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THE 21ST INTERNATIONAL OPERATIONS & MAINTENANCE CONFERENCE IN THE ARAB COUNTRIES

Examples of New Trends in Operation and Maintenance Management in Water Supply Systems

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1. Introduction

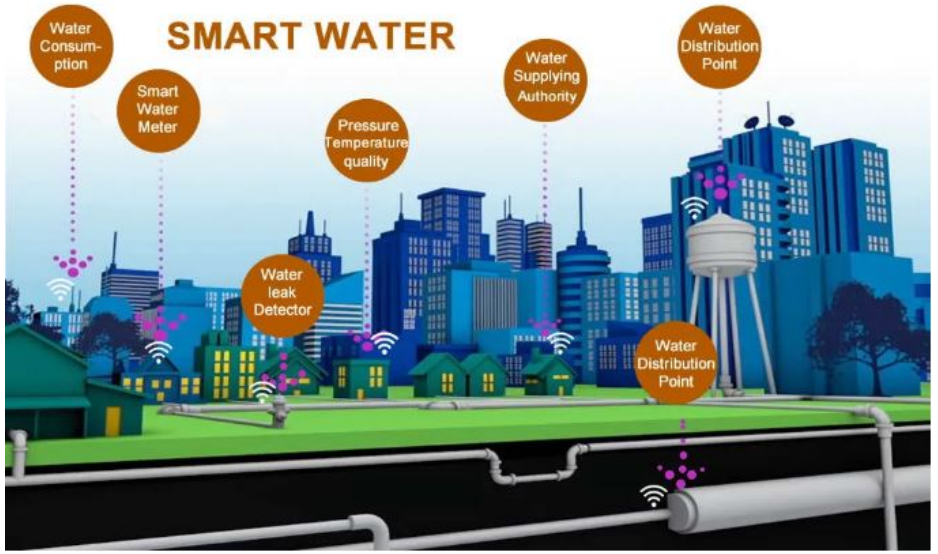
- Because of **population growth**, **rapid urbanization**, and **climate change**, many water supply utilities globally struggle to provide water that is safe to **drink.**
- **A particular problem is the aging** of the water supply facilities, which is exacerbated by their **inefficient O&M.**

1. Introduction

- For this reason, many water utilities have recently **been actively adopting intelligent and integrated water supply O&M solutions** that utilize information , communication technology, the internet of Things, big data, and artificial intelligence to solve water supply system problems.
- Different Smart water solutions **are implemented nowadays** to enhance the efficiency of the water supply system different cities all over the world.
- The smart water solutions support **the design and optimization of district metered areas**, the **reduction and management of water losses**, **real-time water network analysis**, **and** **big data analysis using artificial intelligence.**

1. Introduction

- **Different Economic analysis** were **conducted and revealed** that smart water solutions **produces various direct and indirect benefits** for the water supply system. Moreover, **the huge water losses are controlled and minimized**. (Shim, Berrettini, & Park, 2022)
- The concept of smart water solutions (or smart water systems) is the **more intelligent use of probes, sensors, real-time communication, and automation and control technologies**.



1. Introduction

- Many experts foresee significant changes in water treatment processes and facility operations due to the adoption of 4th Industrial Revolution technologies.
- According to **a Global Water Intelligence report**, the global market for smart solutions in the water sector was expected to reach **USD 31 billion in 2021**, up from **USD 21.3 billion in 2016**, with a compound **annual growth rate (CAGR) of 7.2%**

1. Introduction

- There are three forces driving the adoption of smart water solutions.:
  - The first is the **desire to improve efficiency** where water utilities are constantly seeking to optimize their facilities in terms of operations and management (O&M), including **improving water intake**, **water treatment**, and **water supply networks**, and **providing better services to customers.**
  - The second goal in employing smart water solutions is **cost reduction** through improved monitoring, automated control, and asset management
  - The third important factor has been regulatory compliance. New regulations typically require more spending from water utilities and industrial end-users to remain in compliance, and smart water solutions can help to minimize this additional investment.

2. Research Objectives

- The primary objective of this study is to **identify and describe the emerging trends** in O&M management within water supply system field. This includes a comprehensive review of recent developments, technologies, and methodologies that are transforming the field.
- Moreover, this study **aims to assess the impact of technological advancements**, such as the Internet of Things (IoT), Artificial Intelligence (AI), and predictive analytics, on O&M management practices.
- It will investigate how these technologies are being utilized to **optimize maintenance schedules**, **reduce downtime**, and **enhance operational efficiency**
- **The final objective is to highlight best practices** in O&M management where new technologies are being used **across different real water supply projects in different countries.**
- By addressing these objectives, **this study aims to contribute to a deeper understanding of the evolving landscape of O&M management**, helping organizations stay competitive and efficient in an ever-changing business environment.

3. Methodology

- This **qualitative study** is based on multiple case studies
- **It examines the implementation of new techniques** in O&M management of water supply systems
- **Through the revision of the detailed studies and analysis of those real-world projects**, **this paper highlights the benefits, challenges, and lessons learned from adopting theses new techniques in Water Sector.**

4. Implementation of new Technologies in O&M Management

(1) The National Water Company in Saudi Arabia

- In Saudi Arabia, as part of **the Saudi National Water Strategy**, the National Water Company entrust the technical expertise SUEZ and its local partner with the **Management Operation and Maintenance contract** of water services of the Western Cluster
- The NWC signed a contract with SUEZ **for the Management Operation and Maintenance** of water services of the Western Cluster, including the major cities of Jeddah, Makkah and Taif. The total revenue of the 7-years contract is 98 million euros. (www.suez.com)
- SUEZ technical expertise **will aim at improving and developing** the customer experience as well as **raising the operational efficiency**, which will help NWC to **reduce water losses** and to **improve the whole management of its network**.
- SUEZ will notably implement its WIKTI@methodology to **assess the maturity of the utility**
- The monitoring of the water network through advanced flow and pressure sensors will help to **manage in real time** the water supply and the network performance.

4. Implementation of new Technolgoes in O&M Management

(2) The University of Lille, France

- **An intelligent water meter technology** which uses **Automated Meter Reading (AMR)** has been implemented to detect leakage in a **large-scale demonstration site**, which is conducted at **the Scientific Campus** of the University of Lille, **which is representative to a small town.**
- This presents the demonstration site as well as its monitoring using AMR **and how the recorded data allowed a rapid detection of water leakage in the campus.**
- The used water meter technology has **improved the quantitative monitoring** in water supply and distribution
- Smart meters using Automated Meter Reading (AMR) technology **allowed water utilities** to provide **clear consumption patterns which can help customers to track and control their water usage** and improve active leakage targeting and leak detection capability.
- The AMR installed inside the campus building **offer a continuous monitoring** of the consumption profile. **The AMR helped to reduce the number of the leak by 36%.** (Elias & Shahrour, 2017)

4. Implementation of new Technolgoes in O&M Management

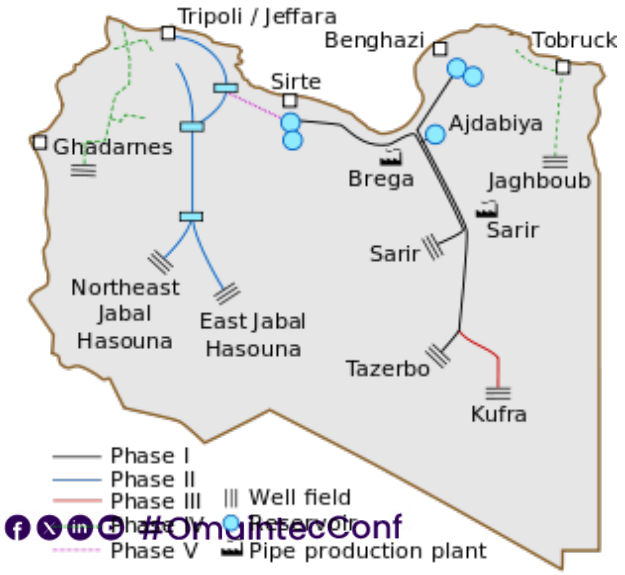
(3) A Water Wise System in Portugal

- **A Water Wise System W2S** results from a R&D project by an EU and Portuguese Government Grant.
- A preliminary study of an architecture solution to Water Wise System software was carried out **focuses on the water challenges, present technology, digital water, IOT and the future of smart cities.**
- The solution **aims to support a paradigm shift in the O&M management** of water distribution networks, **with predictive and analytical convergence supported in** Machine Learning, Deep Learning and integration with SCADA, GIS and EPANET.

4. Implementation of new Technolgoes in O&M Management

(4) Expansion of Existing Monitoring System on Man-Made River Project in Libya Using Acoustic Fiber Optic Technology

- The Man-Made River Project (MMRP) is a massive water infrastructure project in Libya designed to provide a sustainable source of freshwater for the country's arid regions, particularly in the northern part of the Sahara Desert.
- The network **spans thousands of kilometers** and includes pipes of various sizes.
- However, the project has **also faced various challenges**, one of them is **the high cost of maintenance.**



4. Implementation of new Technolgoes in O&M Management

(4) Expansion of Existing Monitoring System on Man-Made River Project in Libya Using Acoustic Fiber Optic Technology

- **Acoustic monitoring has played a major role** in the **Maintenance management of one of the world's largest civil engineering projects.**
- The planned expansion of the existing acoustic monitoring system **will allow for monitoring of over 700 km of pipelines.**
- The said program enables MMRA, at the beginning of the problem, to **conduct a successful selective and preventive maintenance**
- This has provided **valuable information on hundreds of kilometers of pipelines**, and in several instances has been used to likely prevent pipeline ruptures.

4. Implementation of new Technolgoes in O&M Management

(5) Operation and Maintenance of a Water Supply System in Aracatuba, Brazil.

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- Internet of Things, big data, and artificial intelligence to solve water supply system problems, in the city of Aracatuba, Brazil, **smart water solutions (GSWaterS)** **were implemented to enhance the efficiency of the water supply system in the city**
- They were used to **monitor and analyze the operating conditions** of the water supply system in real time
- Allowing for the effective management of water supply assets
- GSWaterS also **supports** **the design and optimization of district metered areas**, the **reduction and management** of **water losses**, real-time water network analysis, and big data analysis using artificial intelligence.
- **Economic analysis revealed** that **GSWaterS** produces various direct and indirect benefits for the water supply system. (Shim, Berrettini, & Park, 2022).

4. Implementation of new Technolgoes in O&M Management

(6) A Smart Water Grid in Singapore.

- **As aging water distribution infrastructures encounter failures with increasing frequency**, there is a real need for integrated, on-line decision-support systems based on continuous in network monitoring of hydraulic and water quality parameters.
- Such systems will form the basis of a Smart Water Grid, allowing water utilities to improve optimization of system operation, manage leakage control more effectively, and reduce the duration and disruption of repairs and maintenance.
- WaterWiSe is an integrated end-to end platform for **real-time monitoring of water distribution systems** that addresses these needs.
- In this project, WaterWiSe's sensing and software platforms have **helped improving the operational efficiency** of the water supply system in downtown Singapore.

4. Implementation of new Technolgoes in O&M Management

(7) Cambridge, Ontario – Canada's First IBM Smarter City

- Cambridge was recognized in 2010 as being Canada's first IBM Smarter City (smarter cities take advantage of the increasing amount of instrumentation and advanced analytics tools).
- The combined adoption of state-of-the-art technology with **forward thinking leade**r has resulted in a number of significant benefits including:

  - ✓ Reduced inflow and infiltration into wastewater system by 22% between 2009 and 2012.
  - ✓ Water loss reduced by 22% between 2009 and 2012 (saved the City $1.6 million in revenue)
  - ✓ Water main breaks down to only **27** in 2012 (from a peak of **52** in 2007)
  - ✓ Better project coordination and improved asset management is expected to save at least $100,000 per year.

4. Implementation of new Technolgoes in O&M Management

(8) Real-Time Modeling of Water Distribution Systems in USA

- The US drinking water infrastructure, which **serves 315** million people, is in serious need of replacement, upgrading, and maintenance if it is to continue to support a growing population.
- **AWWA has warned** that the **cost of repairing and expanding** US drinking water infrastructure **will top $1 trillion through 2035** or **$1.7 trillion through 2050**, and that this cost will likely be funded primarily through higher water bills and local fees.
- The American Society of Civil Engineers 2013 Report Card for America's Infrastructure gave drinking water **a near-failing grade of D**, only a slight improvement **over the D minus** awarded in the previous Report Card, issued in 2009. (C – in 2023)
- **Since 2006**, a Water District in Nevada, has **used real-time network simulation model** to develop daily operating plans to manage energy and water quality, calibrate the hydraulic model, mange planned facility outages, and aid in emergency response
- A real-time network model development and application of operation modeling at LVVWD to gain the benefits of real-time network simulation of the SWNDSS
- An SWNDSS is an essential component of a smart water grid because it gives water utilities real-time surveillance and control over the viability and health of their distribution systems. It plays a key role in enabling utilities to continuously monitor the integrity of their water systems

5. Conclusion

- The operation and maintenance of water supply systems are **critical for ensuring the availability of safe and reliable water supply to consumers.**
- The management of water supply **systems is undergoing a transformation driven by** technological advancements and sustainability imperatives.
- The emerging trends **offer opportunities for improving the performance** and **sustainability** of water supply systems.
- All application of the new techniques through different project described in this study **highlight the importance of the new techniques and benefits achieved.**
- The implementation of these trends **faces challenges** such as lack of funding, technical expertise, and cultural resistance to change
- Addressing these challenges will require a coordinated effort from stakeholders, including government agencies, infrastructure operators, and technology providers.

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