functionality) and expected remaining lifespan of your assets?
- Which services and asset risks need to be prioritised and managed?
- What are the current and desired/targeted levels of services?
- When will repairs, upgrades, or replacement be required?
- How much will it cost?
- Which assets can or should be retired?
- Which new assets may be required and when?

Compiling this information into a consolidated asset inventory will help decision-making. Each utility may have a rudimentary inventory/register of their assets – more or less developed - which can serve as a starting point for collecting asset information. Information should be updated over time to include asset acquisitions or renewals, changing costs, retired assets, changing asset conditions, risks, or levels of service expectations.

The outset for compilation of information varies significantly among utilities, where some is fully digitised and other rely on the good memory of employees. This especially becomes important in regard to the “hidden” assets, the underground pipe network. The distribution network represents in most utilities the major share of the value of assets.

5 Steps to be Taken When Introducing Asset Management

Each utility will develop and align its process for getting started with asset management. This alignment should reflect the company's strategy and culture, and it is crucial to involve staff from the outset.

The tasks outlined at the Figure 5-1 follow the order in which a utility is likely to need to undertake them when seeking to enhance its asset management practices in line with the Asset Management Framework developed for utilities.

One of the key parameters in effective asset management is having access to sufficient and accurate data about assets. While some utilities have well-developed digitalization efforts that provide verified data, others lack shared knowledge about their assets. Most utilities can benefit significantly from an overhaul of their information compilation processes. Initiating this activity as soon as possible is essential.

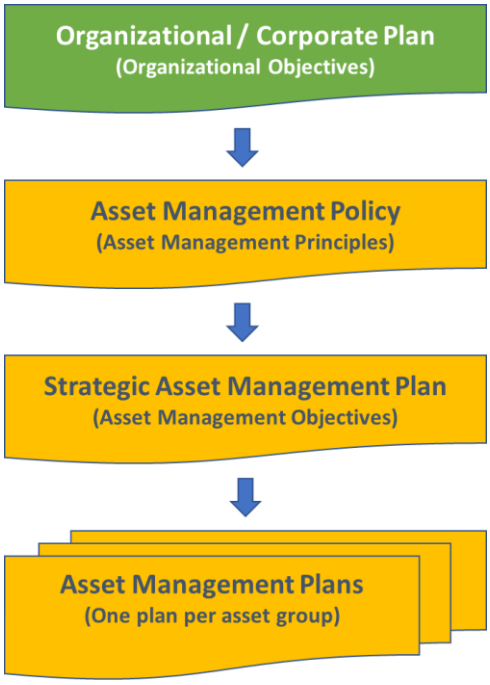

Figure 5-1: Process Flow

To activate the flow the steps to be taken are shown at Figure 5-2. The detailed elaboration of the steps to be activated is given in the following sub-chapters from 5.1.to 5.5.

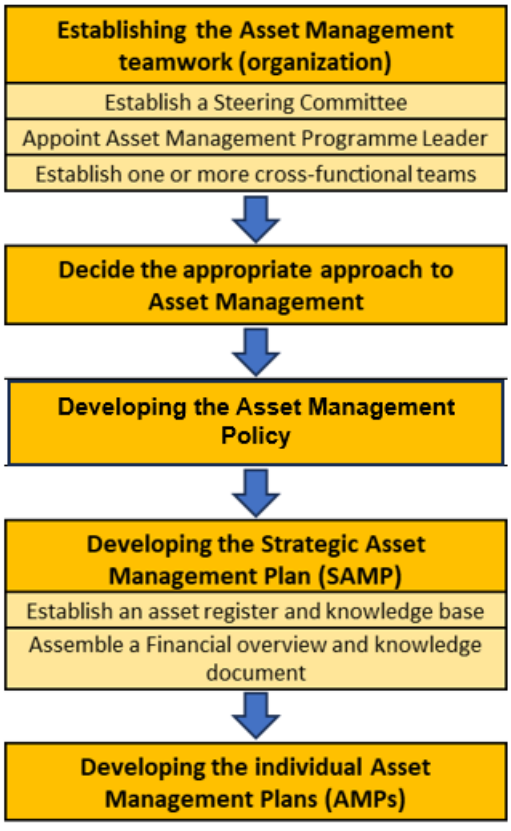

Figure 5-2: Process Flow Steps

5.1 Organisation of Asset Management – Step 1

The way of organising the asset management work will normally depend on the nature of the utility. If it is a multi-utility covering for example drinking water, wastewater, district heating and maybe more it shall be considered at what level in the asset management the process shall be separated between the different branches of supply.

This decision can depend on the size of the utility, but also on the framework under which the utility operate. How much are the economy of the different branches tangled into each other and do a regulator put any special requirements on separation of branches?

However, in most cases it is preferable to have some similarity within the company for the utility branches. This calls for a high-level steering committee who have the mandate to make decisions on strategic issues and formulate an asset management policy, see step 3. It is at this level it is decided if the utility will separate asset management program on branch level or on different level.

It can be decided to appoint an Asset Management Program Leader, (AMPL), to be in charge of the system and implementation of the program. The AMPL will normally report to the Steering Committee. Again, it can be decided to appoint a branch specific AMPL or an overall AMPL. The same reflections will come regarding asset management teams. In Figure 5-3 is shown an example of a cross functional team for drinking water.

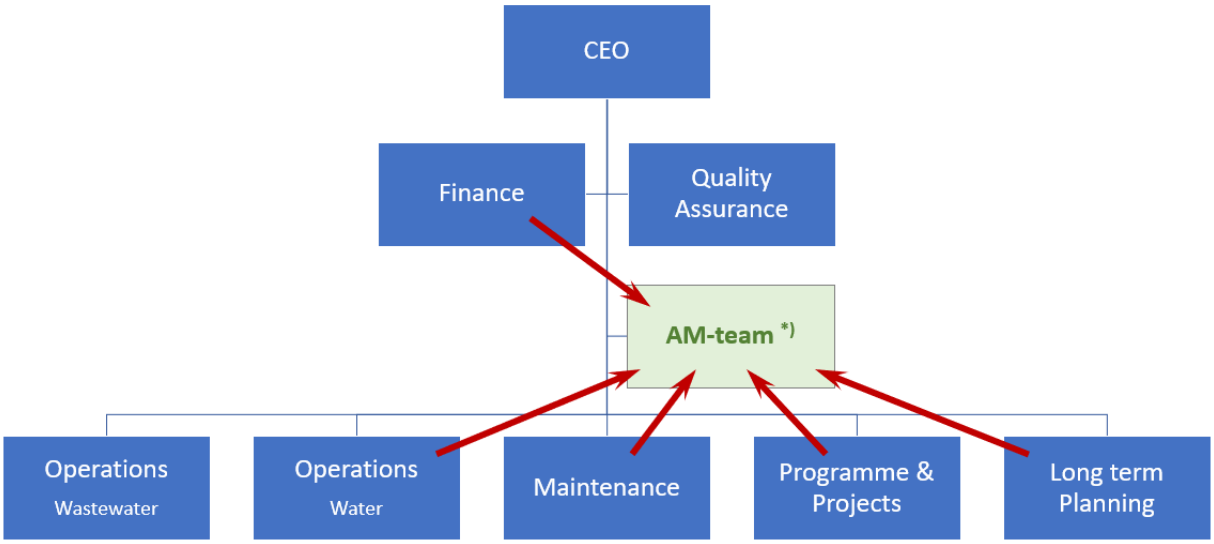

Figure 5-3: Asset Management Team for Drinking Water

*) The Asset Management team is to be manned with relevant representatives from departments involved in the actual asset group or groups.

5.2 Approach to Asset Management – Step 2

The utility company culture needs to be reflected in the asset management program. As illustrated earlier in Figure 2-1**Error! Reference source not found.** “People” is one of the core features in a successful asset management program. And their mode of operation will mirror the company culture. Part of a company culture relevant for an asset management program are represented in the four bullet points below. It is very important to notice that asset management is not an IT-system it is very much about the way of working with the assets within the company - it is about the company culture.

The overall approach can in general be covered by the deciding the position of the utility for the following 4 topics:

1) **Centralization** – How centralized are the management on the development of the assets. Does the utility, when introducing asset management already practice a high degree of delegation, or shall a centralized decision process be continued?

2) **Involvement**– To which degree do the utility the involvement in the asset management procedures, and to which extent shall the employes know and include asset management procedures in their work?

3) **Formalization** – How formalized a system shall be established. Does the utility aim to get a asset management system, which can be certified to meet ISO 55000 standards and having regularly repeated procedures or a more random pragmatic approach?

4) **Scope of assets** –How many of the assets in the utility shall be covered by the asset management procedures? Is it all types of assets or only the utility essential assets. This is the step, where a gradual approach will the most obvious to choose, when introducing asset management.

In Figure 5-4 it is shown a tool for debating on approach to asset management. How far to one side or another do the utility want to place themselves on the 4 topics.

Appendix B4, covers the experiences of the Danish utility VCS Denmark and this includes the VCS position on the matrix.

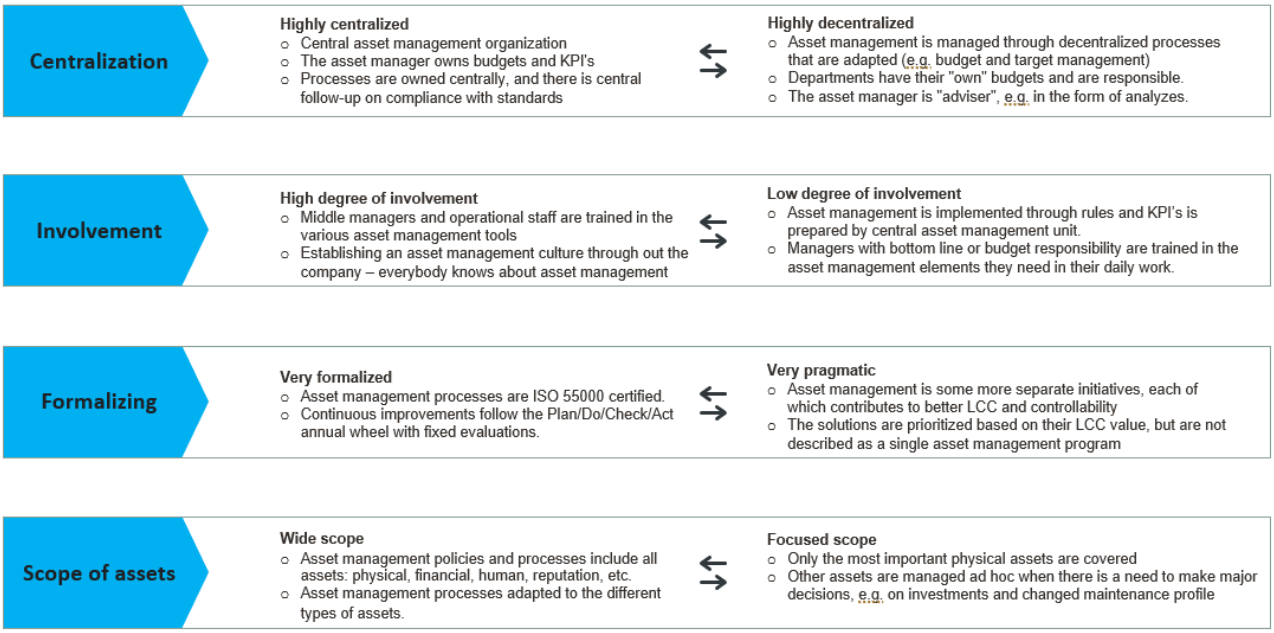

Figure 5-4: Approach to Asset Management

One of the primary challenges in asset management is to achieve the optimal balance between the three drivers:
Cost – Total Cost of Ownership

- *Risk* – Risk of not being able to deliver the required service

- *Performance* – Service requirements

The three elements will often be contradictory, if a low risk is required, this will most often require increased cost to be able to deliver the desired performance.

The costs in the balance triangle are the total costs of the asset. Total costs over the expected lifetime are typically called TCO = Total Cost of Ownership, or LCC = Life-Cycle Cost = Whole-Life Cost, also called total lifetime cost.

Too often a utility does not include the Cost / Risk / Performance balance in their current process planning. In many utilities the focus will be on only one or two of the drivers.

If nothing is done, the utility has indirectly chosen the approach of run to failure, which is not a sustainable solution.

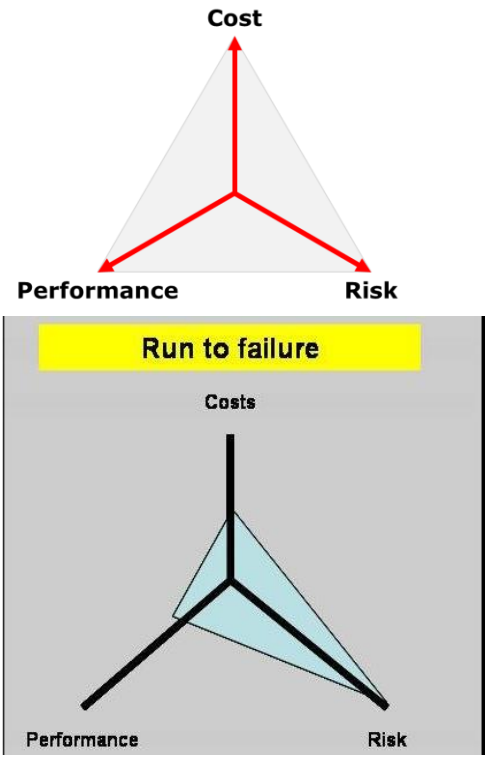

Figure 5-5: Cost/Risk/Performance Balance

5.3 Developing the Asset Management Policy – Step 3

An Asset Management Policy identifies the long-term vision of the utility, objectives and plans and relates these desired outcomes with the managing of assets. From this relationship, key drivers for asset management can be identified. These drivers should definitely be in line with the utility strategy, but also City development plans, but also more universal drivers as the UN Sustainable Development Goals can be included.

The asset management policy should be based on the chosen approach to asset management as well as it should describe how the utility will work on developing goals in accordance with a sustainable Cost / Risk / Performance balance.

Including these aspects an Asset Management Policy can be drafted and approved by the board and top management. It is important to emphasize that it is recommended that the policy should be a short document.

5.4 Developing Strategic Asset Management Plan (SAMP) – Step 4

According to the Institute of Asset Management, a Strategic Asset Management Plan is a “long-term optimized approach to management of the assets, derived from, and consistent with, the organizational strategic plan and the asset management policy.” Stated differently, a Strategic Asset

Management Plan is a high-level but very important document that guides asset management activities within an organization. The strategy sets out the roadmap for implementing the policy.

The SAMP can include a register that provides an overview and knowledge of the different assets. It must be decided in which IT application(s) will be used. However, a single overview is recommended drawing upon data from different systems (GIS, SCADA, O&M etc.).

It is a good idea to assign a score to each asset indicating its condition and fitness for service. These scores can then be used in planning future investments and operations. The future desired level of service should also be stated in the register.

It is most likely that not all asset information is available. It must be expected that data are inadequate, and resources must be used to improve asset information. This can be done within a certain period as it is not necessary to have a complete register to get started with the asset management journey.

Furthermore, a risk assessment should be conducted for the assets. This can either be done on the specific assets or on the shared functions of assets. The risk analysis can be difficult to address, especially the different categories in the analysis and the weighting of these.

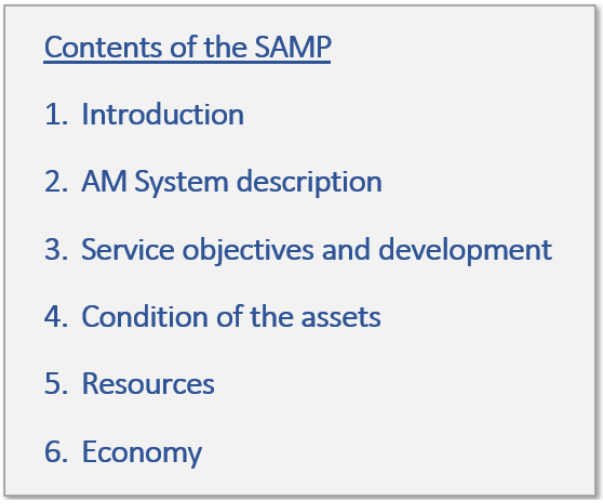

Figure 5-6: SAMP, Proposal for list of Content

As the processes in asset management is repetitive it can wise to include an annual wheel in the SAMP, describing the process timing in relation to work planning, financial procedures etc.

5.5 Developing Individual Asset Management Plans (AMP) - Step 5

An Asset Management Plan is a plan for a specific asset or group of assets.

The first step should be to decide on the level of asset management plans. Plans could cover specific assets or an overall asset group such as network, pumping stations, wastewater treatment plants, etc.

The AMP must identify:

- Data gaps
- Current service level
- Targeted service level
- Required actions to meet targeted level
- Renewal plan
- Maintenance strategy
- Risks
- Costs

Figure 5-7: AMP, Proposal for List of Content

The AMP's will be revised on a yearly basis. Here specific activities and upcoming activities and renewal. This all has to be stipulated financially, to be taken further into the overall investment planning.

When writing the plans, it has to be in mind what is useful information and what is just report standard, which will require work for update, without necessary to bring much value.

5.6 Key Challenges When Taking These Steps

Asset Management requires a significant amount of work, especially when introducing. It is also a complex matter and requires attention to keep momentum and secure a living process. It is demotivating for any process if it has to be restarted several times.

Availability of staff is another classical issue. It is therefore important that roles are well defined, and that management are supportive and gives the impression that asset management is important.

The system created shall bring value and not just be a system with a value of it own in the system. It is therefore important that the people engaged are people with some insight an in the area, this will prevent installing to bureaucratic solutions.

Therefore, it is important to get the right cross functional team, who all can contribute professionally and bring value to the process.

Risk analysis is complicated and for most staff members it will be difficult to quantify the risks. It is especially when doing risk analysis, the cross functionality of the team becomes important. There is always a risk of ranking risks within own area of professionalism as having a stronger impact.

6 Recommendations for MVK

Asset Management as a system has not been used at MVK. Most utilities have elements of asset management in their procedures, typically regarding registration of assets. For utilities the major value of assets is to be found in the pipe network and emphasis is naturally given to these assets. Few utilities have a fully implemented asset management system as it requires great efforts from the utility and often it is not clear for a utility what the full benefit of a well-functioning and integrated asset management system can bring to the utility. However, eventually it will enable the utility to provide a better service.

The main driver for MVK will be to secure sustainability of the existing and new installations. This requires development of maintenance plans that must have a structured approach to maintenance. For this to happen proper registration of assets is required. For all new installations requirements shall be given which data should be registered and what shall be included. For existing installations, procedures shall be formulated for data registration.

There is this an added advantage in introducing asset management for MVK. As it must be foreseen that MVK for some years after the war will be dependent on international loans and grants. An IFI will consider it positive if MVK can document, that they follow well described asset management procedures in their investment planning and operation and maintenance, (O&M), practices.

The primary objective of MVK is to ensure the sustainability of both existing and new installations. Achieving this goal necessitates the development of comprehensive maintenance plans that adopt a structured approach. To facilitate this, proper registration of assets becomes essential. For all new installations, clear requirements should be established regarding the data to be registered and the necessary inclusions. Additionally, procedures must be formulated for data registration in existing installations.

Furthermore, introducing asset management offers an additional advantage for MVK. Given that MVK may rely on international loans and grants for several years after the war, it becomes crucial to demonstrate adherence to well-defined asset management procedures in investment planning and operational practices. Such documentation will be positively regarded by international financial institutions (IFIs).

Asset Management inclusion in MVK will include a number of activities to run in parallel:

- Setting up the Asset management system. This can follow the 5-step approach described in the Chapter 5. This shall, to a large extent, be nested within the utility itself but can benefit from having an external facilitator to drive the process. Asset Management will involve most of the employees at MVK. For a successful implementation it is important that there is a shared understanding of what asset management will imply for MVK.

- Subprojects which are part of normal utility management, but also are mandatory for fulfilling the objectives of the asset management system. These subprojects can be:

    - Digitalization of pipe network,

    - Monitoring and data collection - which data is needed and used, which data is irrelevant,

- Assessment of existing installations,
- Development of O&M plans and implementation of these,
- Development of a SCADA strategy.

The scale of subprojects can vary significantly, and some may be outsourced to consultants to varying degrees. In certain cases, the consultant might even serve as the direct operator, particularly in digitalization efforts. However, for other subprojects, careful consideration is needed regarding staff training within the utility and how job descriptions should align with the new approach.

The duration of subprojects typically spans several years. As for the asset management system, its establishment can occur over a period of 1 to 2 years. The extent of staff involvement in this process will determine the necessary resources, ranging from 1 to 1½ man-years. The process itself is outlined below, and you can also refer to the VCS example in Appendix B2 and B3.

Successfully implementing asset management is a multifaceted endeavour, requiring in-depth discussions on approach, ambition, scope, and timeframe. To navigate this complexity, it is recommended engaging external experts with experience in facilitating such processes. Including an external expert from the outset can greatly assist in team formation and overall success.

An initial and important step will be establishing the Asset Management teamwork (organisation), where the first will to establish a Steering Committee and Appoint an Asset Management Programme Leader. For the initial formulation phase this could be a person from the top management of MVK. Later in the process, when the approach and policy has been decided and formulated a shift on this position can take place introducing someone, who can dedicate more worktime to the programme than a person from the top management can.
This first initial phase could take place over a sequence of full day workshops, with external experts as facilitators. This shared understanding of MVK's continued asset management journey, among this also to develop/revisit/revise key point indicators for MVK's service level, grouping of assets and decision on which asset groups to focus on in an initial phase.

As the national regulator operates with separate budgets for drinking water and wastewater it is sensible to take this down to the asset management practices. Here again the needs to be identified by the asset groups, which can be more or less specific.

For the area of drinking water, the group contains of: water resources, abstraction/intake facilities, water treatment facilities, transport and storage of bulk water, pumping stations, distribution network, consumer metering. Some of the headlines given can be merged into larger groups or even being divided further, but a minimum of groups will be water production and water transport.

For the area of wastewater, the group contains of: sewage network and transporting of sewage, pumping stations, wastewater treatment, sludge handling and deposition. Also, wastewater groups can be adjusted, but with a minimum of transport of wastewater and treatment of wastewater.

For both areas SCADA is an important tool which requires very specialised staff, but it is not seen as an asset group of its own.

Additionally, while other asset groups such as buildings and transport services could be explored in greater detail, they are not considered specialized areas within this context. Nevertheless, it is crucial to recognize their significance both financially and in terms of the number of staff involved in managing these asset groups.

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Appendix B

B.1 Asset Management Introduction at VCS Denmark

This document describes the asset management at the Danish utility VCS Denmark. There are many roads to embark on working with asset management and this is just one example.

B.2 Background information on VCS Denmark

VCS Denmark, VCS, is a very old utility and therefore having assets of all ages. The three main areas of the utility is drinking water, wastewater and climate adaptation. The utility was as the first water utility company in Denmark corporatized back in 1994, with ownership placed at Odense and Northern Funen municipalities. The utility has always been innovative and first movers in many aspects. Related to some of the activities typically included in an asset management approach, VCS started early on a number of these activities.

Back in the early 90'ies VCS embarked on a pipe renovation program based on a drinking water distribution network strategy, as part of this a digitalization of this was started and VCS has for the past 25 years benefitted from a fully digitized network and non-revenue figures between 4-8 %. The platform has changed several times, and the GIS platform used today is still holding some of the initial registrations.

VCS started to use more advanced and systematic approaches to O&M in 2009, where VCS took on working with Reliability Centered Maintenance, RCM. But VCS had already 3-4 years earlier embarked on implementing HACCP, (Hazard Analysis and Critical Control Points), to identify critical points regarding production safety and hygiene. Thereby, experience was gained in working with Risk Matrices. In 2010 VCS introduced RCM in the Operation and Maintenance practices for all drinking water installations.

SCADA is another important element in an advanced O&M procedure, where the entire distribution network is supervised by the SCADA system and a fin masked net of DMA sections. Also the condition of production boreholes is supervised by advanced SCADA routines, which are used for planning maintenance activities at the wellfields.

The initiation of the asset management journey as described in the following section did not start out from scratch at VCS. The utility had a complete digitalisation, advanced systematic O&M practices and a complete SACADA supervision used in O&M planning.

B.3 Process of Introduction of Asset Management at VCS

The Danish water sector experienced major changes when the Water Sector Act was adopted in 2009 on the basis of a political agreement from 2007. Municipal water supplies, which were not previously separated from the municipal administration, were, as a result of the law, separated in 2010 into municipally owned joint-stock or limited liability companies. From 1 January 2011, all the companies covered by the Water Sector Act were subject to price ceilings and ongoing efficiency improvements. As part of new requirements was a benchmarking targeting economic performance, where the former benchmarking organised by the Danish Water association, DANVA; had a stronger focus on service levels.

In 2013 the three largest utilities in Denmark, Hofor, AAV and VCS, started a joint investigation in how to introduce the ISO55000 for asset management standard. This shall be seen as a response to the requirements in the new water sector law.

At VCS a GAP analysis was conducted in 2014 among several key stakeholders. In short, the conclusions could be said to be, that VCS had a good understanding of their assets lifecycle activities, was monitoring them well, but there were no formal reviews or systematic approach to risk assessment, this due to an asset management system not yet were in place. But in VCS there was a growing understanding of that a more formal approach to asset management was needed.

A pilot test of systematic assessment of all wastewater pumping stations at VCS, 287, was conducted as a pilot for providing input to the asset management process for O&M practices, service targets and policy and strategy. This turned out to be a too technical bottom-up approach for developing both service targets as well as asset management policy. This work was finished in 2016.

VCS continued to work with refining risk assessments in an asset management perspective and included asset management as a tool in the company strategy. And in 2018 the continued work with asset management was formalised by the establishment of a cross company working group. It was decided to address the two asset groups: Drinking water and wastewater and starting with drinking water where an asset management group for drinking water was established in 2019.

In the Strategy for 2020-24 it is stated that VCS shall have a focus on finance and efficiencies and will implement Asset Management in the water and wastewater departments for a better insight into the total lifetime costs.

This were included in the work with Asset Management expressed as VCS must provide a more precise prioritization of efforts across operation, maintenance and investment. Asset Management and the associated processes described in SAMP and AMP must thus support fulfilment of VCS's strategy and contribute to an optimization of the total economy of ml. 5-8%.

At the very end of 2021 an asset management policy was approved by the company management.

The state in beginning of 2024 is that for drinking water a Strategic asset management plan, SAMP, and 3 asset management plans, AMP, has been developed in a second edition. For wastewater a working group is established and asset management plans are expected to be finished in 2024.

B.4 Asset Management Approach at VCS

This section describes several principles for how it has been chosen to work with asset management in VCS. The principles are divided into 4 main areas:

- **Centralization** – how centralized is the management of the individual asset classes? In VCS, we have a strong tradition for a value-based approach with a high degree of delegation – i.e. the decentralized approach. This means that asset management is also highly decentralized, but based on common principles in the areas where it is beneficial to have common principles,

- **Involvement** – to what extent is there employee involvement around asset management? As mentioned under point 1, VCS is a company based on value-based management. A high degree of employee involvement has thus automatically been chosen,

- **Formalization** – how formalized is our asset management system? It is expected that VCS will have to be certified at some point, which is why it has been chosen to formalize the system to a sufficient extent to be certified without significant additional requirements for formalization/documentation,

- **Scope of assets** – how many of the company's assets are covered by asset management? So far, it has been chosen to focus on the significant physical assets within water and wastewater. Furthermore, a non-detailed approach has been chosen, which means that for the time being the assets are considered at functional level (e.g a pumping station) unless it is crucial to go deeper in special situations.

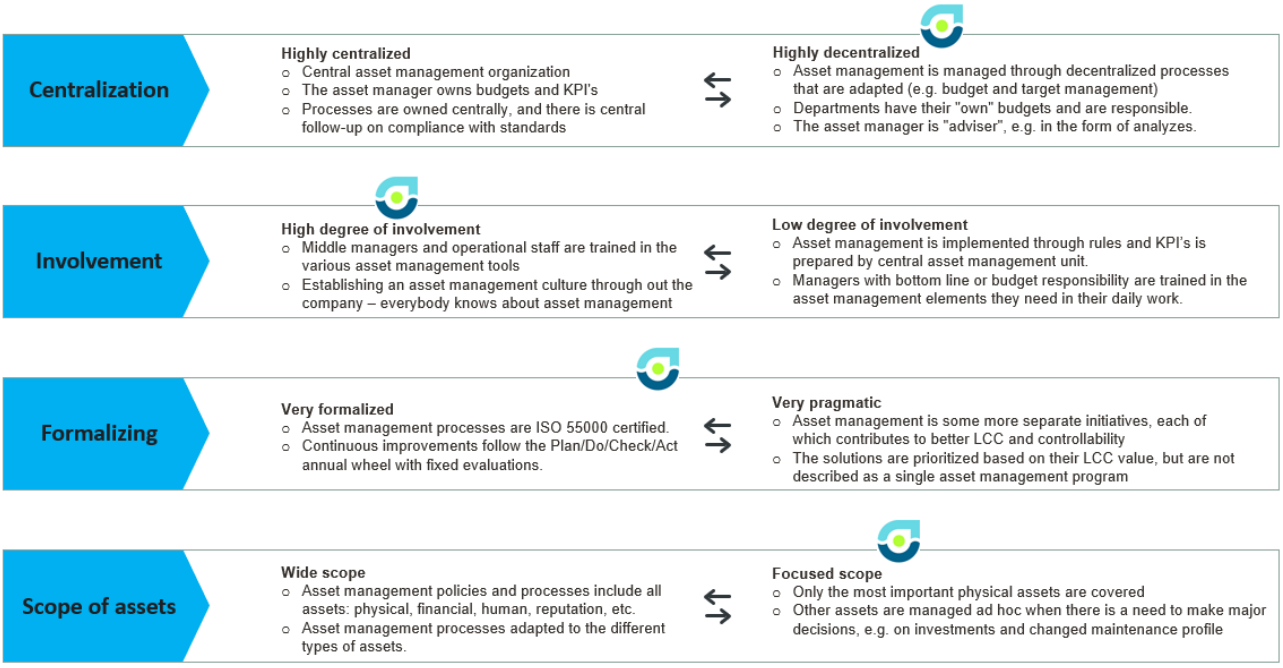

Figure 1: Approach to Asset Management, Marked where VCS positions themselves

B.5 Policy, Asset Groups and SAMP and AMPs

The asset management policy at VCS is a short one-page document, which outlines how asset management is seen at VCS, what VCS will achieve and how this shall be achieved. The policy is off course aligned with the overall company strategy.

At VCS, asset management is the process that brings together the necessary people for assessment and decision-making about significant physical assets.

The decisions are made based on collective knowledge and are assessed in balance between sustainability, performance and total costs for customers and future generations.

The development of SAMP and AMPs for drinking water was initiated, and it was decided to divide the assets into 3 asset groups:

1. The water resource,
2. The water production, and
3. The water distribution.

- The water resource covers the natural assets in form of groundwater reservoirs. This can from an asset management prospective seem a special decision. But as VCS is entirely based on groundwater and spend significant amounts on groundwater protection activities and on monitoring the state of the groundwater,

- The water production covers the boreholes, and all assets related to abstraction from the boreholes and treatment plants for the drinking water,

- The water distribution covers distribution network, reservoirs and pumping stations.

SAMP and AMP's have been prepared by a wide range of employees to ensure thorough grounding and joint learning. This preparation has also taken place against the background that VCS wants an asset management system that reflects the collaborative culture in the company. Thus, the SAMP also clarifies the distribution of roles and responsibilities for the individual functions that deal with the water area.

B.6 Risk Assessment

The assets are considered from a risk perspective, where condition and criticality are assessed and decisions about the asset plans are made from a life cycle perspective. Condition assessment of the physical assets is carried out on an overall and aggregated level which results in an overall assessment of the individual functionally related physical assets such as a spring site, a waterworks or a supply area. The conditions of the assets have been accessed using a 5-point scale, see Table 1.

Table 1: Condition of the Assets-Assessed on a 5 Point Scale

0	Unknown	There is insufficient data or experience to conduct a condition assessment.
1	Very good	The assets within the selected system / area are generally in very good condition. Only a few parts show signs of wear that require attention - this is typically the case with newer or newly renovated systems.
2	Good	The assets within the selected system / area are generally in good condition. Some parts show signs of wear that require attention and action. Only a few parts show significant deficiencies.
3	Medium	The assets within the selected system / area are generally in medium condition. The assets show signs of wear that require attention and action. Some parts show significant defects and acute defects occur.
4	Poor	The assets within the selected system / area are generally in poor condition. The assets are below the desired standard - many parts are worn and require replacement. Large parts of the system show significant deficiencies and often fail => increased operation.
5	Very poor	The assets within the selected system / area are generally in an unacceptable state. The assets are far below the desired standard - many parts require replacement. Large parts of the system have serious faults and deficiencies => increased operation and poor service.

In order to uncover the overall risk around a given asset / asset group, a number of risk categories must also be defined. Table 2 shows 6 risk categories, with associated risk levels within each risk category.

The process around risk assessment of a given asset (e.g. a waterworks) works in such a way that the individual risk categories are treated / placed separately with risk level / consequence and probability of error. If an asset qualifies for several risk categories, the highest risk value in the risk matrix is selected.

For the risk assessment biannual workshops are conducted to access risks and follow up on what the state was an earlier assessment.

Table 2: Asset Management – Risk Assessment model (facilitated; February and August sessions, see annual wheel)

Risk categories						Risk matrix					
Work environment & safety	**Security of supply**	**Environment & Society**	**Customers & Image**	**Legislation & Authorities**	**Financial consequence**	**Conse-quence**					
More than 30% invalid	Very large supply shortage e.g., > 10% without water > 8 hours unannounced	Comprehensive irreparable damage	Prolonged image damage	Serious law-breaking or authority administration	Loss > 5% of TOTEX	Very seriously	75	150	225	300	375
Damages with permanent injury	Large supply shortage e.g. > 10% without water> 6 hours unannounced	Extensive recoverable damage	Complaints with significant negative media coverage	Immediate order to rectify the situation	Loss < 5% of TOTEX	Seriously	25	50	75	100	125
Injuries with long-term absence	Greater exceeding of primary service targets	Moderately recoverable damage	Complaints from many customers, or organized customer groups	Order or request to rectify the relationship	Loss < 1 % of TOTEX	Moderate	10	20	30	40	50
Injuries with short-term absence	Minor exceeding of primary service targets	Limited damage	Complaints from several customers at the same time	Incident reporting and operational adjustment	Loss < 0,5% of TOTEX	Small	5	10	15	20	25
Injuries without absence	Exceeding of secondary service targets	Insignificant damage	Individual inquiries and complaints	Reporting of insignificant incident	Loss < 0,2% of TOTEX	Insignificant	1	2	3	4	5
						Probability or Frequency:	Very rarely > 50 year	Rarely > 10 year	Occasio-nally > 5 year	pretty often > 1 year	Often < 1 year

B.7 Investments, Planning

A fundamental challenge in asset management is to create the most optimal balance between:

- Cost – total costs (Total Cost of Ownership)
- Risk – the risk of not being able to deliver the service.
- Performance – wishes or requirements for performance.

The three elements are often opposed, so if a lower risk is desired, it will typically be associated with increased costs to establish and maintain a low risk of not being able to deliver the desired performance.

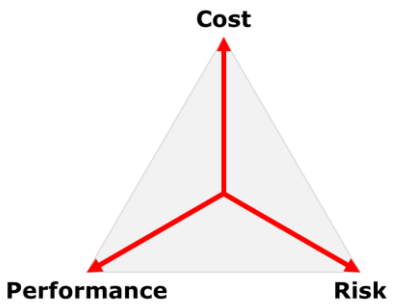

Figure 2: Investments, Planning Elements

The costs in the balance sheet are the total costs of the asset. Total costs over the expected lifetime are typically called TCO = Total Cost of Ownership.

Substantial and long-term solutions around assets are therefore decided in a balance between the total lifetime costs, seen in relation to which service you want to achieve, and which risks you want to accept.

As an example of a balanced application of cost/risk/performance at VCS, is the addition of UV treatment to the supply system: a) There is a desire/need to reduce the risk of bacteriological contamination of the drinking water; b) It is analysed and decided to include an additional bacteriological barrier (UV treatment); c) The consequence is increased cost, reduced risk of failure due to pollution, and increased performance (service target) due to increased uptime. The before/after situation is shown in Figure 3.

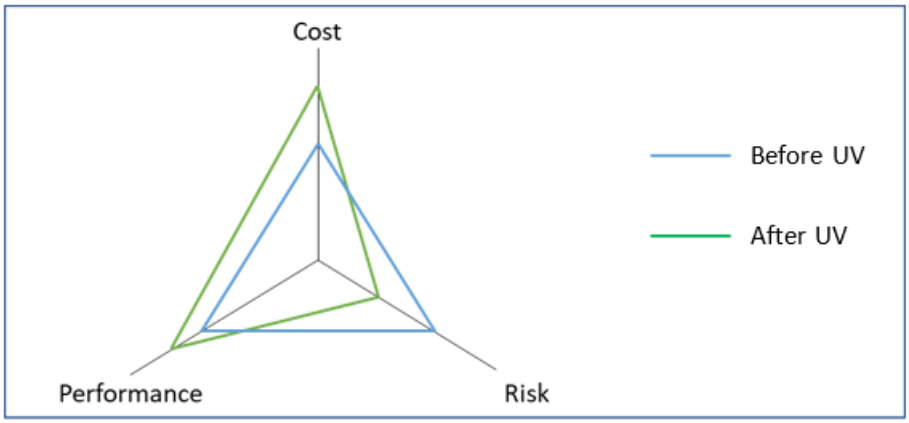

Figure 3: Balancing Cost/Risk/Performance Before and After UV Treatment

B.8 Asset Management Organisation and Structure of Work

In order to ensure the necessary progress and updating of the asset management system, a meeting structure applicable to the meetings at SAMP level has been determined. The meetings at SAMP level are called AM drinking water meetings and the participation consists of key persons across all AMPs, thus representing the entire asset management system.

AM- drinking water is responsible for preparing and presenting the overall expected work and budget plans in both the short and long term. AM-drinking water must ensure that the management team is adequately informed about developments in the water area. AM-drinking water is also responsible for the ongoing follow-up meetings on the current work plans and budgets, and for reporting significant deviations.

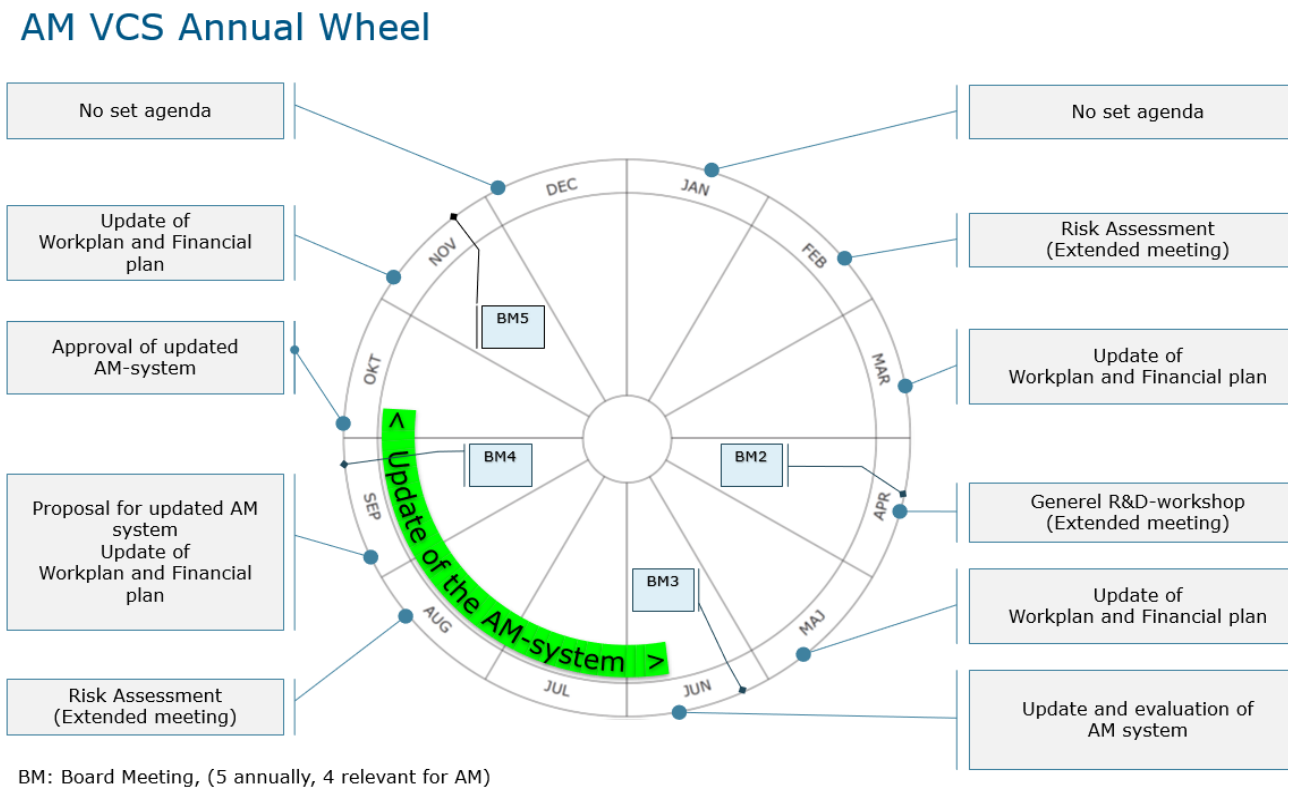

Figure 4: Annual Wheel for Asset Management at VCS

As a starting point, AM drinking water meets 11 times a year, cf. the annual wheel on Figure 4. The annual update of the asset management system is between mid-June and mid-October. The rest of the year is spent following up on the approved activity plans.

The Asset Management system at VCS is evaluated at least once a year at an AM drinking water meeting. The asset management system and the performance of the assets are evaluated for its suitability, adequacy and effectiveness, and a decision is made as to the need for changes and improvements.

The asset management development at VCS for water supply has mainly been an internal matter, with some external facilitation in the very beginning. Over the 2-3 year a little bit more than 2 man-years have been used. A significant part of these time has been used on regular asset management meetings, as described in the annual wheel, Figure 4, planning meetings which also took place before the introduction of asset management, just with a slightly different agenda.