Final **Report**

White Paper: Management of Water Sector Utilities:
Summary of Industry Initiatives and Research

THE
Water
Research
FOUNDATION

White Paper:
Management of Water Sector Utilities: Summary of Industry Initiatives and Research

Prepared by:

Z. Cello Vitasovic

James Horne
U.S. EPA Office of Water

Andrew Kricun
Camden County MUA

Scott Haskins
CH2M

2018

THE
Water
Research
FOUNDATION

The Water Environment & Reuse Foundation (Now known as The Water Research Foundation) is a nonprofit (501c3) organization officially formed in July 2016 as the result of the merger of Water Environment Research Foundation and the WateReuse Research Foundation. The merged research foundation, with a combined research portfolio representing over $200 million, conducts research to treat and recover beneficial materials from wastewater, stormwater, and seawater including water, nutrients, energy, and biosolids.

The Foundation also plays an important role in the translation and dissemination of applied research, technology demonstration, and education, through creation of research-based educational tools and technology exchange opportunities. Foundation materials can be used to inform policymakers and the public on the science, economic value, and environmental benefits of wastewater and recovering its resources, as well as the feasibility of new technologies.

For more information, contact us at:
1199 North Fairfax Street, Suite 900
Alexandria, VA 22314
Tel: (571) 384-2100
www.werf.org
werf@werf.org

About WE&RF **(Now known as The Water Research Foundation)**

The Water Environment & Reuse Foundation (WE&RF - Now known as The Water Research Foundation) is a 501c3 charitable corporation which conducts research to treat and recover beneficial materials from wastewater, stormwater, and seawater including water, nutrients, energy, and biosolids while facilitating interaction among practitioners, educators, researchers, decision makers, and the public. Our research represents a portfolio of more than $200 million in water quality research.

The Foundation operates with funding from subscribers, donors, state agencies, and the federal government. Our supporters include wastewater treatment facilities, stormwater utilities, state and federal government agencies, technology vendors and equipment companies, engineers, and environmental consultants. We take a progressive approach to research, stressing collaboration among teams of researchers, environmental professionals, scientists, and staff. All research is peer reviewed by leading experts.

The Foundation is driven by one overarching theme – To provide exceptional water research to advance science and technology. Our research, both relevant and impartial, and of the highest quality, forms a critical foundation for the adoption of sound policies and regulations to protect our natural resources and public health. We build that foundation through four core program elements:

- Applied research in water and the environment – Providing greater value to the industry by linking research with practical applications in the field.
- Accelerating innovation and adoption of technology – Through engagement, evaluation, and sharing of new technologies and solutions to complex problems to create impact.
- Transferring knowledge – The rapid and cohesive dissemination of research results to our subscribers and the water community to facilitate positive action.
- Setting an industry research agenda – As an accelerator for launching new research initiatives that will be needed to address future challenges for our industry.

Our mission is to catalyze innovation through actionable research in water and the environment. We accomplish this mission by seeking to achieve four principal goals:

- Establish water research and innovation priorities to address current and future needs.
- Initiate transformative, integrated, and collaborative research and demonstrations.
- Fund and conduct independent and unbiased, actionable water research.
- Effectively communicate the results and progress of our research and innovation activities in a timely manner.

Interwoven in our mission and goals is the need to provide industry leadership, to collaborate with interested parties and our partners, to uphold the integrity of the scientific process to ensure research is unbiased and is credible, and to do so in a transparent and accountable fashion that provides value to our subscribers and partners.

For the most current updates on our research, sign up to receive Laterals, our bi-weekly electronic newsletter.

Learn more by visiting www.werf.org.

Acknowledgments

Research Team
Principal Investigators:
Z. Cello Vitasovic

Project Team:
James Horne
U.S. Environment Protection Agency

Andrew Kricun
Camden County MUA

Scott Haskins
CH2M

WE&RF (now known as The Water Research Foundation) Staff
Fidan Karimova
Project Manager

Jeffrey J. Mosher
Chief Research Officer

Carrie W. Capuco, J.D.
Director of Communications

Contents

Executive Summary

This paper provides an overview of several key ongoing industry initiatives and research related to management of water resource utilities. Each of these efforts is conducted on a national (U.S.) and/or international level, and each examines utility management from a different perspective. These efforts share a common goal to provide utility managers with useful information and methodologies for monitoring and continuous improvement of utility performance. The initiatives are listed below and summarized in Table 1:

- **Effective Utility Management (EUM) Initiative.** EUM takes a broad look at all aspects of water sector system sustainability, from product quality to customer satisfaction. The initiative is supported through the collaboration of EPA and professional associations across the water sector.
- **Utility of the Future Initiative.** The Utility of the Future framework provides a model for utilities of all sizes to achieve more efficient operations, enhanced productivity, and long-term sustainability.
- **Collaborative Water Utility Benchmarking.** This Water Research Foundation (WRF) project (No. 4659) reviewed a tool and process that allows water utilities to assess leading practices in asset management and align with AWWA Benchmarking Survey performance metrics, EUM attributes, and ISO 55000.
- **LIFT for Management**. This Water Environment & Reuse Foundation-sponsored project – now The Water Research Foundation (LIFT17T16) is intended to improve water and wastewater utility management by developing a business process model and methodology to document the processes that deliver value to utilities through metrics and benchmarks.

The first section of the white paper presents brief summaries of the four initiatives which focused on management of water sector utilities. Summaries include a description of purpose, schedule, sponsorship, key deliverables, and methodology.

The second section discusses the relationships between these projects and describes a road map for collaboration that would maximize the overall value of these initiatives to utility managers.

Table 1. Current Water Utility Management Initiatives

Name	Sponsors	Websites
Effective Utility Management (EUM) Initiative	U.S. EPA and water sector professional associations	www.watereum.org
Utility of the Future	• National Association of Clean Water Agencies (NACWA) • Water Environment Federation (WEF) • The Water Environment & Reuse Foundation • WateReuse Association	www.wef.org/UtilityoftheFuture www.nacwa.org/resources/utility-of-the-future
Collaborative Water Utility Benchmarking	Water Research Foundation, professional associations, utility and consulting partners	www.waterrf.org/Pages/Projects.aspx?PID=4659 https://www.wsaa.asn.au/about-us/asset-management-customer-value-project
LIFT for Management	The Water Research Foundation, utility partners, and consulting firm partners	http://www.werf.org/lift/utilitymanagement

Keywords: Utility Management, Utility Performance, Monitoring, Benchmarking

1. Effective Utility Management (EUM) Initiative

First endorsed by six leading water sector organizations in 2008, EUM has now been endorsed by a total of 11 organizations and is the most widely recognized and utilized utility management framework in the country. Utilities are encouraged to use EUM as the starting point as they move toward becoming 21st century water service providers and ensuring the sustainability of the communities they serve.

1.1 Purpose and Scope

Effective Utility Management (EUM) has become a foundational framework to help water sector utilities of all capacity levels comprehensively assess their current effectiveness, adopt best management practices, and employ metrics to measure their performance improvements based on priorities they choose. EUM has filled a major void by providing an easily understood, cost effective, and replicable approach to utility management that can be implemented by utilities themselves.

EUM is based on a series of *Attributes of Effectively Managed Utilities and Keys to Management Success,* which are depicted in Figure 1. The key implementation document for EUM is the *Effective Utility Management: A Primer for Water and Wastewater Utilities,* first issued in 2008 and updated in 2017. The Primer is the foundation of EUM and is designed to help water and wastewater utility managers make informed decisions and practical, systematic changes to achieve excellence in utility performance in the face of everyday challenges and long-term needs for the utility and the community it serves. The Primer distills the expertise and experience of utility leaders into a framework intended to help utilities identify and address their most pressing needs through an incremental, continual improvement management approach.
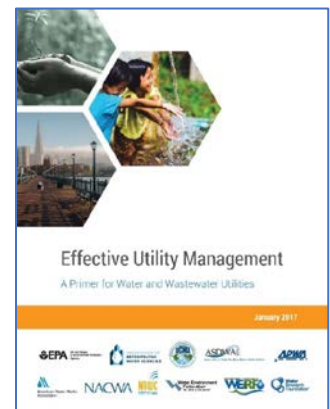
Another document, the *Moving Toward Sustainability: Sustainable and Effective Practices for Creating Your Water Utility Roadmap (December 2014)* enables utilities to benchmark specific utility management practices as a result of the initial assessment described in the Primer. Both documents are available at www.watereum.org.

1.2 Schedule

EUM implementation around the country is ongoing. EPA sponsors webinars and workshops in states around the country to help utilities understand and use the Primer and other EUM-based tools for their operations. As a result, numerous webinars, presentations, and other training events on EUM take place on an ongoing basis.

1.3 Sponsors

EUM is sponsored by the U.S. EPA and a range of water sector professional associations, which are listed to the right. Collectively these sponsors serve as the EUM Utility Leadership Group.

EUM Sponsoring Organizations:

- U.S. EPA
- Water Environment Federation
- National Association of Clean Water Agencies
- American Water Works Association
- American Metropolitan Water Agencies
- American Public Works Association
- National Association of Water Companies
- Association of Clean Water Administrators
- Association of State Drinking Water Administrators
- The Water Research Foundation

1.4 EUM Tool

An important EUM tool is the report *Moving Toward Sustainability: Sustainable and Effective Practices for Creating Your Water Utility Roadmap* (December 2014). This document helps utilities identify and implement specific best practices organized around each of the EUM Attributes. The purpose of this document is to assist utility leaders with implementing proven and effective practices over time to improve their operations and move toward sustainability, at a pace that is consistent with their needs and the needs of their communities.
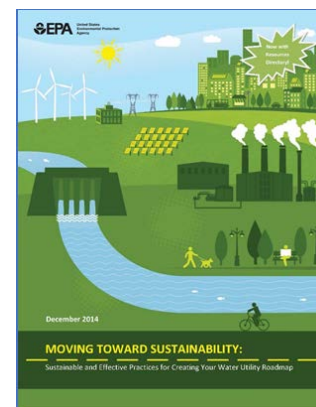
This report provides utility leaders with a cohesive structure to help them address various challenges proactively and with confidence. The practices described in this document reflect the lessons learned and the practical experience utilities have derived as they have improved their operations. A utility can use this document to identify specific opportunities for improvement and draw on the example practices to create an individualized "roadmap" to more sustainable operations. This guide is also used in EPA-sponsored EUM workshops.

1.5 Long-Term Vision

The long-term vision for EUM is to have every water sector utility in the nation understand and use the EUM framework to improve their performance and ensure sustainable operations going forward.

EUM can interact with, and leverage, other utility management initiatives, tools and methods. That is, other industry initiatives can be used as part of the Effective Utility Management cycle, as depicted in **Figure 1**.

The connections and interactions of EUM with other utility management efforts is illustrated in **Appendix A**.

Figure 1. Effective Utility Management Attributes and Keys to Management Success

8

2. Utility of the Future

The Utility of the Future concept is defined by water utility leaders pioneering innovative technologies and cutting-edge practices, with a focus on resource recovery, efficiency, and sustainability.

2.1 Purpose and Scope

Water agencies are looking beyond the traditional operational models based on the Clean Water Act and are considering innovations that create an organization structure that encourages a range of best practices, while incorporating sustainable principles such as energy recovery, nutrient recovery, watershed stewardship, and community engagement, which ultimately benefit their communities.

The purpose of the Utility of the Future framework is to:

- Recognize clean water utilities for successful innovative practices.
- Create a community of practice among the recognized Utilities of the Future for encouraging dissemination and cross-pollination of innovations.
- Facilitate dissemination of information about these successful innovative practices across the entire clean water industry to encourage replication by other utilities.

By disseminating information, the benefits from each successful innovation practiced by each clean water utility can be leveraged to have multiplied benefits across the clean water industry as these innovative practices are adapted by other utilities.

The Utility of the Future focuses on key building blocks of this transformation, including:

- Recovery and new uses of a full range of resources
- Engagement as a leader in the full water cycle and broader social, economic, and environmental sustainability of the community
- Transformation of the internal utility culture in support of these innovations
- Engagement in the community and formation of partnerships necessary for success when operating outside of the traditional span of control of the utility

**Figure 2. Components of the Utility of the Future**

2.2 Schedule

In 2013, WEF, NACWA, and WE&RF (now known as The Water Research Foundation) released the publication, *Water Resources Utility of the Future: A Blueprint for Action*, to capture the transformation that was occurring at wastewater utilities as they progressed beyond simple compliance with the Clean Water Act. This Blueprint for Action examines barriers, suggests incentives for innovation, and compiles a series of actions that could change the dynamics of this industry. The Blueprint presents the clean water industry's vision for the future as well as a series of actions that will help deliver that vision.

The "Utility of the Future Today" recognition program was launched in 2016 by four water sector organizations — NACWA, WEF, WE&RF, and the WateReuse Association – with input EPA. The program honors agencies implementing the innovative "Utility of the Future" business model. The program seeks to promote and recognize utilities that are building on a foundation of excellent management and help small, medium, and large utilities transform their operations over time.

In 2016, 61 water agencies were recognized as "Utilities of the Future" for their innovative work in areas such as organizational culture, community service, green infrastructure, green energy, nutrient recovery, and other innovative practices. In 2017, the second year of the program, an additional 20 utilities were recognized for a total of 81 utilities in the Utility of the Future community of practice. A compendium of successful innovative practices, implemented by the recognized Utilities of the Future, was created in 2016 and will be updated each year as new utilities and new innovative practices are added to the community of practice.

In addition, there has been an ongoing series of Utility of the Future web seminars, spotlighting the recognized utilities and their innovative practices. For more details on the Utility of the Future Today recognition program, visit www.wef.org/UtilityoftheFuture.
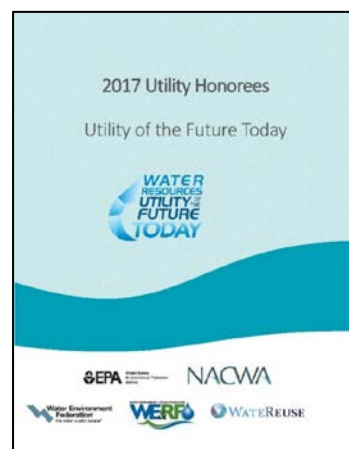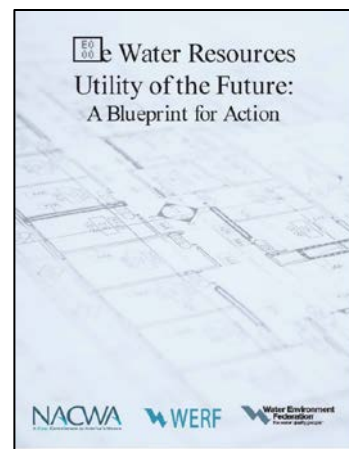
2.3 Sponsorship
The Utility of the Future initiative is a partnership between NACWA, WEF, The Water Environment Research Foundation, and the Water Reuse Association with input from EPA. Currently, 79 water utilities have been recognized in the Utilities of the Future Today recognition program.

2.4 Key Deliverables
The Utility of the Future initiative not only spotlights innovative utility practices across the industry, but also more importantly, results in an accelerated and more systematic dissemination of these innovative practices across the water industry. The deliverables will include the ongoing Utility of the Future community of practice and an annually updated Utility of the Future Today compendium of innovative utility practices.

2.5 Long-Term Vision
The successful innovations developed by the Utility of the Future initiative are making a positive difference for the customers served by these utilities and the environment. The main goal of the Utility of the Future initiative is to accelerate dissemination of these practices across the clean water industry, and to promote and support replication by other industries. The goal is to create more "Utilities of the Future".

3. Collaborative Water Utility Benchmarking

Benchmarking is an approach for utilities to assess their performance, usually in the form of practice maturity and metric performance.

3.1 Purpose and Scope

Measurement can assist in identifying a utility's current state of performance, a desired future state, and provide a comparison against itself and others to identify improvement opportunities. It is a proven means of linking to strategic plans, governing boards, customers, and environmental requirements. Consortium benchmarking – participating with peer organizations – helps connect utilities under a common framework, encouraging both targeted self-assessment, as well as learning and networking opportunities with others. The Water Research Foundation project *Collaborative Water Utility Benchmarking in North America* (No. 4659), reviews a tool developed for the Water Services Association of Australia's 2016 Asset Management Customer Value (AMCV) Project for use by North American water utilities. The tool allows water utilities to align leading practices in asset management activities with AWWA Benchmarking Survey performance metrics, effective utility management attributes, and ISO 55000. The review process enables industry leaders to help with the implementation of the tool. The WRF project resulted in a summary of the suggestions and changes made to the AMCV tool, an evaluation of the participating utilities' experience in using the tool, a business case for water utilities, and recommendations for collaboration in benchmarking activities moving forward. See Figure 3 for the steps of the AMCV framework and Figure 4 for a depiction of the benchmarking process and delivery approach.

Examples of other benchmarking efforts in the U.S. include the use of available industry tools and processes from EUM and AWWA's Metric Benchmarking survey. As part of improvement strategies, linkages are increasingly being made to international or federal standards such as ISO 55000 and the Institute of Asset Management framework.

The WRF project evaluates industry benchmarking efforts and makes recommendations on potential improvements. The project provided an updated framework and process for use by North American utilities based on a consortium benchmarking process that links together metrics, practices, and industry association efforts. The WRF project enhanced the value offered by WSAA's AMCV, AWWA's Utility Benchmarking Survey and various management standards, EUM, and the new ISO standard for asset management.

Under the WRF project, the benchmarking itself involved a one to two week assessment process, measuring utility practice maturity against 500+ practice measures. A gap analysis was conducted, strengths and opportunities identified, and approximately 25 internal cross-functional staff per utility conducted each assessment. Utility and industry-wide reports were prepared, and leading practices

were documented, with a workshop held for North American participants to share this information with each other. The measures and functions were holistic, cutting across the utility organization; and performance was confidentially reported against the AMCV functional structure, as well as being mapped to EUM attributes and ISO 55000 categories. AWWA metrics were rated in terms of importance and urgency.

This project evaluated the linkage of the tools, frameworks, and processes of AMCV, AWWA's Utility Metric Benchmarking, EUM, and ISO 55000 – gathering survey information and feedback from utilities and industry associations. **Appendix B** highlights the Asset Management Customer Value Framework and the Benchmarking Process and Delivery Approach.

3.2 Schedule

WSAA's 2016 AMCV Project was conducted from December 2015 through August 2017. The approach included the following:

- **December 2015 - March 2016:** Steering Group and Project Advisory Committee workshop and guidance; training on the AMCV project and tool; completion of business driver survey, utility profile, and the pre-project survey.

- **April - August 2016:** Utility AMCV assessments; AWWA survey completions, using either a consultant facilitated or self-assessment approach.

- **August - September 2016:** Leading practices identified for each utility.

- **October - November 2016:** Confidential utility reports prepared and reviewed.

- **November 2016 - February 2017:** Leading Practice Workshops held in Los Angeles, California and in Melbourne, Australia (33 utilities in regions outside North America also participated in AMCV project).

- **March 2017:** Final Industry Report produced.

- **June - August 2017:** Project Evaluation Report submitted, reviewed, and finalized.

Information on the WSA AMCV project can be found at www.wsaa.asn.au/about-us/asset-management-customer-value-project.

WRF's project supporting review of AMCV for use in North America was completed in 2018. The WRF Research Manager on the project is Jonathan Cuppett (jcuppett@waterrf.org).

3.3 Sponsors

The Water Research Foundation is the sponsor of the project *Collaborative Water Utility Benchmarking in North America* (No. 4659).

The project consists of eight utility representatives on the Project Steering Committee, three Project Advisory Commmittee Members, 11 utility participants, and three project team members.

The Project Steering Committee members consists of these utility representatives:

- Michael Sweeney (Toho Water Authority)
- Lisa Thompson (Metropolitan Council Environmental Services)
- Sarah Neiderer (DC Water)
- Jeff Leighton (Portland Water Bureau)
- Frank Roth (Albuquerque-Bernalillo County Water Utility Authority
- Stephanie Passarelli (American Water Works Association)
- Ken Mercer (American Water Works Association)
- Greg Ryan (Water Services Association of Australia)

The Project Advisory Committee members:

- Kevin Campanella (Burgess & Niple)
- Heather Pennington (Tacoma Water)
- Kurt Vause (Anchorage Water and Wastewater Utility)

The project team includes:

- Greg Ryan (WSAA)
- Scott Haskins (CH2M)
- Priscilla Bloomfield (CH2M)
- Terry Brueck (EMA)

Utility Participants:
• Albuquerque-Bernadillo County Water Utility Authority
• City of Vancouver, Washington
• DC Water
• Los Angeles Sanitation
• Rancho California Water District
• Metropolitan Council Environmental Services
• Montgomery County Environmental Services
• Portland Water Bureau
• Region of Peel (Canada)
• Region of York (Canada)
• Toho Water Authority

3.4 Key Deliverables

It is expected that benchmarking, in addition to being complementary with other water sector initiatives such as EUM and UAIM, will deliver the following benefits to utilities:

- Continuous improvement through advancement of practices and metric performance – ability to set targets and improvement initiatives.

- Peer collaboration and learning, particularly leading practices and consortium benchmarking; networking with leading practitioners regionally, nationally, and internationally.

- Use of established and commonly used measures and practices, particularly an understanding of what is a good and legally defensible practice for any size and nature of organization.

- Integration with major industry programs such as EUM attributes and keys to management success; strategic planning, ISO 55000 and other standards.

- Demonstration to customers and regulators that utility programs are current, effective, and efficient.

- Capturing economies of scale and best industry knowledge.

- Leveraging industry data, tools, and processes for utility advantage – sharing consolidated databases, survey information, tools, processes, and research.

- Achieving cost savings through application of improved practices. (While cost savings from benchmarking is difficult to isolate and monetize, the important ingredients of major capital, life-cycle, operational, and utility-wide improvement have been demonstrated. There is evidence that large monetary savings and return on investment can be achieved in one to three years).

3.5 Long-Term Vision

Business drivers are causing water utilities to look toward best practices and metric performance as part of their efforts to assess and improve their operations. Benchmarking is an effective means of linking organizations to strategic plans, governing boards, customers, and environmental requirements. Consortium benchmarking – participating in practice and metric benchmarking with peer utilities – connects like utilities under a common framework, allowing not only for targeted self-assessment, but learning and networking opportunities from others.

There is a hopeful future for benchmarking that envisions: growing participation; more integrated tools, databases, frameworks, processes and repositories for utilities; and one that presents options for utilities based on appetite, needs and maturity level. Greater industry sharing and connection to international partners and standards is anticipated, as well as cross sector learning. Benchmarking will be more integrated with the power of technology and a more customer centric environment. Culture change, cost-savings and process improvement will better incorporate the ten attributes and keys to success that are embedded in EUM; and the power of process improvement and metrics will be recognized.

Finally, several issues need to be addressed for benchmarking in North America to reach its potential: barriers to utility participation (i.e. cost of participation and support for benchmarking investment); availability and consistency of benchmarking data, tools and processes, as well as issues of data quality; and a clear value proposition for utilities, which considers their continual improvement journey, different levels of maturity and resources.

4. LIFT for Management

The LIFT for Management project is sponsored by The Water Environment & Reuse Foundation.

4.1 Purpose and Scope

The project is intended to improve water and wastewater utility management by developing a business process model and methodology to understand and document the processes that deliver value to utilities through metrics and benchmarks.

The project is organized into two phases:

- **Phase 1 – Water Sector Value Model.** The objective of Phase 1 is to develop the Water Sector Value Model, a conceptual model that provides a description of how water sector utilities perform their work.

- **Phase 2 – Utility Analysis and Improvement Methodology.** The objective of the second phase of the project is the development of a methodology, the Utility Analysis and Improvement Methodology, which will assist water sector utility managers in improving the performance of their utility.

4.2 Schedule

Each of the two phases is scheduled for one year. Phase 1 (development of the Water Sector Value Model) began in December 2016 and was completed in the fall of 2017. Phase 2 (the development of the Utility Analysis and Improvement Methodology) was started in the fall of 2017 and is scheduled for completion in November of 2018.
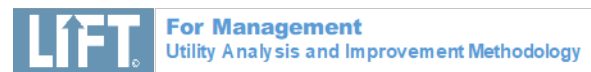
4.3 Sponsorship

This research project is conducted by The Water Environment & Reuse Foundation. The support for the project, including direct financial contributions and extensive in-kind support, is provided by Utility Partners including:

- Alexandria Renew (Virginia)
- Avon Lake (Ohio)
- City of Charlotte (North Carolina)
- Clean Water Services (Oregon)
- DC Water (Washington, D.C.)
- Grand Rapids (Michigan)
- Hampton Roads Sanitation District (Virginia)
- King County (Washington)
- Louisville MSD (Kentucky)
- Metropolitan Council Environmental Services (Minneapolis, Minnesota)
- Orange County (Florida)
- San Francisco PUC (California)
- Toho Water (Florida)
- VCS Denmark (Denmark)
- Washington Suburban Sanitary Commission (Maryland)
- Watercare (New Zealand)

Consulting partners providing support for the project include CH2M, EMA, and Raftelis.

The Water Environment & Reuse Foundation LIFT for Management Project Manager is Fidan Karimova (fkarimova@werf.org).

4.4 Key Deliverables

The deliverables for the two phases of the project are described below.

Phase 1 – Water Sector Value Model. The main deliverable of Phase 1 is the *Water Sector Value Model*, a conceptual model that provides a description of how water sector utilities perform their work. The model includes three levels:

- **Value Chain Hierarchy**. The top level of the hierarchy is the *Value Chain* for the water sector, including key areas where utilities create value. The reference Water Resource Value Chain components (components in blue, **Figure 3**) were defined by the project team and utility partners during the 2016 WEFTEC workshop.

- **Hierarchy of Processes.** Utilities generate value by executing business processes. The Business Process Model describes a hierarchy of processes that are executed to generate value. The top levels of the business process model hierarchy (shown in green, **Figure 3**) describe how the work is organized. This part of the model allows us to break down the complexity of overall utility management into key business processes, and organize them in a generic hierarchy.

- **Downward Hierarchy of Management Processes.** Following a workshop in February 2017 at the Utility Management Conference, six utility working groups worked in parallel to expand the hierarchy of management processes downwards. That is, they developed an "inverted tree" type of hierarchy under each of the top-level processes. By Fall 2017, the project team had defined hundreds of such sub-processes, and reached consensus on the top four levels of the overall hierarchy. To see an example of an inverted tree type of hierarchy, refer to **Appendix C**.
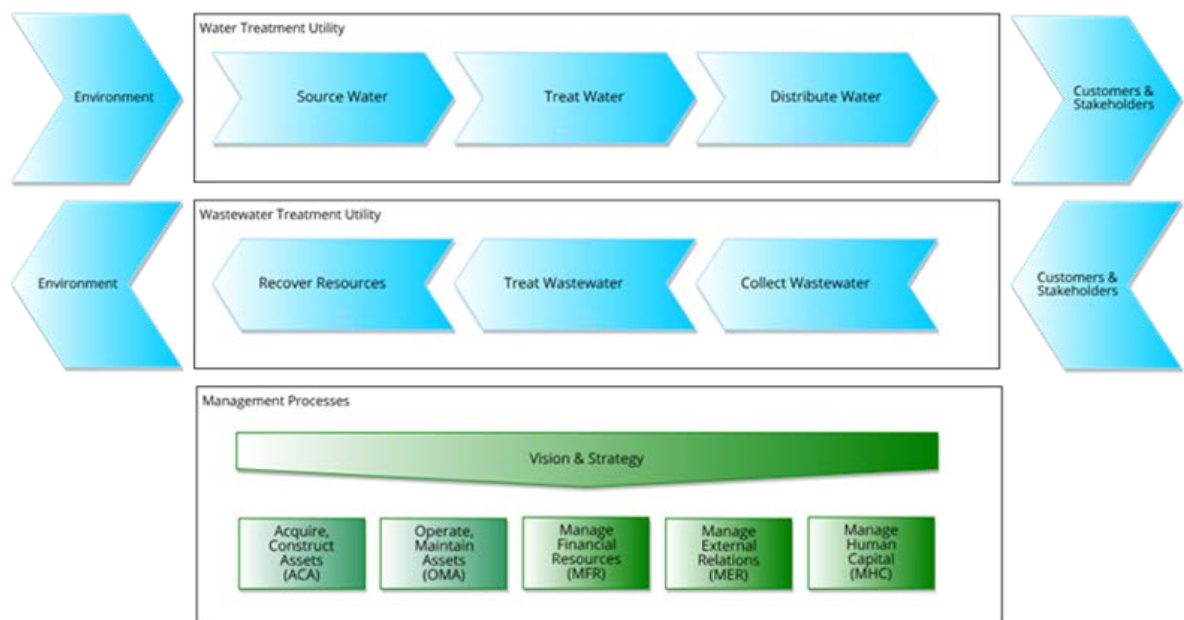

Figure 3. Water Sector Value Model – Value chain and the top-level management processes.

16

The upper levels of the Water Resource Value Chain show how the work is organized; the models on the lower levels (typically levels five and below) provide a detailed description of how the business process is executed. To describe the business processes with greater specificity and detail, we shift to the Business Process Modeling Notation (BPMN2.0). The BPMN allows us to describe the workflows, specify the information required to perform tasks, show the sequence of actions, and identify how different roles (e.g. business units) are involved in completing the work. By August of 2017, the working groups have developed a number of detailed BPMN diagrams. An example of a BPMN diagram is shown in **Figure 4**.
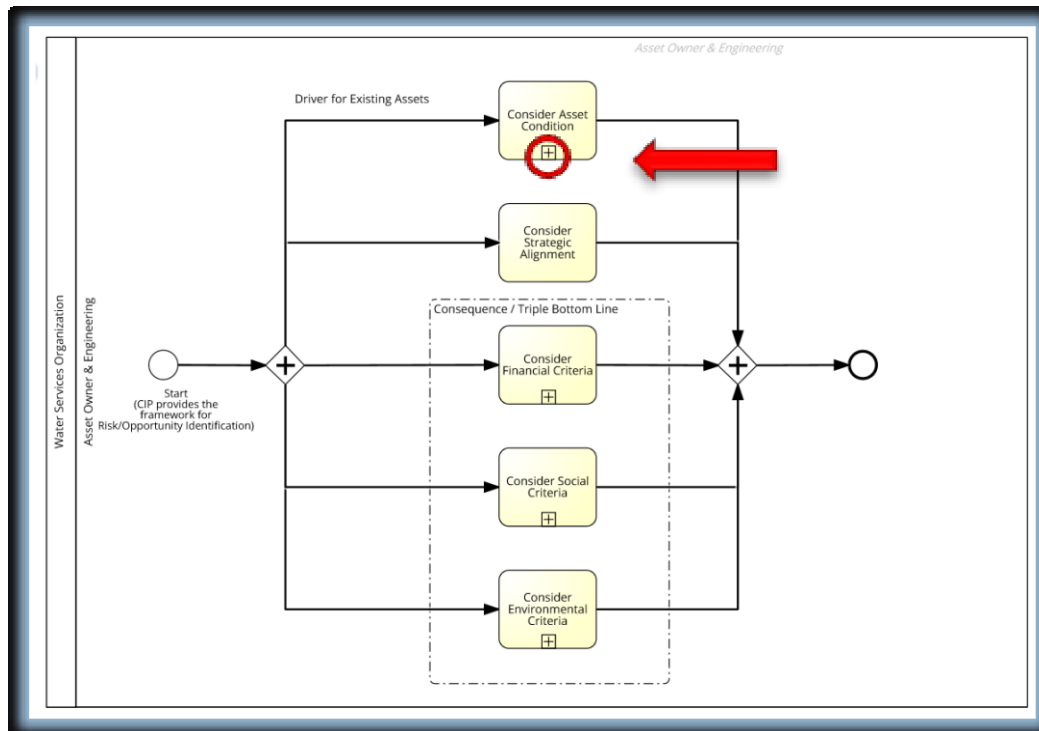
Figure 4. Example of BMPN diagram for a business process "Identify Risk Model"
Note: Task "Consider Asset Condition" is further decomposed and presented in Appendix D.

Phase 2 – Utility Analysis and Improvement Methodology. The main deliverable of the second phase of the project is a methodology (the Utility Analysis and Improvement Methodology) that assists water sector utility managers in improving the performance of their utility. Phase 2 includes three major tasks, to be executed concurrently. The three major tasks will be executed by three teams, each of which includes representatives from Utility Partners, as follows:

- **Team 1 – Processes.** This team will identify the specific business processes that their utilities want to examine and improve. These will be detailed processes on lower levels of the hierarchy that are described in BPMN format. Utilities will construct the "As Is" and "To Be" diagrams, and take steps to implement the improvements. The results of this task will include case studies in process improvement.

- **Team 2 – Technology.** This team will examine strategies to leverage technology to improve the performance of the utility. Their focus will include Information Technology, Operational Technology, and engineering or process improvements. The deliverables of this task may include recommendations regarding Enterprise IT Architecture, innovation programs, and/or other aspects of technology.
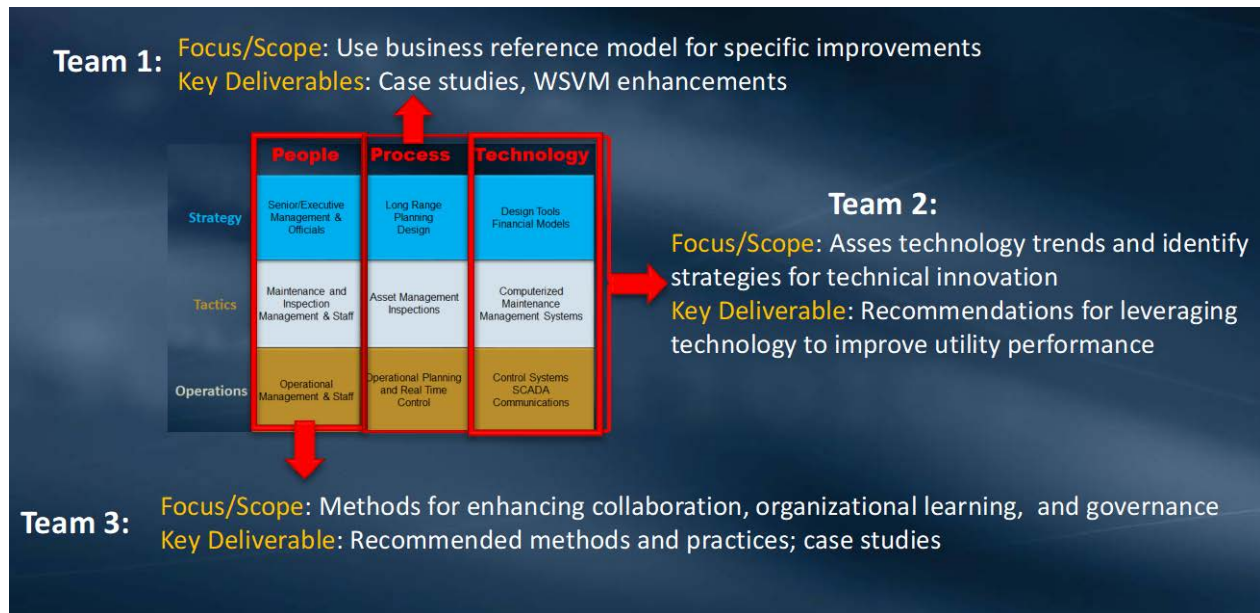
Figure 5. The focus and key deliverables of Phase II teams.

- **Team 3 – People.** This team will focus on the "People" column of the UAIM matrix. They will examine organizational and people issues that influence utility performance. The results of this task will be recommendations regarding organizational analysis, assessment, and improvement.

Overall, the deliverables from the second phase of the UAIM research project will include methodologies, practices, and case studies from water sector utilities that demonstrate how performance can be improved by:

- Adjusting individual business processes to impact the metrics and improve performance by making improvements to specific business processes:
  o Streamlining/simplifying the workflows
  o Automation (e.g. by applying technology)
  o Eliminating activities that do not add value

- Improving interactions between different cells in the UAIM matrix:
  o Improving communication between teams
  o Improving governance (e.g. organizational structure is best for effective execution of processes)
  o Ensuring that technologies are aligned with business needs (e.g. effective Enterprise IT Architecture)

4.5 Long-Term Vision

The long-term goal of LIFT for Management is to provide a platform to facilitate collaboration and exchange of ideas between water sector utilities. It is envisioned that utilities will have online access to the LIFT for Management tools and case studies. In the future, a utility manager who is interested in improving a business process (e.g. Procurement, or Onboarding New Personnel) could log into the tools online and find out how different utilities have structured these processes and use these examples as a starting point and reference for their own efforts.

5. Utility Management Initiatives: Summary, Interactions, and Connections

Each of the four initiatives/projects above takes a different look at utility management, and they focus on answering different types of questions. The four efforts mentioned in this white paper are not competing. Each utility can choose their own entry point. Some utilities may wish to begin with the fundamental building blocks incorporated within EUM, and then move on to the other efforts over time. Other utilities may see themselves already well established in the fundamentals and wish to move into other initiatives. Others may see a fact-sensitive opportunity to go right into a particular initiative because of their specific circumstances. There are no right or wrong approaches: each of the four initiatives bring benefits to the utilities, their customers and the environment. Specifically:

- There are logical connections between these four views of utility management, and if the connections between them are considered, these efforts can be complimentary to each other.

- These efforts are ongoing, and they are all envisioned to continue evolving and improving through future updates.

- These efforts include active participation of water sector utilities, other leading water sector organizations such as U.S. EPA, WRF, NACWA, AWWA, WEF, AMWA, and other stakeholders.

Figure 6 provides a high-level view of interactions and relationships between these efforts:

- **Effective Utility Management** is a foundational program and a logical choice for a utility wishing to take a detailed and objective look at its current operations and chart a course toward sustainable management to meet the needs of the communities it serves. EUM defines the "attributes of effectively managed water-sector utilities and keys to management success". EUM can also help utilities that wish to move toward becoming the Utility of the Future or incorporate more complex business improvement models like UAIM.

- The **Utility of the Future Program** seeks to promote and recognize actions that build on the foundation of excellent management embodied in EUM and help wastewater utilities transform their operations over time. UOTF focuses on various building blocks to bring about this transformation: recovery and new uses of a full range of resources; engagement as a leader in the full water cycle and broader social, economic, and environmental sustainability of the community. In addition, transformation of the internal utility culture in support of these innovations and engagement in the community and formation of partnerships are a critical part of the UOTF recognition program supported by WEF, EPA, NACWA, WRF, and the WateReuse Association. The goal of the Utility of the Future program is to encourage the utility to go further and build from its efforts to engage in robust community service initiatives.

- **AMCV Practice Framework and Measures** and **AWWA Utility Benchmarking Survey** provide an in-depth examination of performance metrics and management practices.

- **LIFT for Management** defines a value-based business reference model for the water sector, and provides a methodology and a platform for documenting, sharing, and improving the utility performance. It also provides an overall methodology that considers all aspects (people, process, technology) of utility management.

The four initiatives are independent of each other and each can be beneficial to a utility in different ways. Moreover, the initiatives can be interrelated and so participation in one initiative could enhance the work in another initiative.

For example, EUM defines "Customer Satisfaction" as one of the 10 attributes for effectively managed utilities. AWWA's benchmarking survey could provide industrywide information and metrics about "Customer Satisfaction" that could be helpful to the utility looking to improve in this area; the customer is at the center of the AMCV practices, including considerations of service levels, risks and cost tradeoffs. LIFT for Management provides even more detailed information regarding the business processes that could impact "Customer Satisfaction." Lastly, the Utility of the Future program would encourage the utility to go further and build from its "Customer Satisfaction" efforts to engage in robust community service initiatives.
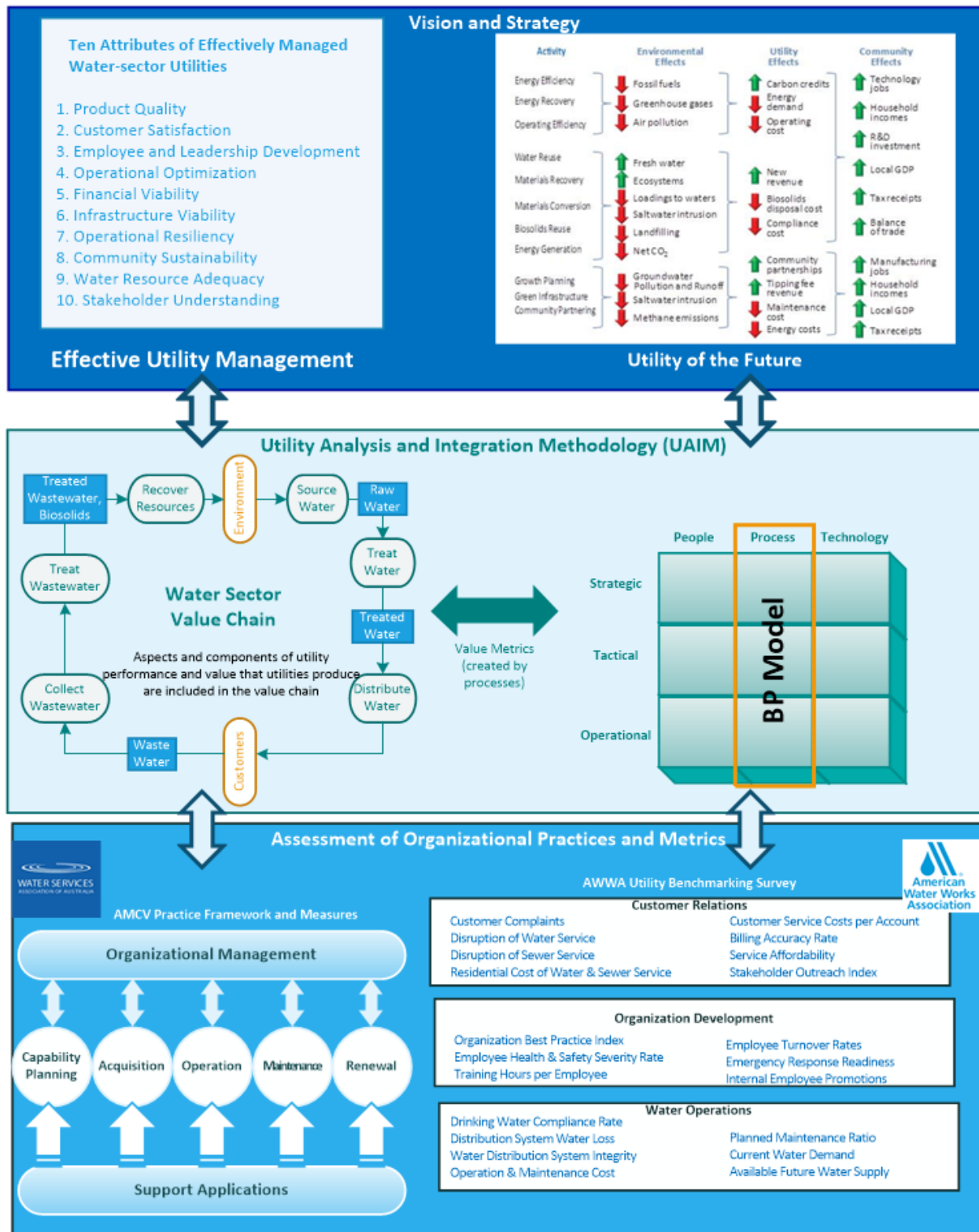
Continuous Improvement in Utility Management

Vision and Strategy

Ten Attributes of Effectively Managed Water-sector Utilities

1. Product Quality
2. Customer Satisfaction
3. Employee and Leadership Development
4. Operational Optimization
5. Financial Viability
6. Infrastructure Viability
7. Operational Resiliency
8. Community Sustainability
9. Water Resource Adequacy
10. Stakeholder Understanding

Effective Utility Management

Utility of the Future

Activity	Environmental Effects	Utility Effects	Community Effects
Energy Efficiency	↓ Fossil fuels	↑ Carbon credits	↑ Technology jobs
Energy Recovery	↓ Greenhouse gases	↓ Energy demand	↑ Household incomes
Operating Efficiency	↓ Air pollution	↓ Operating cost	↑ R&D investment
Water Reuse	↑ Fresh water	↑ New revenue	↑ Local GDP
Materials Recovery	↑ Ecosystems		↑ Tax receipts
Materials Conversion	↓ Loadings to waters	↓ Biosolids disposal cost	
Biosolids Reuse	↓ Saltwater intrusion	↓ Compliance cost	↑ Balance of trade
Energy Generation	↓ Landfilling		
	↓ Net CO$_2$	↑ Community partnerships	↑ Manufacturing jobs
Growth Planning	↓ Groundwater Pollution and Runoff	↑ Tipping fee revenue	↑ Household incomes
Green Infrastructure	↓ Saltwater intrusion	↓ Maintenance cost	↑ Local GDP
Community Partnering	↓ Methane emissions	↓ Energy costs	↑ Tax receipts

Utility Analysis and Integration Methodology (UAIM)

Treated Wastewater, Biosolids → Recover Resources → Environment → Source Water → Raw Water → Treat Water → Treated Water → Distribute Water → Customers → Waste Water → Collect Wastewater → Treat Wastewater

Water Sector Value Chain

Aspects and components of utility performance and value that utilities produce are included in the value chain

Value Metrics (created by processes)

	People	Process	Technology
Strategic			
Tactical		**BP Model**	
Operational			

Assessment of Organizational Practices and Metrics

AMCV Practice Framework and Measures

Organizational Management

Capability Planning — Acquisition — Operation — Maintenance — Renewal

Support Applications

AWWA Utility Benchmarking Survey

Customer Relations
Customer Complaints	Customer Service Costs per Account
Disruption of Water Service	Billing Accuracy Rate
Disruption of Sewer Service	Service Affordability
Residential Cost of Water & Sewer Service	Stakeholder Outreach Index

Organization Development
Organization Best Practice Index	Employee Turnover Rates
Employee Health & Safety Severity Rate	Emergency Response Readiness
Training Hours per Employee	Internal Employee Promotions

Water Operations
Drinking Water Compliance Rate	
Distribution System Water Loss	Planned Maintenance Ratio
Water Distribution System Integrity	Current Water Demand
Operation & Maintenance Cost	Available Future Water Supply

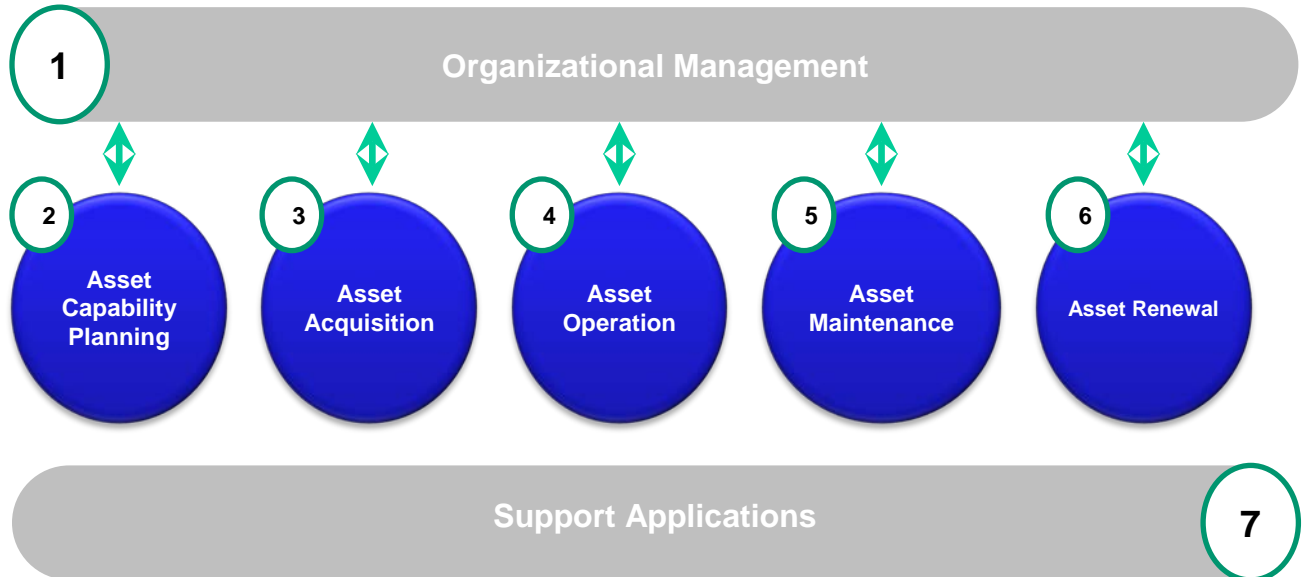**Figure 6. Interactions between initiatives and projects**

Appendix A

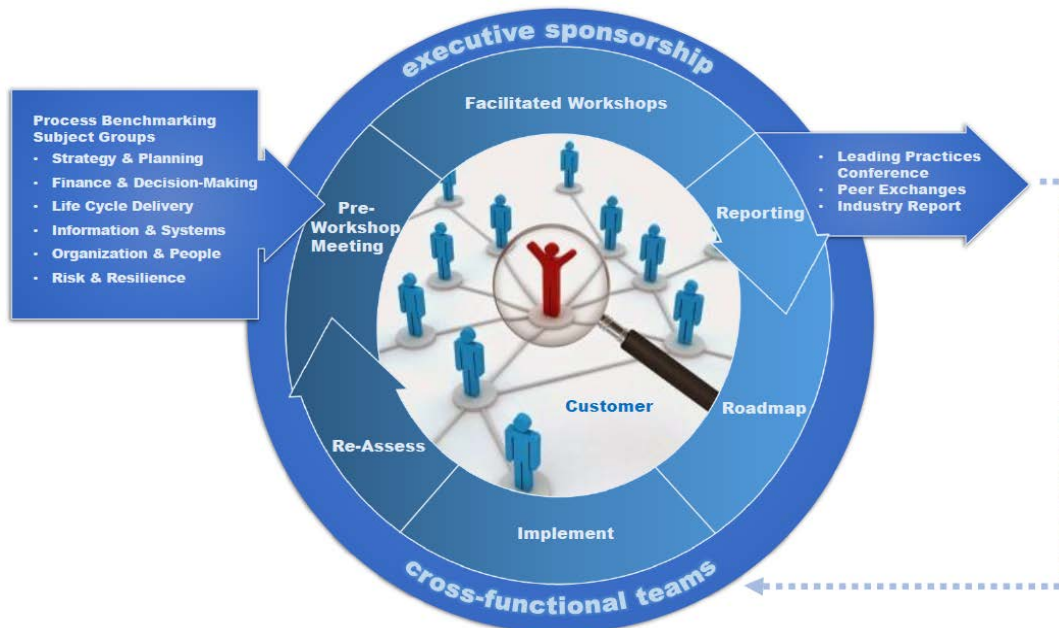Connections and interactions between EUM and other initiatives.

Appendix B

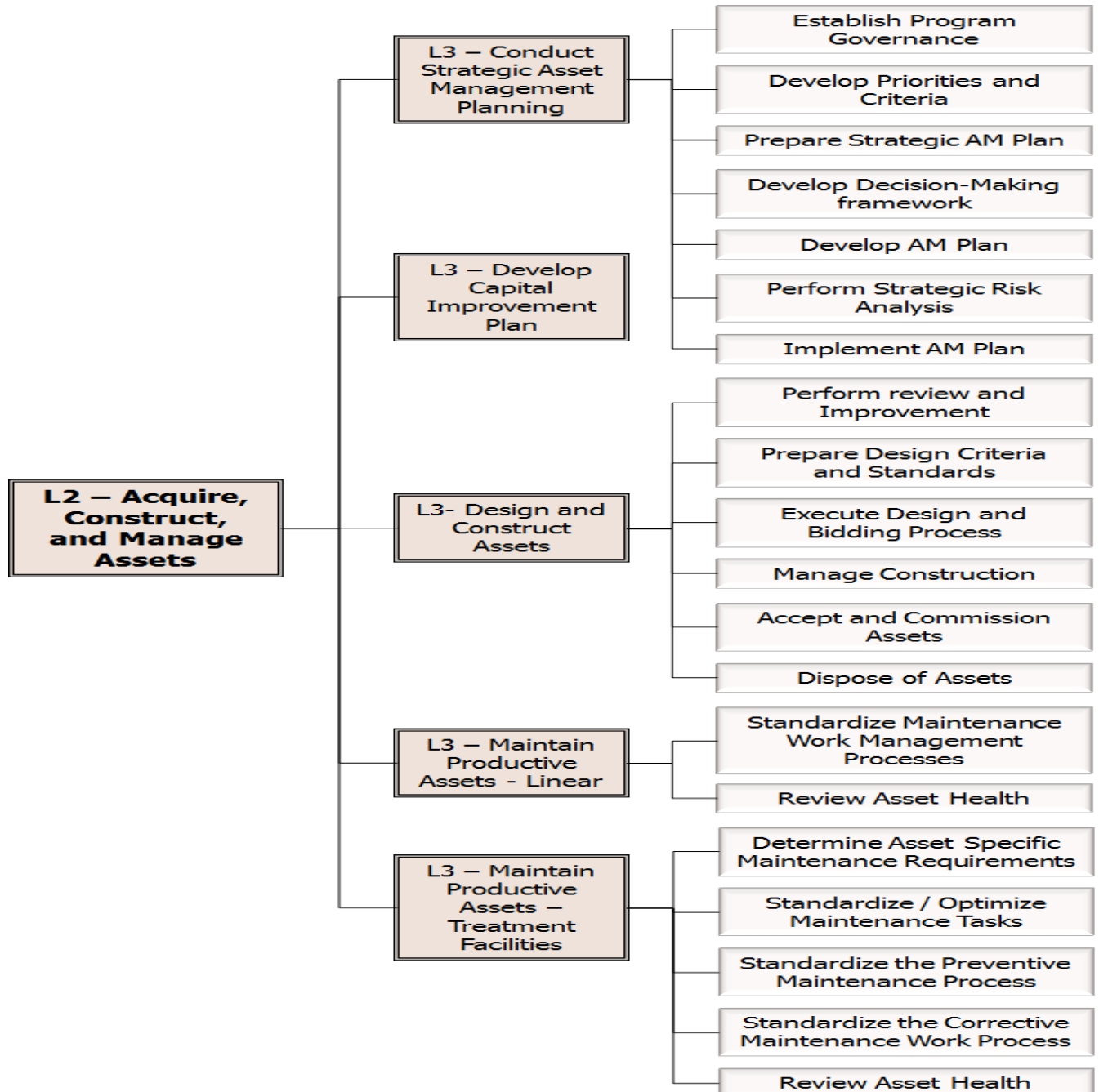Asset Management Customer Value Framework.
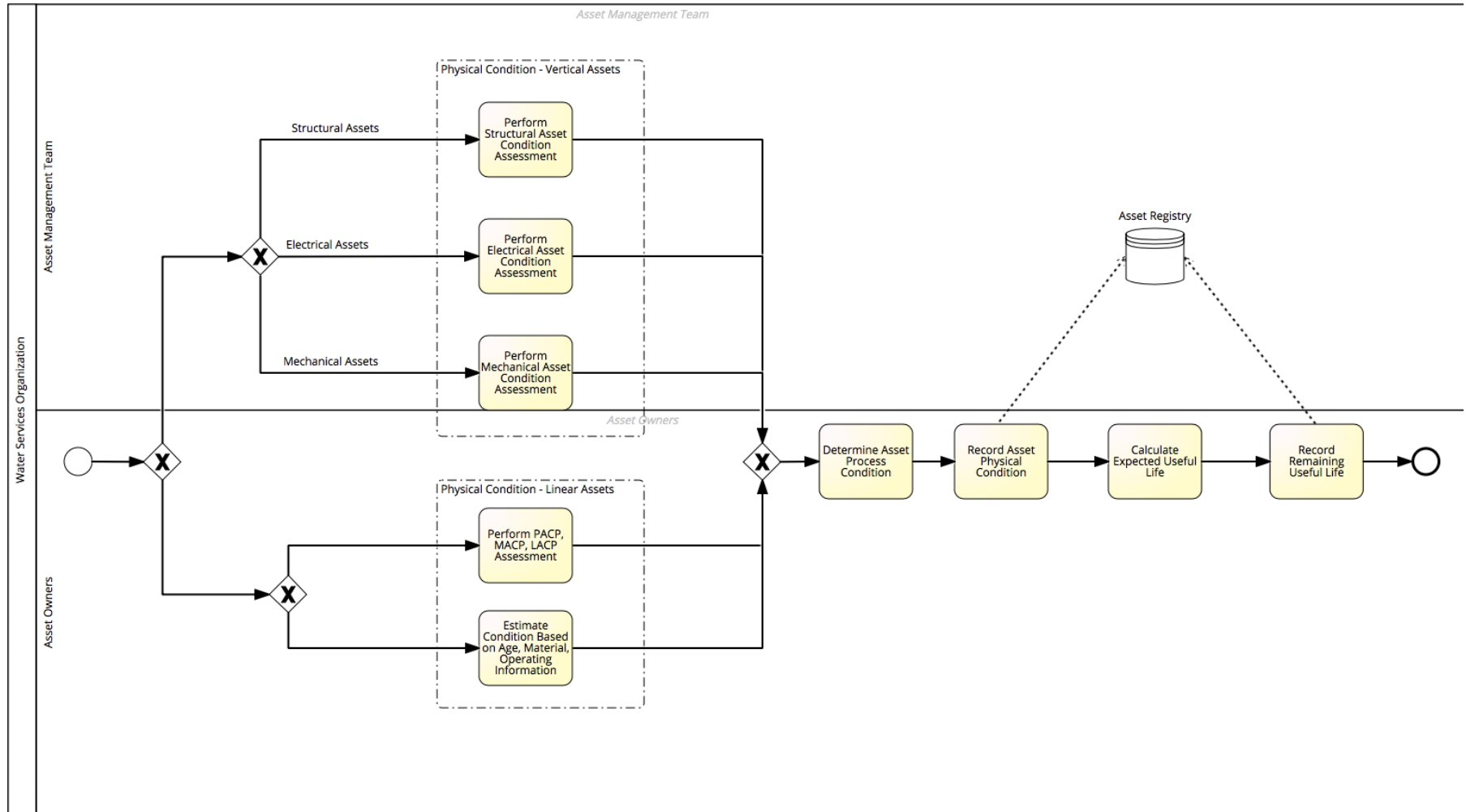

Benchmarking Process and Delivery Approach.

Appendix C

An example of business process hierarchy. Note: Figure is incomplete as it omits some processes, it is for illustration only.

Appendix D

Example of a BPMN diagram for a business process ("Consider Asset Condition").

References

Vitasovic, Z.C., Olsson, G., Liner, B., Sweeney, M., and Abkian, V. (2015). Utility analysis and integration model. *Journal of American Water Works Association, 107:8*.

Vitasovic, Z.C., Horne, J., Haskins, S. (2016) *Connecting siloes to solve wicked utility management problems*, World Water November/December 2016, pp. 41,43.