Digitalisation of the Water Sector: Opportunities and Challenges

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Topics covered in this presentation

- The digitalising world
- Opportunities for the water sector
- Challenges (threats) with digitalisation
- Best practices

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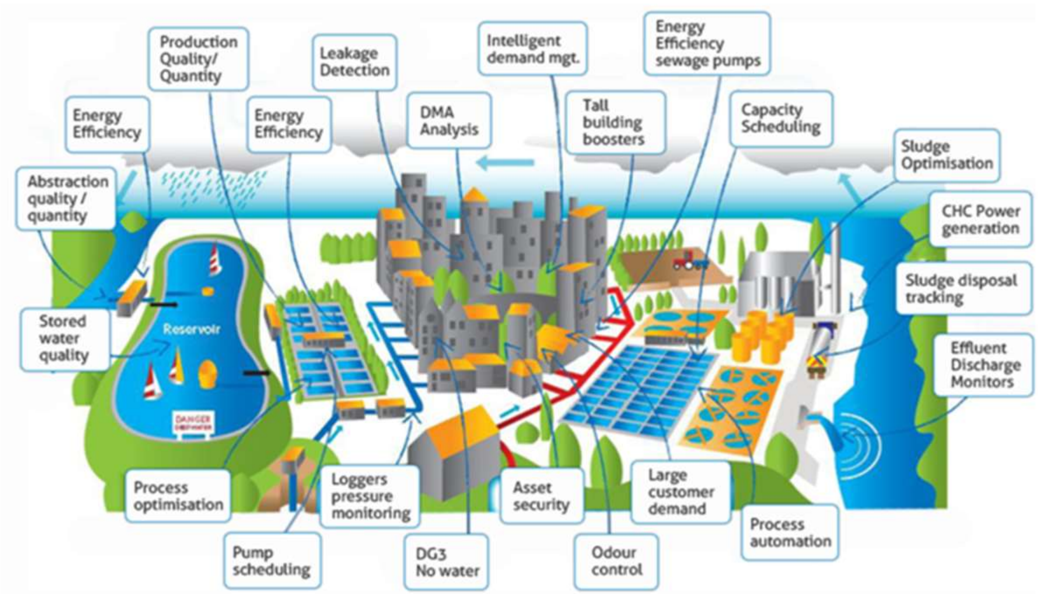
Our world is going digital - fast

We are in the middle of a **transformation** from "*physical infrastructure*" to "*physical with some sensors*" to "*cyber-physical infrastructure*"

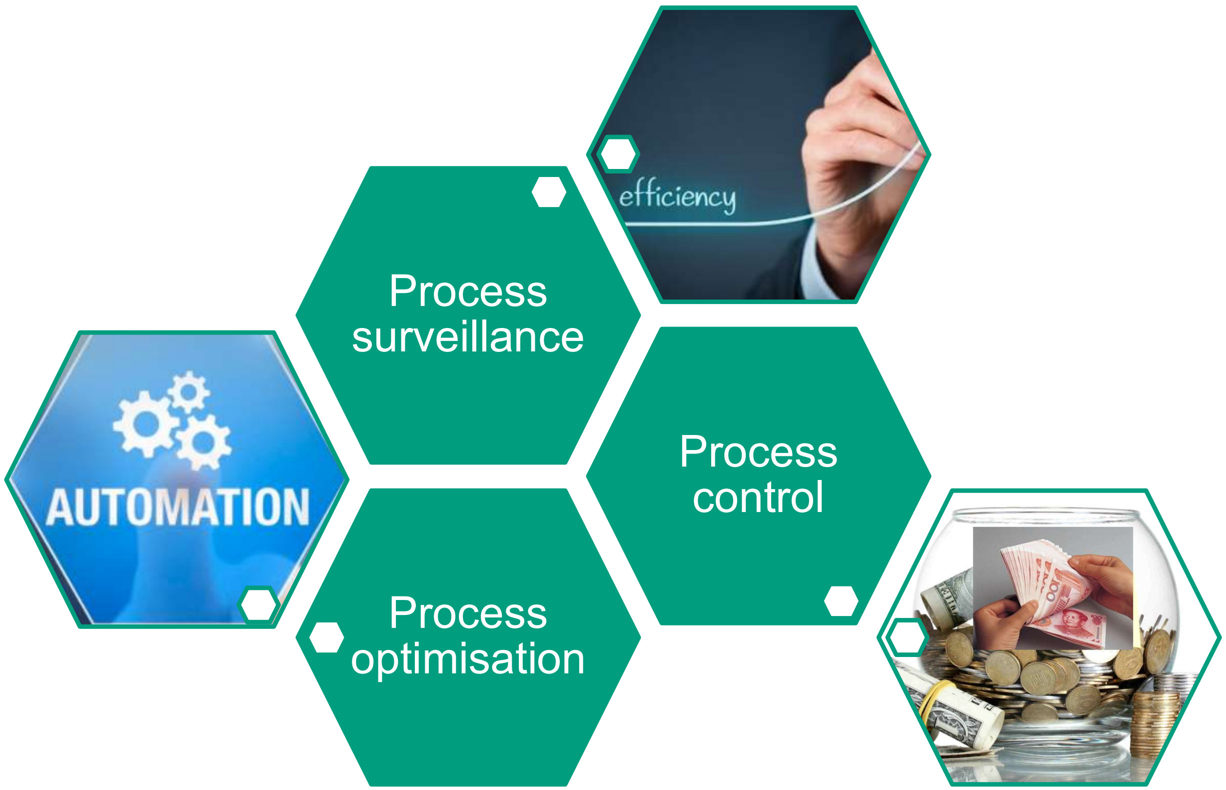
- **Advantages are numerous**: automation, adaptability, efficiency, functionality, reliability, safety, and usability of large systems
- **But there is a catch**: Exposure to an expanded attack surface…

Status and potential of digitalisation in the water sector

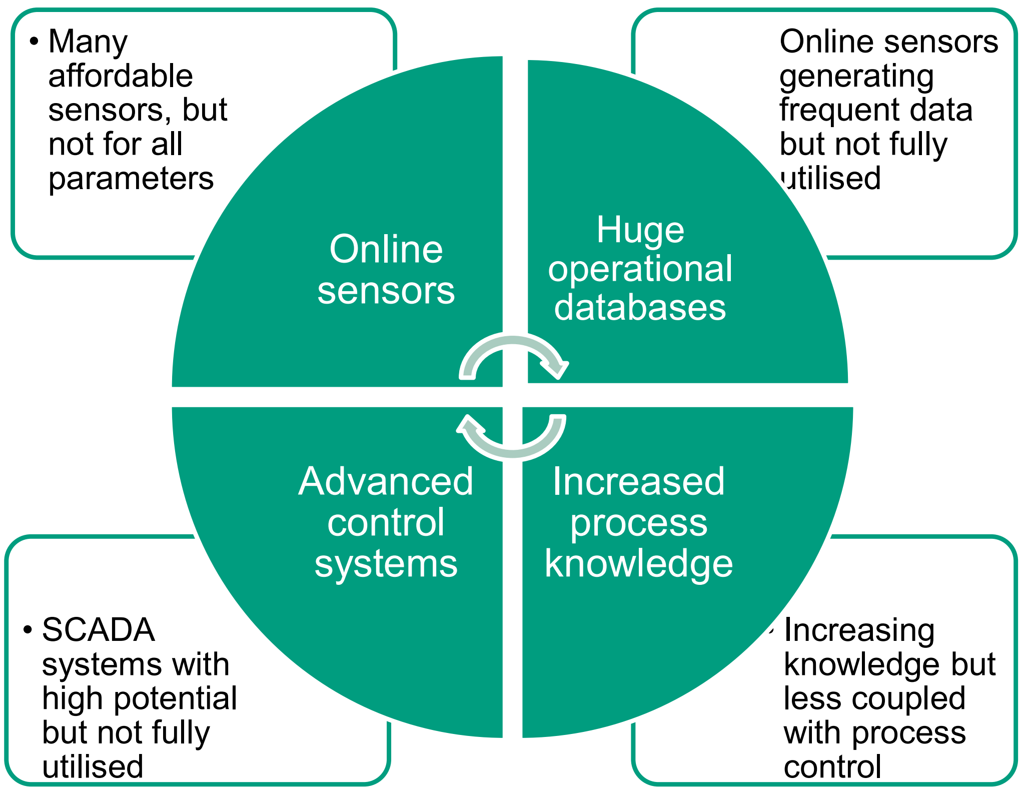


Smart by design - adaptive, distributed, advanced
Smart use - doing more with less
Smart control - sensors, analytics, OT-IT integration

Recent developments in the data sciences has changed to world - also the water sector



Increased automation – many benefits



The SCADA* market for water and wastewater management is predicted to reach US$ 2.2 billion by 2025, an increase from US$ 1.3 billion in 2015.

Transparency Market Research (TMR)

**SCADA: supervisory control and data acquisition*

Defining the digital water

Digital water, Smart Water, Internet of Water, Water 4.0, …….

Efficient collection and use of digital data
for smart digital solutions
to address the challenges in critical physical assets and their services…..

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Digitalisation – opportunities in the water sector

Digital solutions for water & wastewater utilities

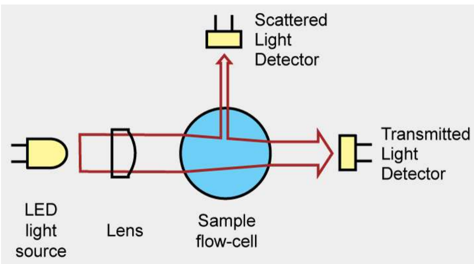
- **Remote watershed integrity** Proactive remote monitoring enables fewer callouts and surprises in headwater parameters, including monitoring of multiple parameters (Temperature, pH, Nitratets, etc)
- **Treatment process optimization** Water quality sensors combined with advanced logarithms to optimize the treatment processes, reducing operational costs (e.g. energy, treatment chemicals, etc)
- **Water network management** Sensors and algorithmic solutions provide monitoring of network pressure, failures, and overall asset condition
- **Combined sewer overflow management** Intelligent equipment and real time analytics to prepare for and prepare sewage and stormwater overflows, reducing the need for emergency call-outs

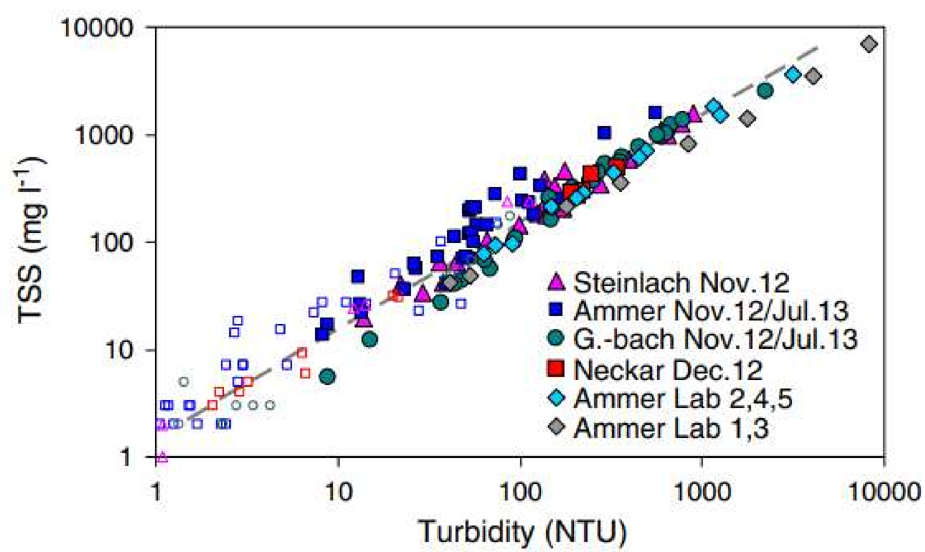
Digital solutions for water & wastewater utilities

- **Preventative & predictive maintenance** Connected equipment and maintenance solutions to reduce downtime and failures of critical equipment and pipelines, reducing the need for emergency call outs
- **Stormwater management and flood relief** Comprehensive range of on-site water capture and dewatering solutions – including emergency response capabilities – to mitigate and manage a range of stormwater and wastewater flooding events
- **Intelligent pumping & treatment equipment** Intelligent equipment – including pumps, mixers, diffusers, and other equipment- which is capable of self-optimizing for enhanced performance, lower maintenance, and lower total cost of ownership

Virtual sensors (software/surrogate sensors)

Typical example: measurment of SS via turbidity





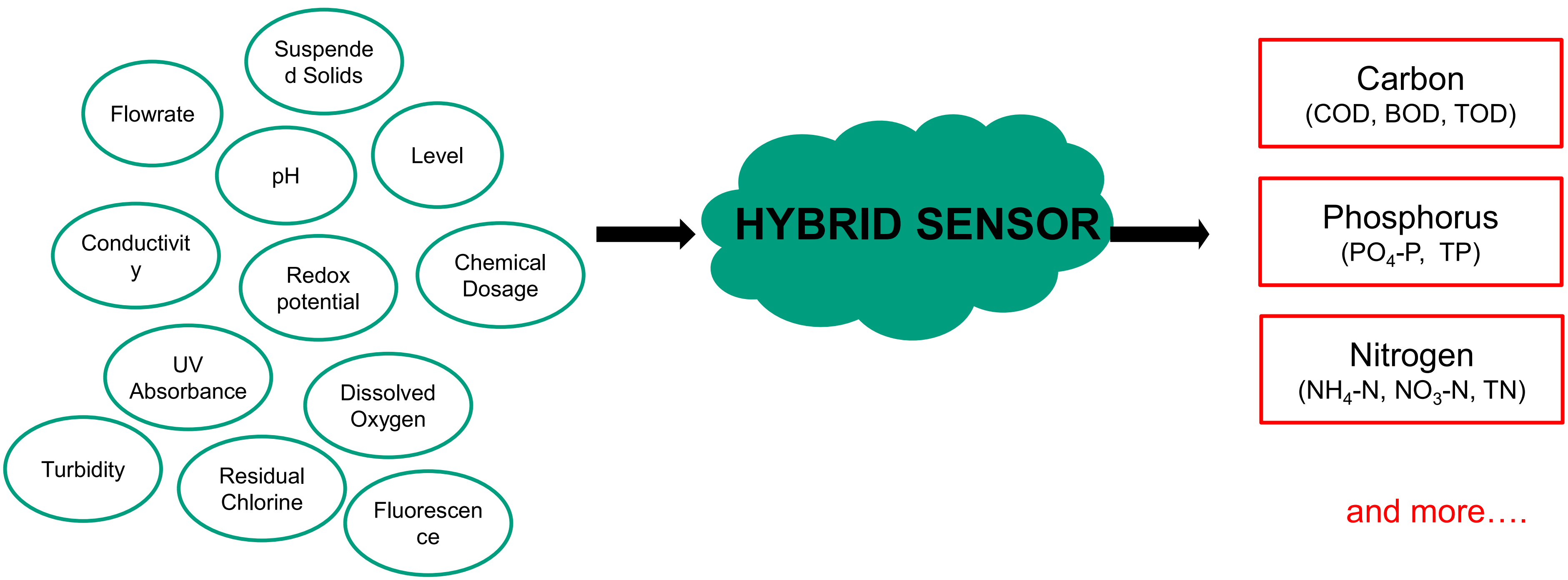
Hybrid sensors

Secondary variables (physical probes)

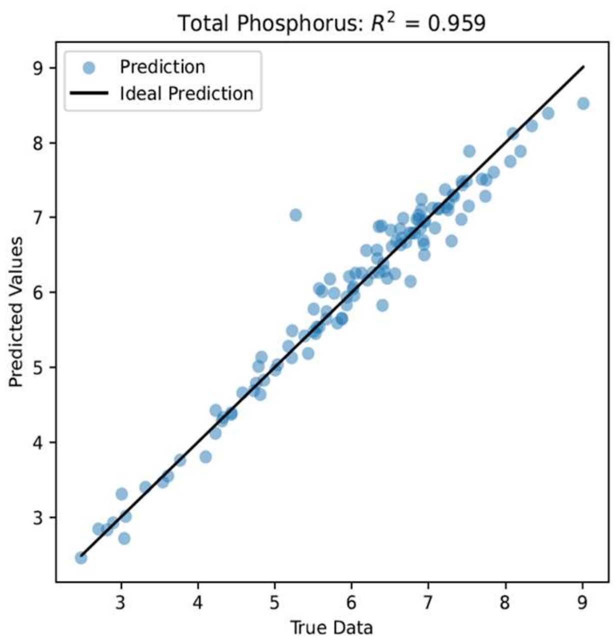
- Easy-to-measure
- Reliable
- Low capital costs
- Low maintenance

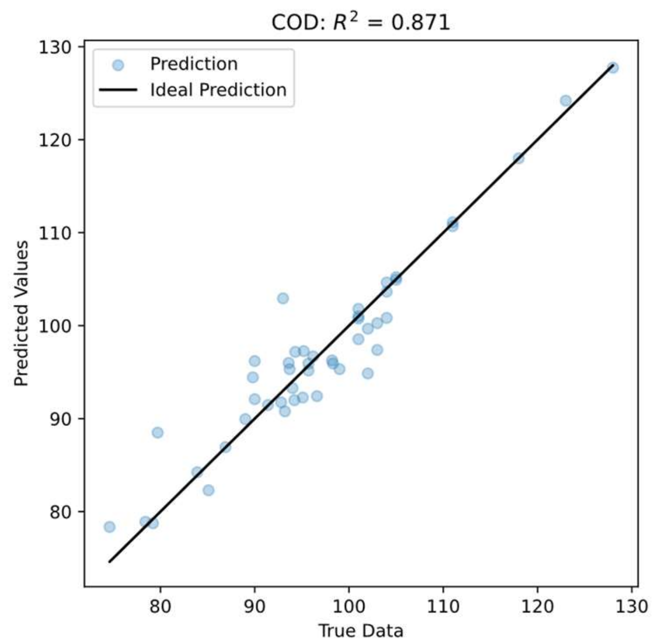
Primary variables (Hybrid sensors)

- Hard-to-measure
- Expensive
- High maintenance costs
- Time delayed-response



Virtual /Hybrid sensors





EDITOR'S CHOICE | AUGUST 12 2019

Implementing an Extended Kalman Filter for estimating nutrient composition in a sequential batch MBBR pilot plant

Abhilash M. Nair; Abaynesh Fanta; Finn Aakre Haugen; Harsha Ratnaweera

Check for updates

Water Sci Technol (2019) 80 (2): 317–328.
https://doi.org/10.2166/wst.2019.272 **Article history**

Open Access | Feature Paper | Article

Estimating Phosphorus and COD Concentrations Using a Hybrid Soft Sensor: A Case Study in a Norwegian Municipal Wastewater Treatment Plant

by Abhilash Nair [1,*], Aleksander Hykkerud [1] and Harsha Ratnaweera [1,2]

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[*] Author to whom correspondence should be addressed.

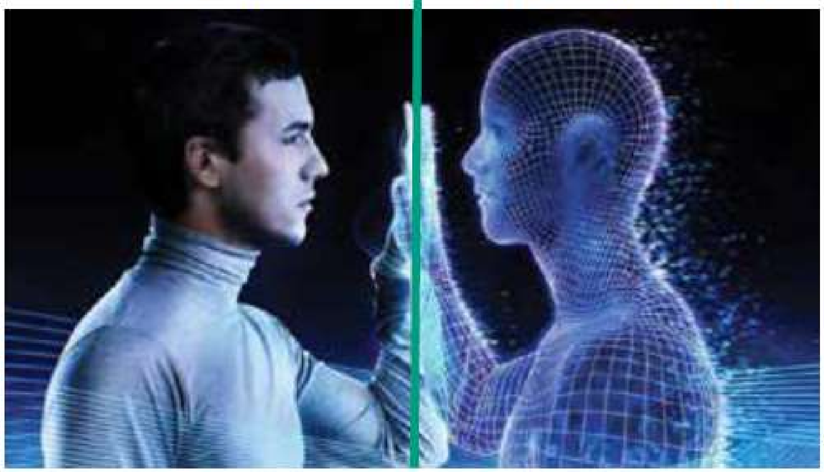
Digital twins

ORIGINAL | DIGITAL TWIN

Physical Entity

Systems

Process



Model

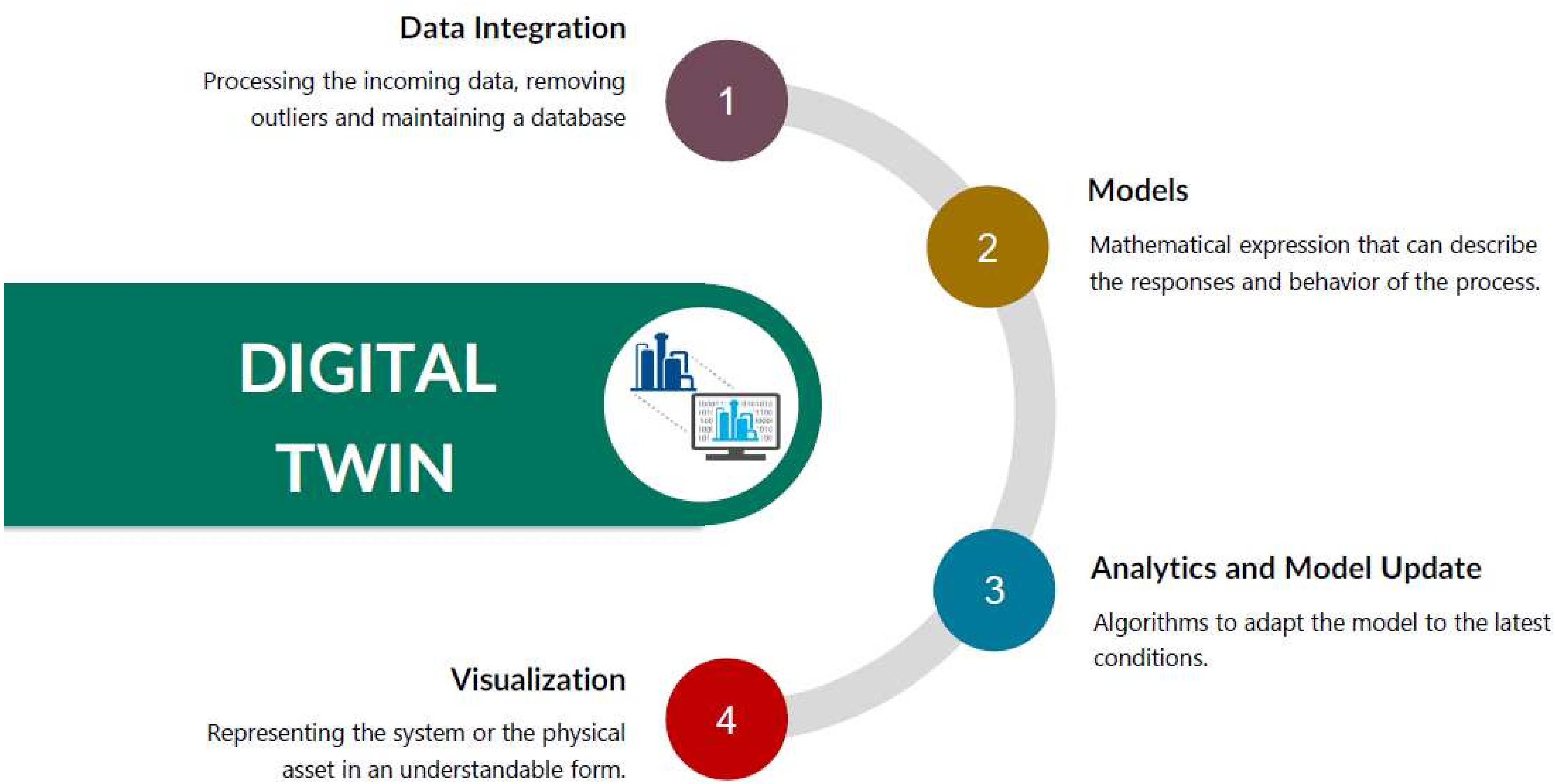
Algorithms

Analytics

GUI

Photo: CSI Communications

Components of a Digital Twin



Example of a Digital Twin in the water sector

1 Data Integration

2 Process Models

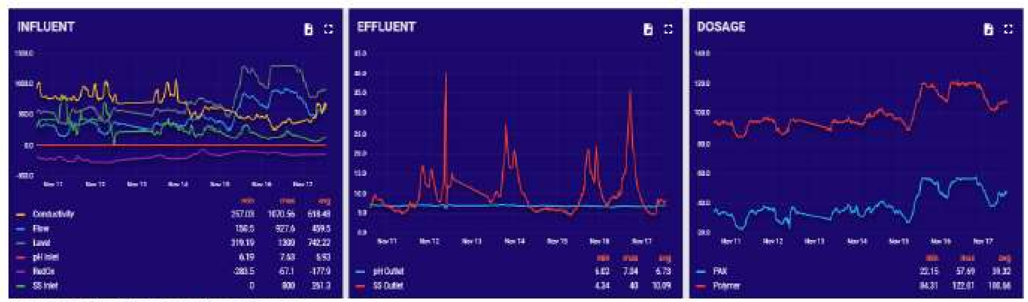
3 Analytics and Model Update

4 Visualization

Dashboard Widgets

www.thingsboard.doscon.no

Trend Curves



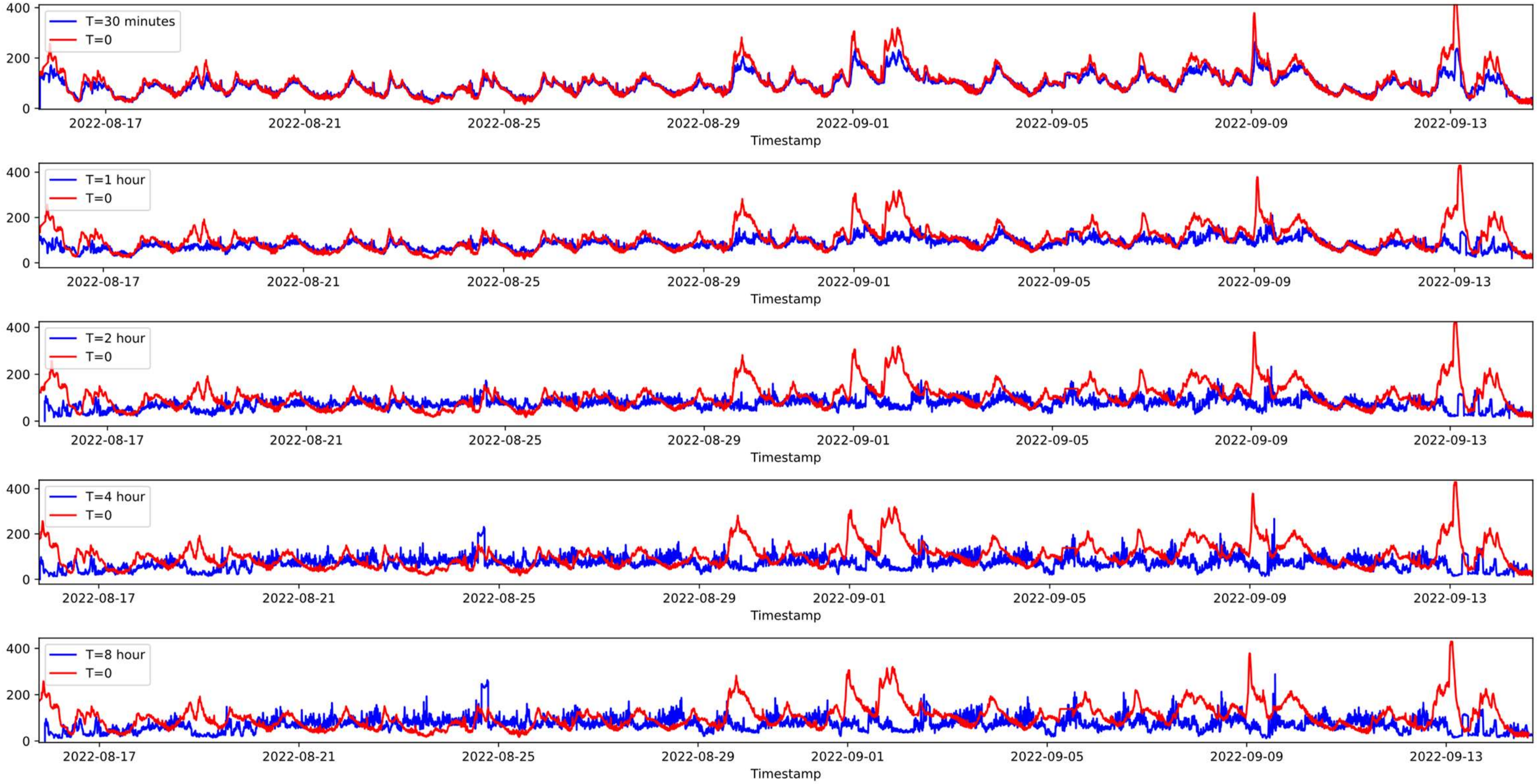
www.thingsboard.doscon.no

Virtual Reality

www.stambol.com

www.esri.com

Forecasting effluent quality (total COD)



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20 years of attacks….

edition.cnn.com/2021/02/10/us/florida-water-poison-cyber/index.html

CNN US Crime + Justice Energy + Environment Extreme Weather Space + Science Edition

Florida water treatment facility hack used a dormant remote access software, sheriff says

By Alex Marquardt, Eric Levenson and Amir Tal, CNN

Updated 2203 GMT (0603 HKT) February 10, 2021

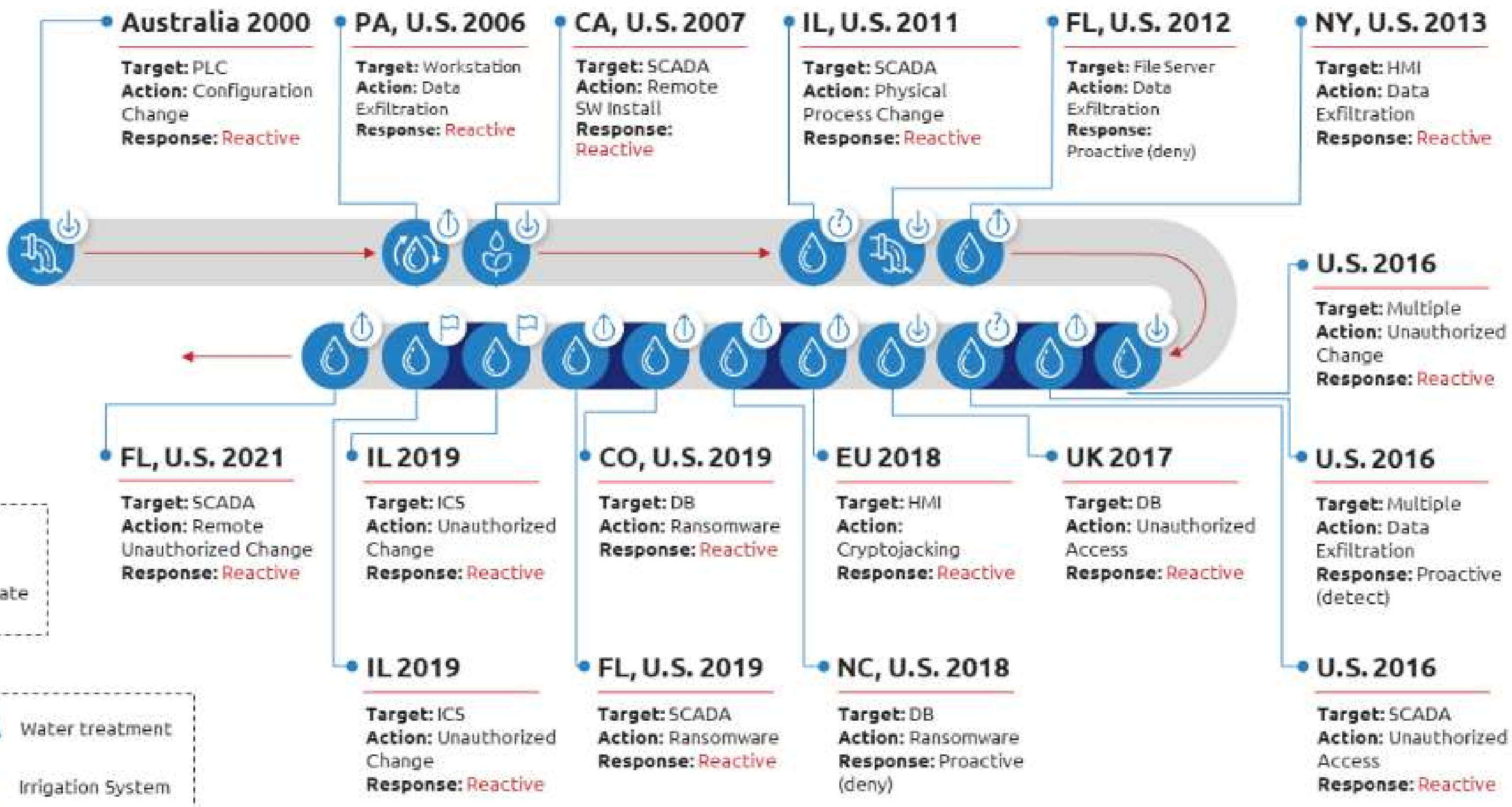
U.S. Water Supply System Being Targeted By Cybercriminals

Iranian Hackers Access Unprotected ICS at Israeli Water Facility

Cyber attacks in the water industry

According to ICS-CERT (ICS-CERT, 2016b), WWS is the third most targeted sector.

Many cybersecurity incidents either go undetected, and consequently unreported or are not disclosed because doing so may jeopardize the victims reputation, customers trust, and, consequently, revenues.



SCADAFence

Risks arising from digitalisation

- **Increased dependency on automation**
  - Risk of technical failures (no sensor works 24/7 & 365 days/year…)
  - Easier escalation from a single unit failure to system collapse
  - Do they make our operators less knowledgeable on processes?
  - Increased vulnerability of process stability
  - Increased risk of cascading effects between critical infrastructure (e.g. water and energy)

- **Causes**
  - System failures
  - Natural phenomena
  - Human errors
  - Malicious actions – cyber attacks
  - Third-party failures

What can cyber attacks do?

- Interfere with operations – over/under dosage
- Unauthorised changes to programmed instructions; reduced pressure, overflow of sewage, malfunction of unit processes
- Modify control systems to produce unpredictable results
- Block data or send false information to operators
- Change alarm thresholds or disable them
- Prevent access to account information
- Access to personal information (GPDR directive)
- Ransomware

The biggest threat….

Unpreparedness

How prepared are we for cyber threats?

Rapid digitalisation, also induced by the COVID-19 challenges, have increased vulnerability in the water sector.

ISRAEL HAYOM
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'Israel unprepared for Iranian cyberattack on water infrastructure'

CYBERSECURITY

Water utilities ill-prepared to deal with cyber threats

New report sheds light on the cybersecurity challenges facing those that manage the nation's water supplies

Joel Griffin

Aug. 3, 2021

HEIMDAL™ SECURITY

American and Israeli Water Sectors Are Unprepared for Cyber Attacks

Water Industries Are Frail in the Face of Potential Cyber Threats, Warn Experts.

LAST UPDATED ON NOVEMBER 7, 2022

Cybersecurity Risk & Responsibility in the Water Sector

Cybersecurity is a top priority for the water and wastewater sector. Entities, and the senior individuals who run them, must devote considerable attention and resources to cybersecurity preparedness and response, from both a technical and governance perspective. Cyber risk is the top threat facing business and critical infrastructure in the United States. Government intelligence confirms the water and wastewater sector is under a direct threat as part of a foreign government's multi-stage intrusion campaign, and individual criminal actors and groups threaten the

Strategic principles for secure water sector against cyber threats

1. **Understand threats:** Build on our joint work to develop our shared understanding of the cyber threats facing the water sector as they evolve.
2. **Manage risks**: Develop and implement approaches to manage risks and address cyber security vulnerabilities in the water sector, now and in the future.
3. **Manage incidents**: Respond effectively, with industry, to any serious cyber incidents, including those that compromise critical water infrastructure.
4. **Develop capabilities**: The government and sector enhance the cyber skills and capabilities of the water sector to meet future needs.
5. **Strengthen collaboration**: Strengthen collaboration between government and the water sector and within the water sector.

Managing cyber threats

The key to reduce risks

- Know your risks!
- Preventive measures work!
- So does preparedness when dealing with post-attacks!

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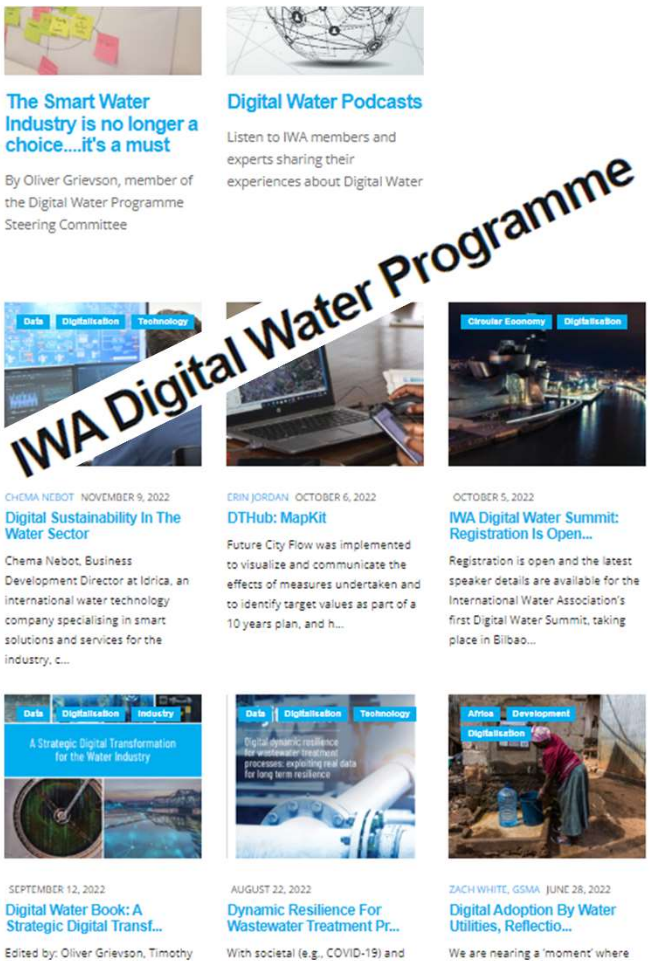
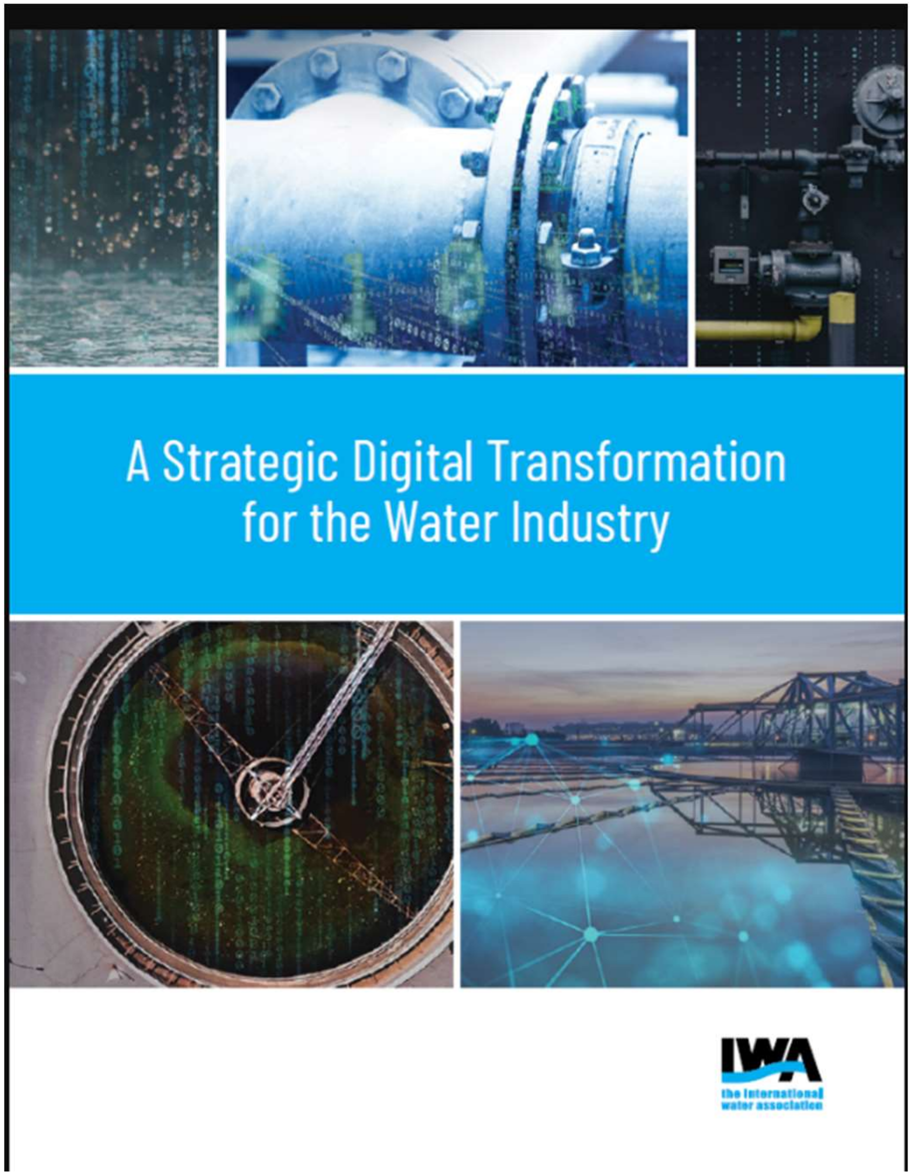
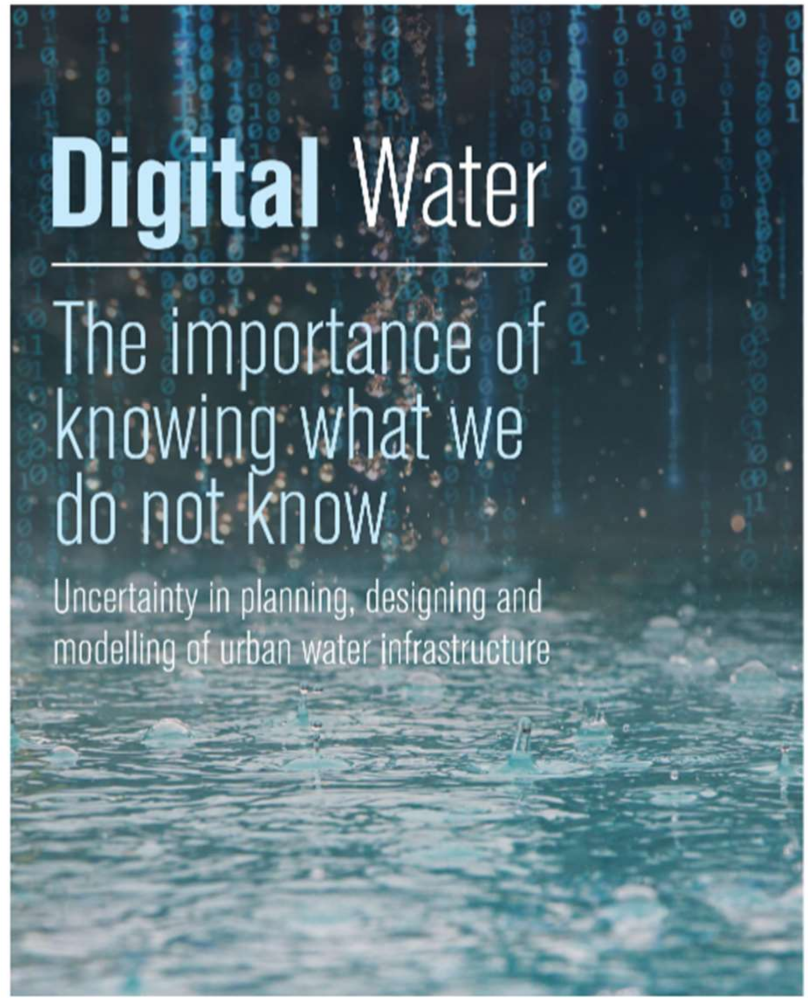
Best practices – readily available!- use them!





IWA
the international
water association



Good Practice Principles

1. To have robust and accountable cyber security governance
2. To proactively manage cyber risk and compliance
3. To ensure all our people are cyber aware with suitable training and communication
4. To make best use of good threat intelligence
5. To improve incident response
6. To proactively manage procurement, third parties and the wider supply chain

WaterUK, 2017

IWA Digital Water Summit

29 November – 2 December 2022 | Bilbao, Spain