CHINA EUROPE Water Platform
www.cewp.eu

Digital transformation in the Water Sector

Henrik Dissing, Danish Environmental Protection Agency

Co-funded by the European Union and P.R. China

Water – the Global Perspective

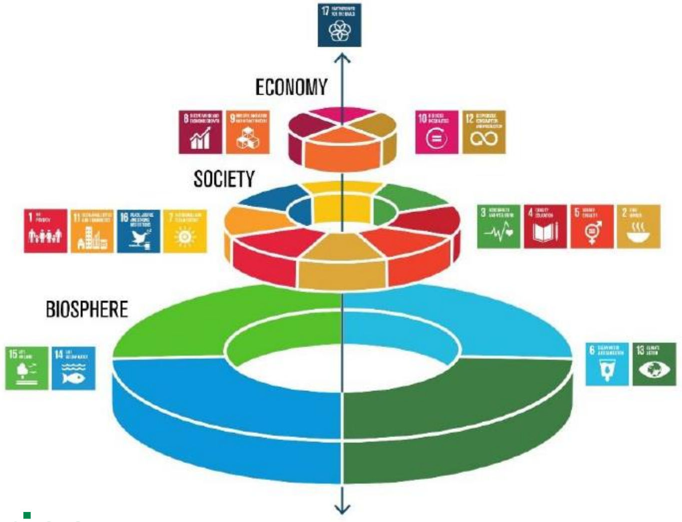
* World Economic Forum – ”top 3 Global Risk Factor for 7 consecutive years”

* SDG 6: Nearly 1 billion without access to safe drinking water and sanitation

* At a global scale, Demand will outstrip Supply by 40% in 2030

* Climate Change will magnify the challenges

* Digital Transformation is <u>the</u> opportunity!



* Water is just different from anything else – it don’t respect boundaries

* The Water Sector – Conservative, slow, risk averse, difficult for investors

* Getting the business case is difficult, policy risks and lack of getting prices right

The Value Chain of the Pulic Water Sector
An entire Ecosystem to be changed

System Boundaries for data-generation
- Water-cycles
- Authorities
- Utilities
- Plants

Monitoring Equipment, drones of sufficient quality
- Sensors
- Drones
- Robots

Data Quality
- Compatible across silos
- Format, frequency, intensity
- Accessible

Tools, Tech Solutions
- Analysis
- Modelling
- Prognosis
- AI

Beneficiaries
- ”The Challenge Owners”
- Digital Competences
- Financial Resources
- Costs Benefit Assessments

Framework Conditions
- Incentives
- Pricing; Water, Energy

System Boundaries
- Management
- Monitoring
- Planning
- Operational

Optimization or Transformation?

It is all a matter of creating value for end-users, but how do you begin? Do you have a transformative vision, or do you improve step-by-step?

Which of these approaches will have most optimal use of funds?

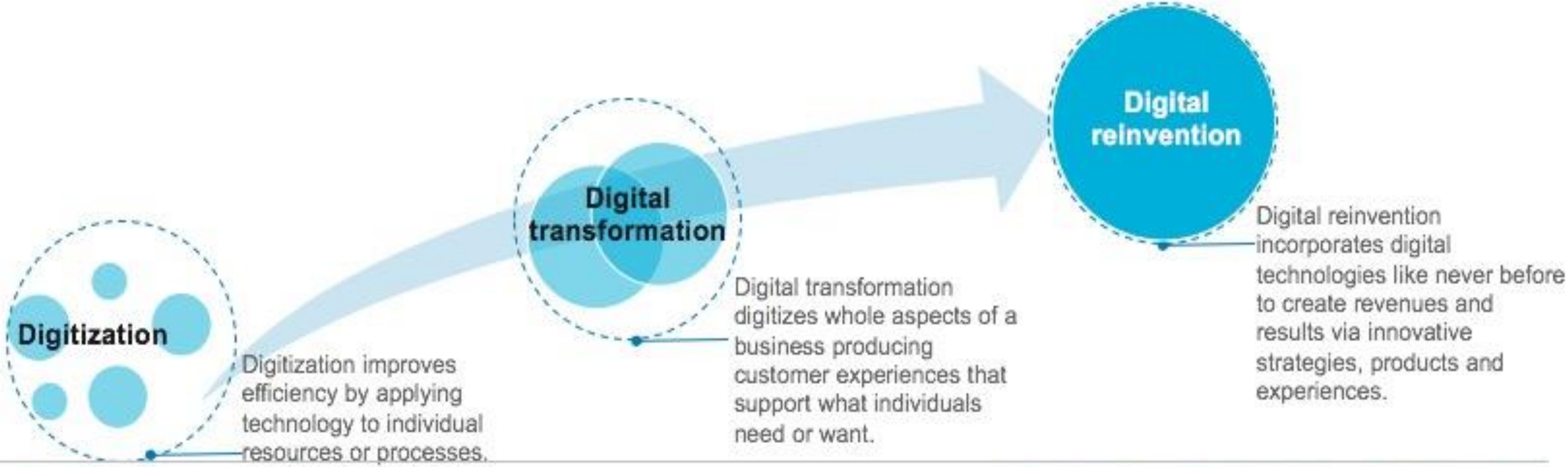
Optimization

2020 →

Transformation

← **2030**

IBM Point of View: To thrive in the face of technology led disruption, organizations require digital reinvention



***Digitization** in banks involves translating analog processes into digital processes such as online banking or electronic funds transfer*

***Digital transformation** in banks involves integrating across multiple digital processes to offer customers individualized experiences, e.g., omni-channel and single view of the customer initiatives*

***Digital reinvention** in banks involves fundamental reimaging of the way bank engages with customers and other stakeholders e.g. constructing deep customer relationships in which a bank orchestrates comprising financial & other associated services to realize customer ambitions and aspirations*

Smart Water - Significant Opportunities and Potential for Better Results and Highly Improved Efficiency - Major Challenges

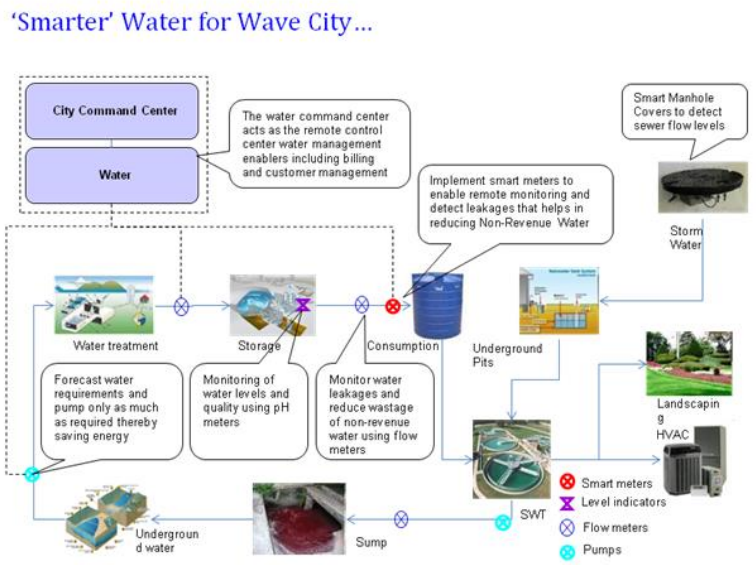
- **Increased Efficiency, Increased Speed, Improved Understanding, Better Performance, Better and more Precise Results**

- **Increased automation, improved analysis, AI solutions Improved Asset management, Field Staff Management Operations and Customer Services**

- **Foundation for Increased Effectiveness, more data for modelling, scenarios, planning, monitoring, evaluation,**

- **Leakage Reduction, Drinking Water Quality and Improving Health, Reducing pollution events**

- **Increasing Cross-sector Solutions, Smart Water as element Smart Cities; May lead to change of roles and responsibilities**



Expectations – selected use cases

Asset management – Monitoring and control systems can ensure the optimal operation of treatment plants and networks, and find ways to maximise the lifetimes of these assets.

Process economization – utilities and industrial end-users alike are constantly striving to make savings in processes- being able to run a system at its most optimal state provides economic benefits in terms of energy reduction and lower chemical usage.

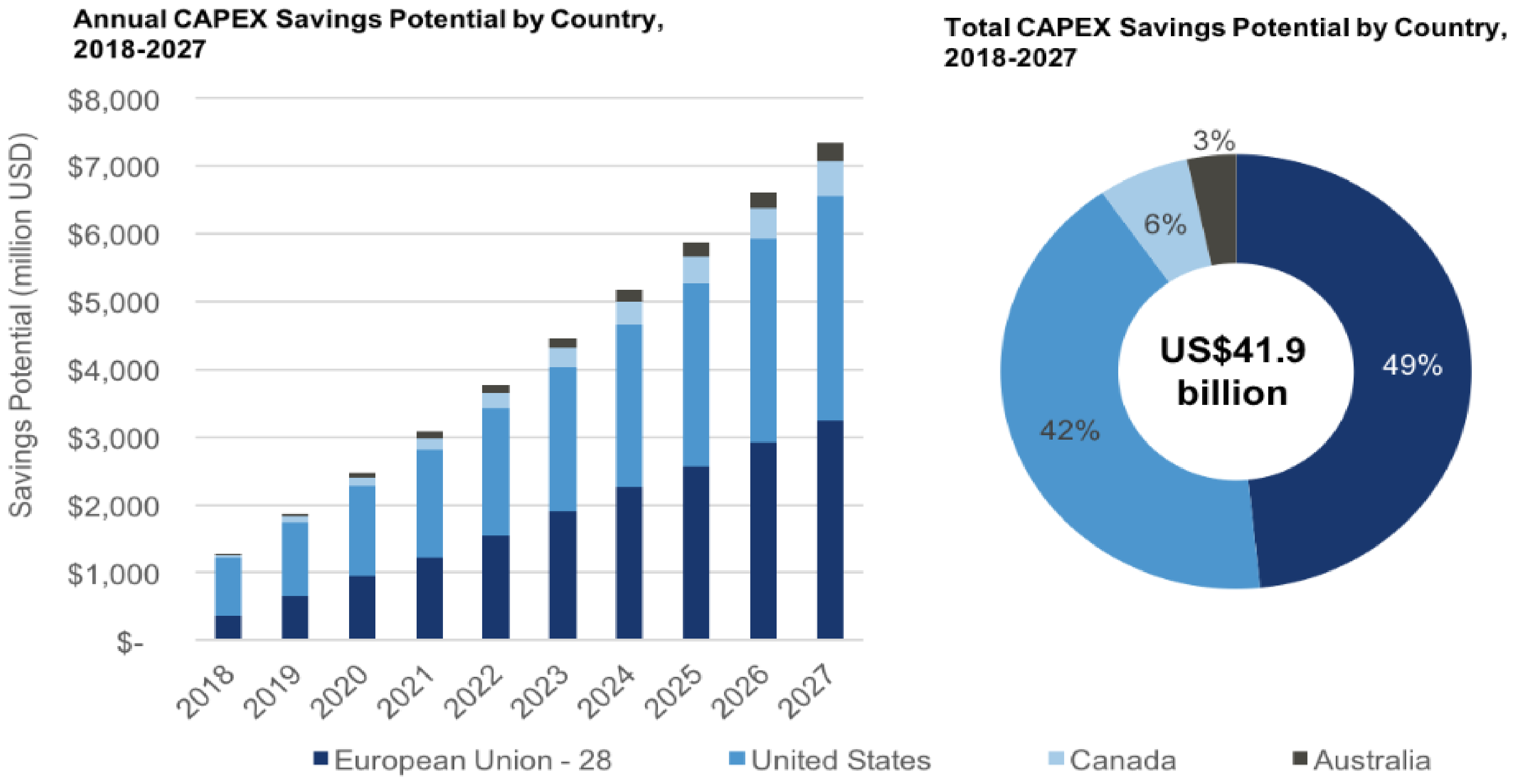
Increased automation – being able to save the amount of time that it takes for a problem to be dealt with in a treatment plant or network is a huge opportunity that monitoring and control systems can fill. Reduction of in-house expertise surrounding water management. End-users want to be able to focus fully on their core processes.

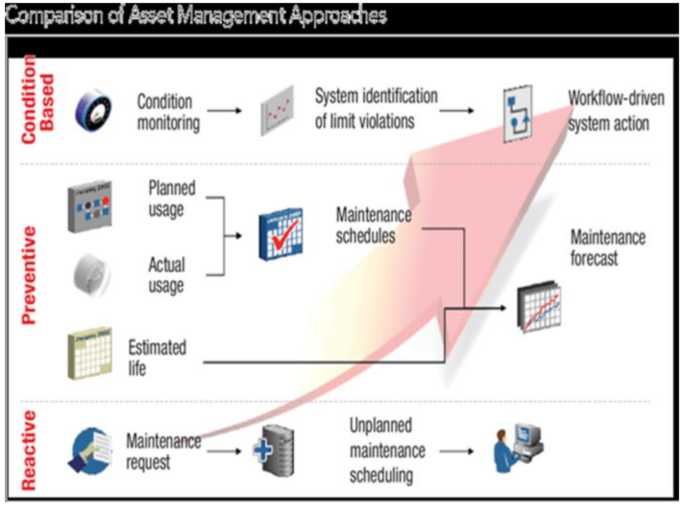
Operations and Customer Services – faster response rates to incidents; increased network uptime; near real-time situation awareness; substantially improved documentation for field staff work, improved feedback mechanisms, planning of service operations; interpretation of multi-factor systems etc.

Over the next decade, it is estimated that the Municipal Water Sector will invest more than 20 bio. $ on software, data and analytics solutions in Europe as well as USA

Utilities in the U.S., Canada, Australia, and Europe (representing 31 countries) currently manage US$2.9 trillion in water, wastewater and stormwater assets, which provide critical infrastructure services to over 822 million people, globally. Bluefield's forecasts indicate that advanced asset management solutions will save these utilities US$1.2 billion in annual CAPEX savings in 2018 and scale to US$7.3 billion in annual savings by 2027.

Exhibit: CAPEX Savings by Country, 2018-2027 (Annual and Total)





Source: Bluefield Research

Expectations – selected use cases # 2

Leakage management – In line with ageing infrastructure, utilities in many parts of the world face the challenge of reducing non-revenue water to minimize water and revenue losses from their networks. The adoption of more intelligent monitoring and control solutions is a key way.

Integrated solutions and partnerships - understand how different elements of the market interlink, how it can work effectively with other companies' offerings and devise strategies to collaborate with key industry players in order for solutions to be developed most effectively.

Reducing pollution events - during periods of high rainfall, cities with combined sewer systems are at risk of having serious water pollution issues caused by overflow events. Being able to rapidly react or prevent these CSO events forms another major opportunity for monitoring and control systems.

Improved Public Management, Better Scenarios and Models, More Precise Design of Investments – The Public Benefit side holds huge potentials, giving more accurate use of funds

Availability of sensors

	WWTP	Sewer System	Surface Water	Drinking Water
Level	[green]	[green]	[green]	[green]
Flow	[green]	[green]	[green]	[green]
Precipitation	[green]	[green]	[green]	[green]
Temperature	[green]	[green]	[green]	[green]
Pressure	[green]	[green]	[green]	[green]
pH	[green]	[yellow]	[yellow]	[grey]
Conductivity	[green]	[yellow]	[yellow]	[grey]
Salinity	[green]	[yellow]	[yellow]	[grey]
Redox	[green]	[yellow]	[yellow]	[grey]
Dissolved Oxygen	[green]	[yellow]	[yellow]	[grey]
Tuebidity	[green]	[yellow]	[yellow]	[grey]
Dissolved Solids	[yellow]	[yellow]	[yellow]	[grey]

Mature sensors	[green]
Analyzers	[light blue]
Limited experience	[yellow]
Not available	[red]
Not relevant/mentioned	[grey]

Table 3: Current availability of sensors for physical and simple chemical parameters

	WWTP	Sewer System	Surface Water	Drinking Water
Level	[green]	[green]	[green]	[green]
Flow	[green]	[green]	[green]	[green]
Precipitation	[green]	[green]	[green]	[green]
Temperature	[green]	[green]	[green]	[green]
Pressure	[green]	[green]	[green]	[green]
pH	[green]	[green]	[green]	[grey]
Conductivity	[green]	[green]	[green]	[grey]
Salinity	[green]	[green]	[green]	[grey]
Redox	[green]	[green]	[green]	[grey]
Dissolved Oxygen	[green]	[green]	[green]	[grey]
Turbidity	[green]	[green]	[green]	[grey]
Dissolved Solids	[green]	[green]	[green]	[grey]

Mature sensors	[green]
Analyzers	[light blue]
Limited experience	[yellow]
Not available	[red]
Not relevant/mentioned	[grey]

Table 5: Physical and Simple Chemical Parameters - Probable Availability 3-8 Years from Now

Availability of sensors

	WWTP	Sewer System	Surface Water	Drinking Water
Ammonia	Mature sensors	Limited experience	Limited experience	Not relevant/mentioned
Nitrate	Mature sensors	Limited experience	Limited experience	Not relevant/mentioned
Chloride	Limited experience	Limited experience	Limited experience	Not relevant/mentioned
Sodium	Limited experience	Limited experience	Limited experience	Not relevant/mentioned
Calcium	Limited experience	Limited experience	Limited experience	Not relevant/mentioned
Phosphate	Analyzers	Not available	Not available	Not relevant/mentioned
Total-N	Not available	Not available	Not available	Not relevant/mentioned
Total-P	Not available	Not available	Not available	Not relevant/mentioned
Suspended solids	Analyzers	Not available	Not available	Not relevant/mentioned
Sludge blanket	Mature sensors	Not relevant/mentioned	Not relevant/mentioned	Not relevant/mentioned
H_2S	Limited experience	Not available	Not relevant/mentioned	Not relevant/mentioned
N_2O	Mature sensors	Not available	Not relevant/mentioned	Not relevant/mentioned
Methane	Analyzers	Not available	Not relevant/mentioned	Not relevant/mentioned
CO_2	Analyzers	Not available	Not relevant/mentioned	Not relevant/mentioned
BOD, COD, TOC	Analyzers	Not available	Not relevant/mentioned	Not relevant/mentioned
Chlorophyll a	Limited experience	Not relevant/mentioned	Limited experience	Not relevant/mentioned
E. coli	Analyzers	Not available	Not relevant/mentioned	Not relevant/mentioned
Phenols	Analyzers	Not available	Not relevant/mentioned	Not relevant/mentioned
Cyanide	Analyzers	Not available	Not relevant/mentioned	Not relevant/mentioned
Hydrocarbons	Analyzers	Not available	Not relevant/mentioned	Not relevant/mentioned
Heavy metals	Analyzers	Not available	Not relevant/mentioned	Not relevant/mentioned
PAH	Not available	Not available	Not available	Not available
Micro plastics	Not available	Not available	Not available	Not available

Mature sensors	(green)
Analyzers	(light blue)
Limited experience	(yellow)
Not available	(red)
Not relevant/mentioned	(grey)

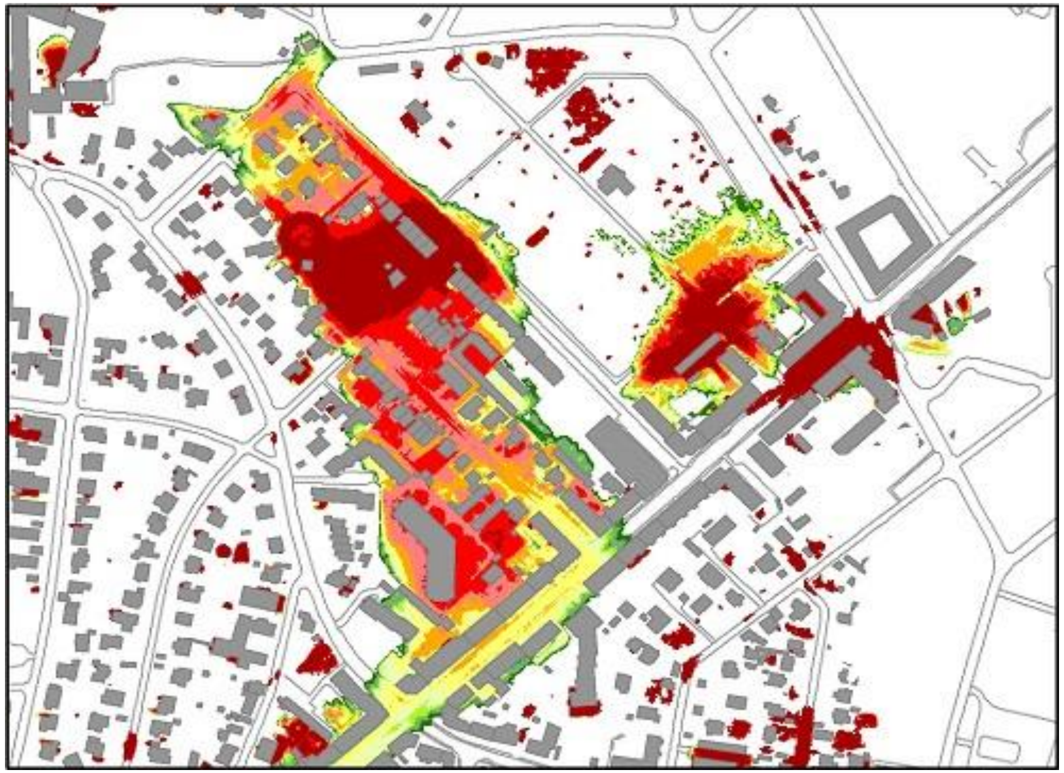
Table 4: Current availability of sensors for Advanced Chemical and Biological Parameters

	WWTP	Sewer System	Surface Water	Drinking Water
Ammonia	Mature sensors	Mature sensors	Limited experience	Not relevant/mentioned
Nitrate	Mature sensors	Mature sensors	Limited experience	Not relevant/mentioned
Chloride	Mature sensors	Mature sensors	Limited experience	Not relevant/mentioned
Sodium	Mature sensors	Mature sensors	Limited experience	Not relevant/mentioned
Calcium	Mature sensors	Mature sensors	Limited experience	Not relevant/mentioned
Phosphate	Limited experience	Limited experience	Limited experience	Not relevant/mentioned
Suspended solids	Limited experience	Limited experience	Limited experience	Not relevant/mentioned
Sludge blanket	Mature sensors	Not relevant/mentioned	Not relevant/mentioned	Not relevant/mentioned
H_2S	Limited experience	Not available	Not relevant/mentioned	Not relevant/mentioned
N_2O	Mature sensors	Not available	Not relevant/mentioned	Not relevant/mentioned
Methane	Analyzers	Not available	Not relevant/mentioned	Not relevant/mentioned
CO_2	Analyzers	Not available	Not relevant/mentioned	Not relevant/mentioned
BOD, COD, TOC	Limited experience	Limited experience	Limited experience	Not relevant/mentioned
Chlorophyll a	Limited experience	Not relevant/mentioned	Limited experience	Not relevant/mentioned
E. coli	Limited experience	Limited experience	Limited experience	Limited experience
Phenols	Analyzers	Not available	Not relevant/mentioned	Not relevant/mentioned
Cyanide	Limited experience	Limited experience	Limited experience	Not relevant/mentioned
Hydrocarbons	Limited experience	Limited experience	Limited experience	Not relevant/mentioned
Heavy metals	Analyzers	Not available	Not relevant/mentioned	Not relevant/mentioned
PAH	Not available	Not available	Not available	Not available
Micro plastics	Not available	Not available	Not available	Not available

Mature sensors	(green)
Analyzers	(light blue)
Limited experience	(yellow)
Not available	(red)
Not relevant/mentioned	(grey)

Table 6: Advanced Chemical and Biological Parameters – Probable Availability 3-8 Years from Now

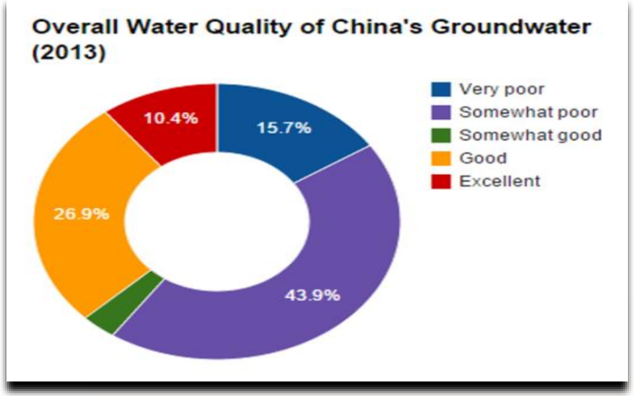
Climate Change Adaptation in Cities – many interests, many stakeholders – who pays, who benefits?

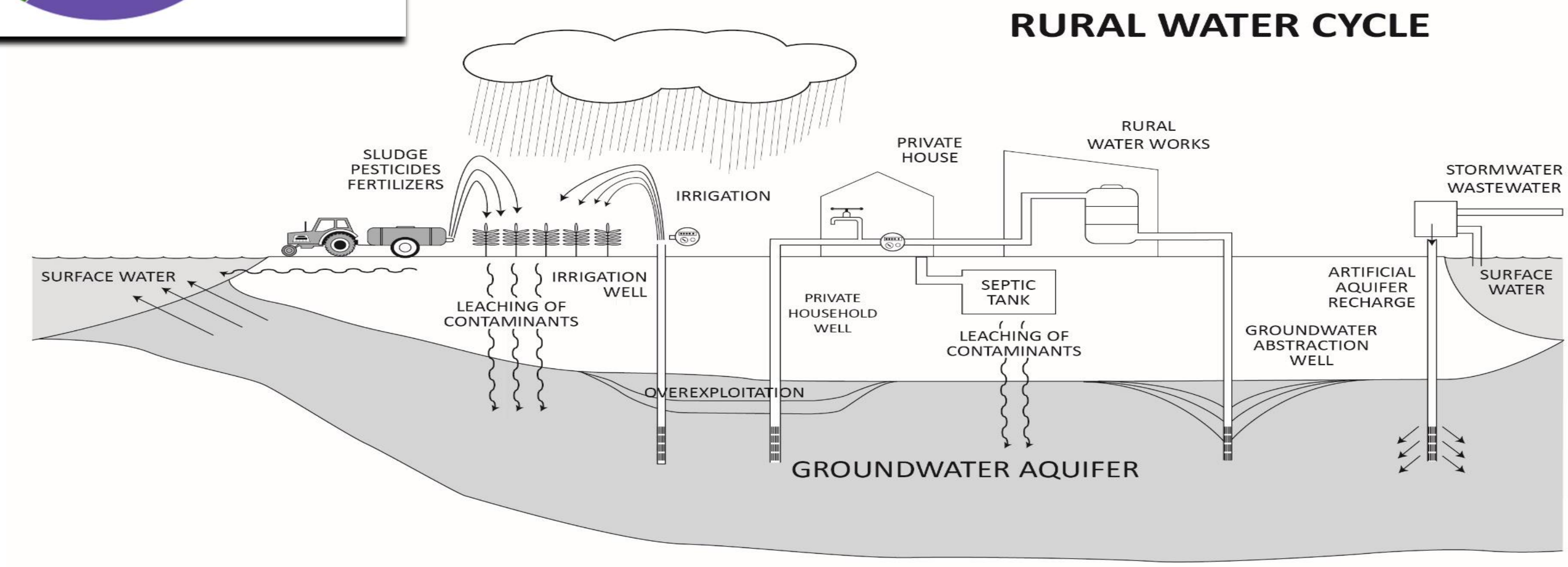


Planning of new measures e.g.

- **River restoration, buffer zones, establishment of wetlands**
- **Climate Change Adaptation, water retention**
- **Water Resources Allocation**

Groundwater





Smart Water integrated with Smart Systems

* Smart Industries

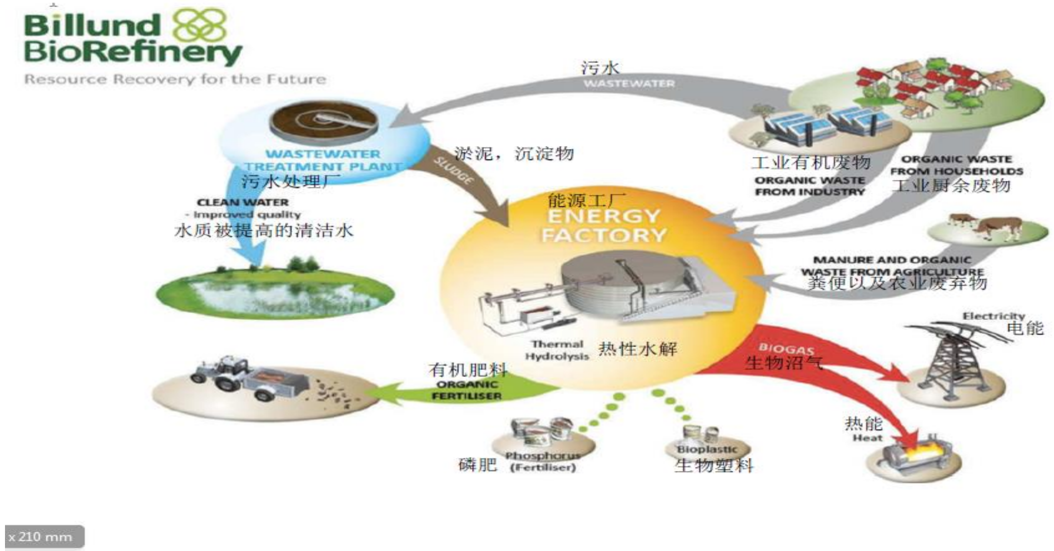
* Smart Utilities

* Smart Farming

* Smart Water Management eg Groundwater Cycle

* Smart Monitoring Systems

* Smart River Basin Management



* Smart Cities

- Data will be key! - Imagineering!

Smart Cities – Great Expectations but lack of common definition

The Blueprint for Building a Smart City - Re...
readwrite.com

The Importance of Smart Cities – Zify – Medium
medium.com

Technology Research for Smart Cities and Build...
arcweb.com

What Is A Smart City? | Infrastructure |...
computerworlduk.com

Why Smart Cities Are a Golden Opportunity for ...
entrepreneur.com

Council Post: Building A Smart City? 10 ...
forbes.com

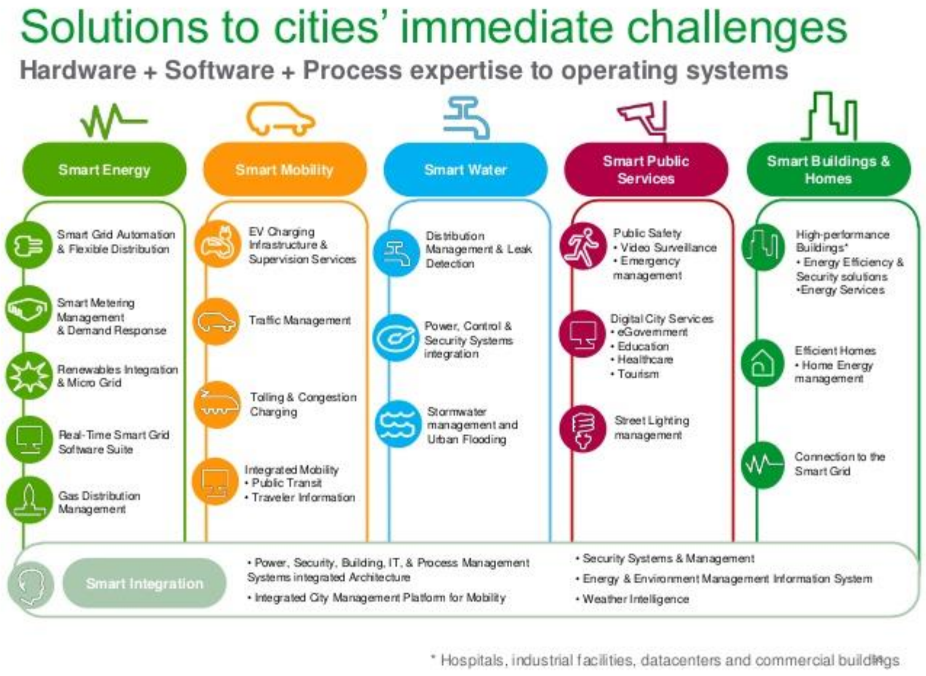
Smart cities report forecasts trillions in e...
smartcitiesworld.net

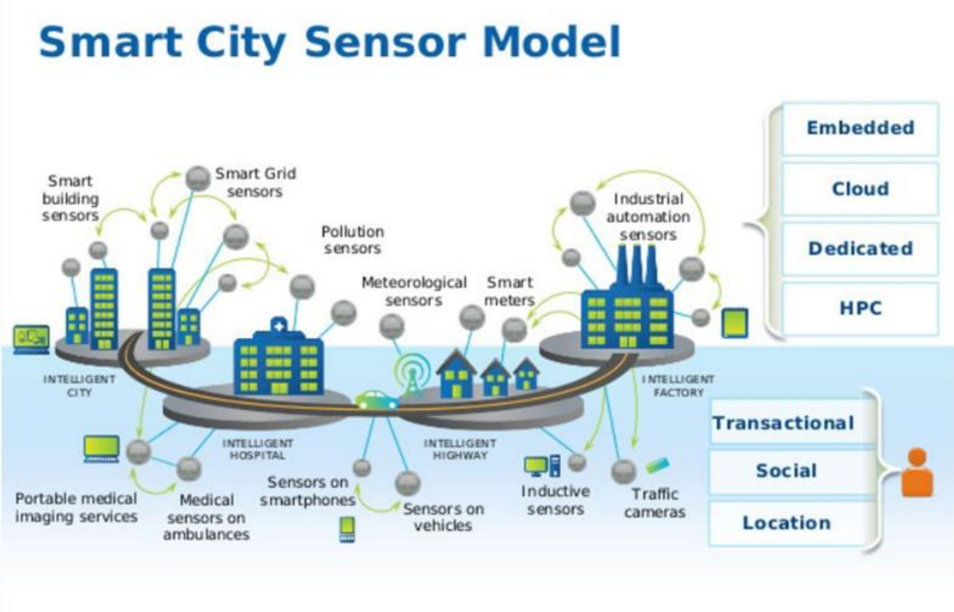
What is a smart city?
gemalto.com

How to Outsmart the Smart City
securityintelligence.com

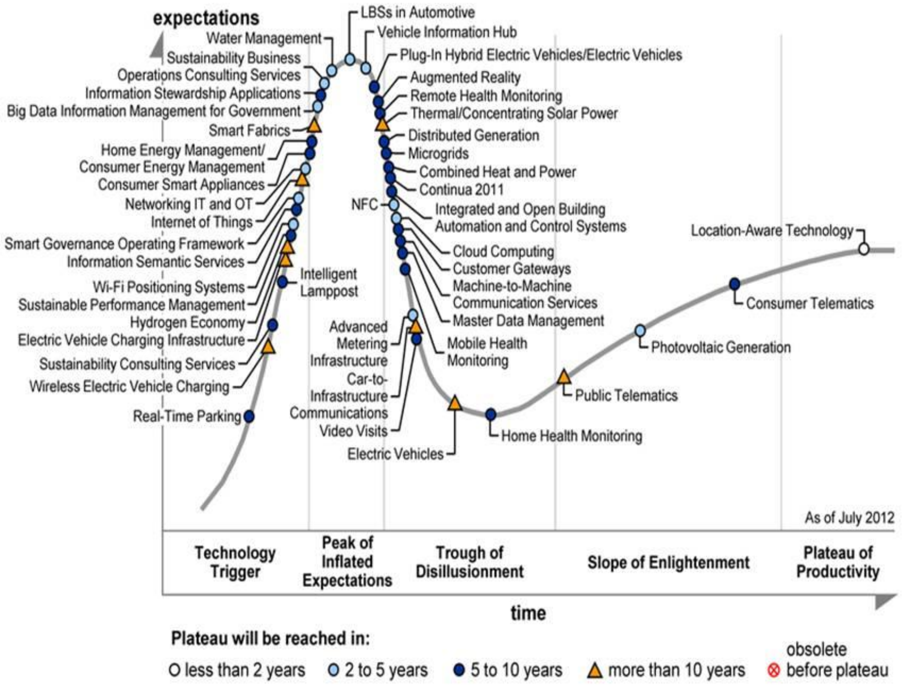
Home | Marketplace of the European Innovation P...
eu-smartcities.eu

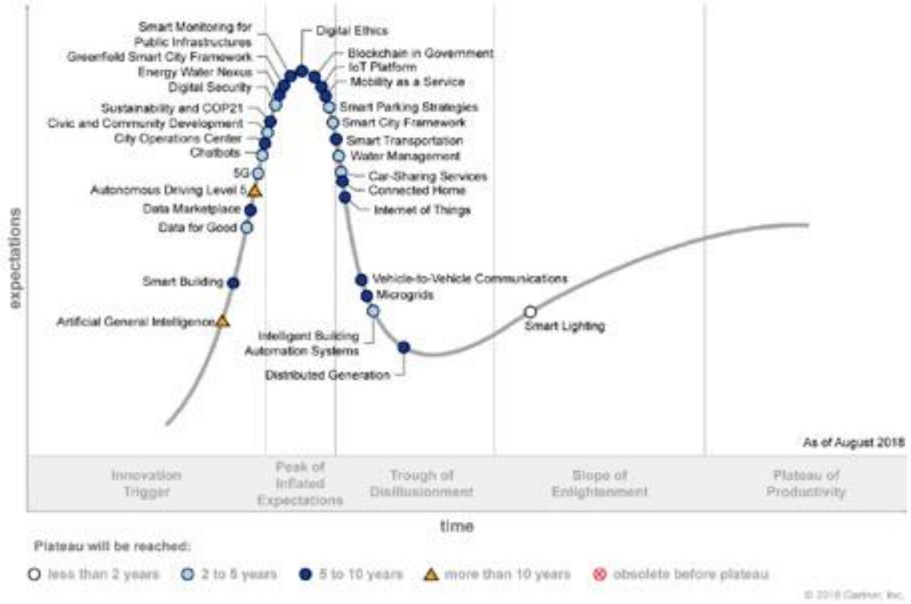
Smart Water – Element of Smart City





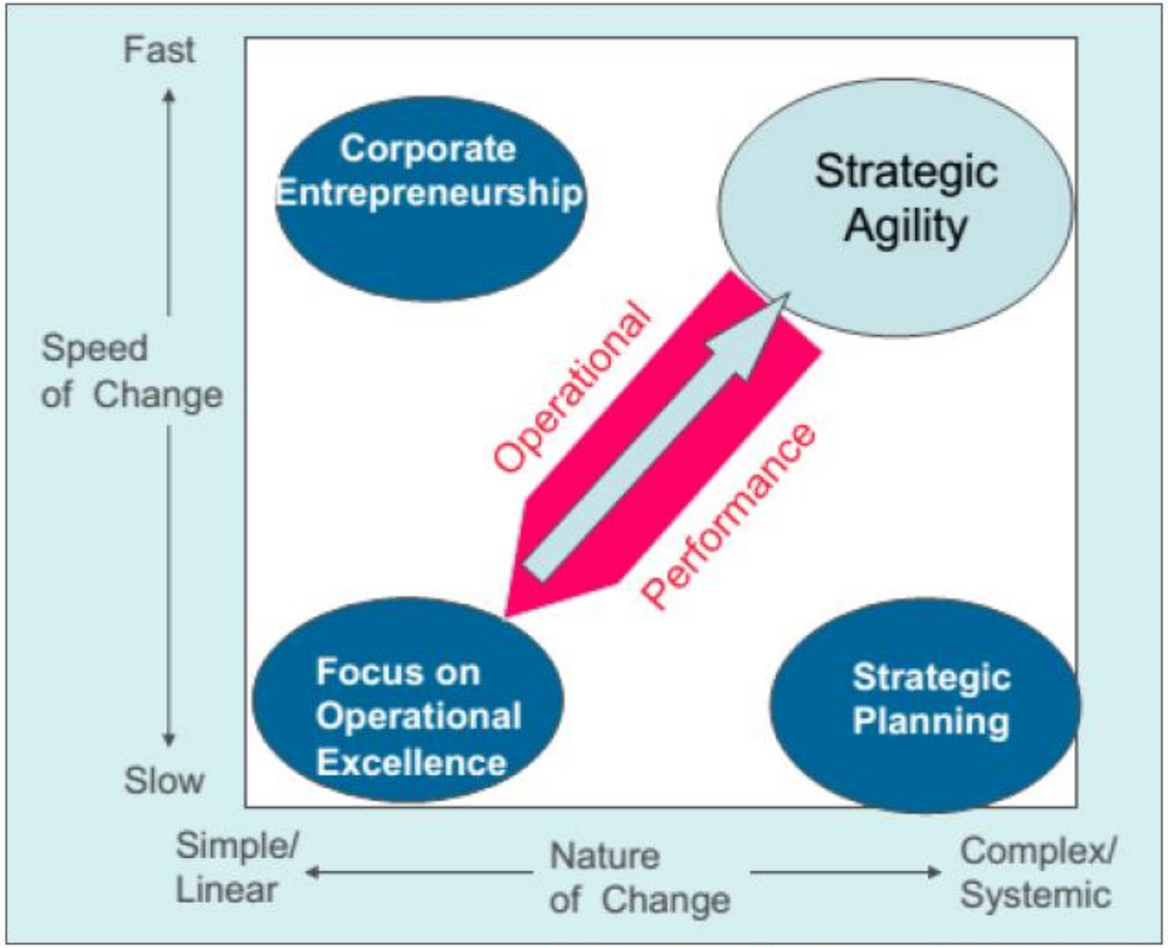
Smart City Technologies – Hype Cycles Urenio 2012 and Gartner 2018





Source: Gartner (August 2018)

Strategic agility



Yves Doz and Mikko Kosonen, Fast Strategy, 2007

Thank you for your attention

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RIVERSCAPES – Monitoring riverscapes with unmanned airborne vehicles

Monitoring by Drones will help prevent flooding

In the future, monitoring will take place using drones equipped with a special combination of sensors and instruments, which will make monitoring of rivers more detailed and more precise.

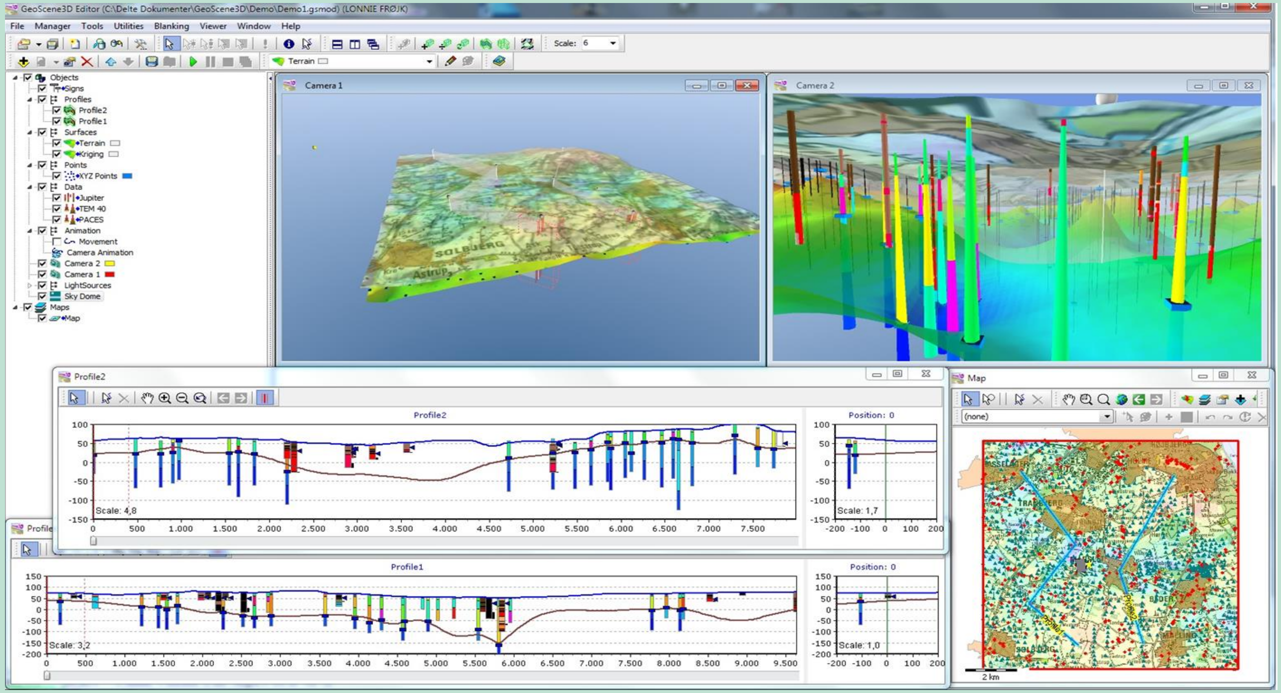
Partners: DTU Environment, DTU Space, Copenhagen Region, South Denmark Region, Vejle Municipality, DHI, Orbicon, Drone Systems, Photrack AG

Budget: Total 12 mio. og IFD 8 mio kr.
Period: 2017-2020

https://innovationsfonden.dk/da/presse/dronemaalinger-skal-forhindre-oversvoemmelser

GAP

Groundwater Architechture Project v. Stanford University, California



Projektet GAP under MUDP udvikler nyt datamanagement system, som skal give input til multiple point geostatistiske algoritmer for hydrogeologiske modeller. Der vil blive udviklet metoder til at kvantificere usikkerheder i 3D hydrostratigrafiske modeller. 3 pilotprojekter skal levere data fra grundvandskortlægningen i Californien.

Partnere: I-GIS, Rambøll A/S, Aarhus Universitet, Stanford University.

Budget: Total 14 mio. kr. MUDP: 4 mio. kr.

Periode: 2018-2020

mudp

TURBUS – Turbidity Ultrasonic Sensor for Water Quality

The Vision is to develop a Sensor to monitor harmful substances in the water.
The objective is to have a sensor which is robust, operating at low costs, low maintenance levels and low energy consumption, allowing for widespread use of a vast number of the sensors in the infrastructure of utilties.

Partners: Kamstrup A/S og Aarhus University

Budget: Total 11,3 mio. kr. IFD: 7 mio. kr.

Periode: 2016-2019

https://innovationsfonden.dk/da/case/sensorer-skal-holde-oeje-med-drikkevandet-i-roerene

CHAIN

Water 4.0: Artificial Intelligens will secure drinking water of the future

The CHAIN project combines the use of Artificial Intelligens with the drinking water supply infrastructure.

As the groundwater is increasingly faces pressure from pollution, AI is used to optimize the management of the infrastructure and the main components involved, including smart meters, pumps and valves.

Partners: DHI, Alexandra, Envidan, Kamstrup, Aarhus Water Utility, Skanderborg Water Utility.

Budget: Total 21 mio. kr. IFD: 9 mio. kr.
Periode: 2018-2021

https://innovationsfonden.dk/da/presse/vand-40-kunstig-intelligens-skal-sikre-fremtidens-drikkevand

Sino-Danish Co-operation in Changchun

Leakage Reduction Project

Pressure Zone Management – Highly improved operations and maintenance – Leakage Detection and Leakage Reduction

Partners: Cities of Changchun and Hjørring; Krüger A/S

Budget: n.a., Contribution from MUDP: n.a.
Periode: 2014-2019

mudp

HEPWAT

Higher Environmental Performance in WastewATer systems

The HEPWAT project develops new solutions for wastewater treatment and for connecting data from sewage system to the WWTP. The objective is to develop new processes and process combinations, which both increase the capability of the WWTP to convert organic matter to bioenergy , while at the same time use less energy. Further, methods to remove other substances from the wastewater will be developed.

Partners: Assens Utility A/S, Krüger A/S, Grundfos A/S, Artogis A/S.

Budget: Total 43.164.876 mio. kr. Controbution from MUDP: 18.845.137 mio. kr.
Period: 2017-2020

mudp

Water Smart Cities

Water Utilities co-operating on Water Management

Severe Cloudbursts causes the sewage system to send spill-overs to rivers, coastal areas and into the basements of buildings and houses. Development of new state-of-the-art water technology will give water utilties and public authorities a new tool for a more coherent planning and management of the water – whether caused by cloudbursts or floods.

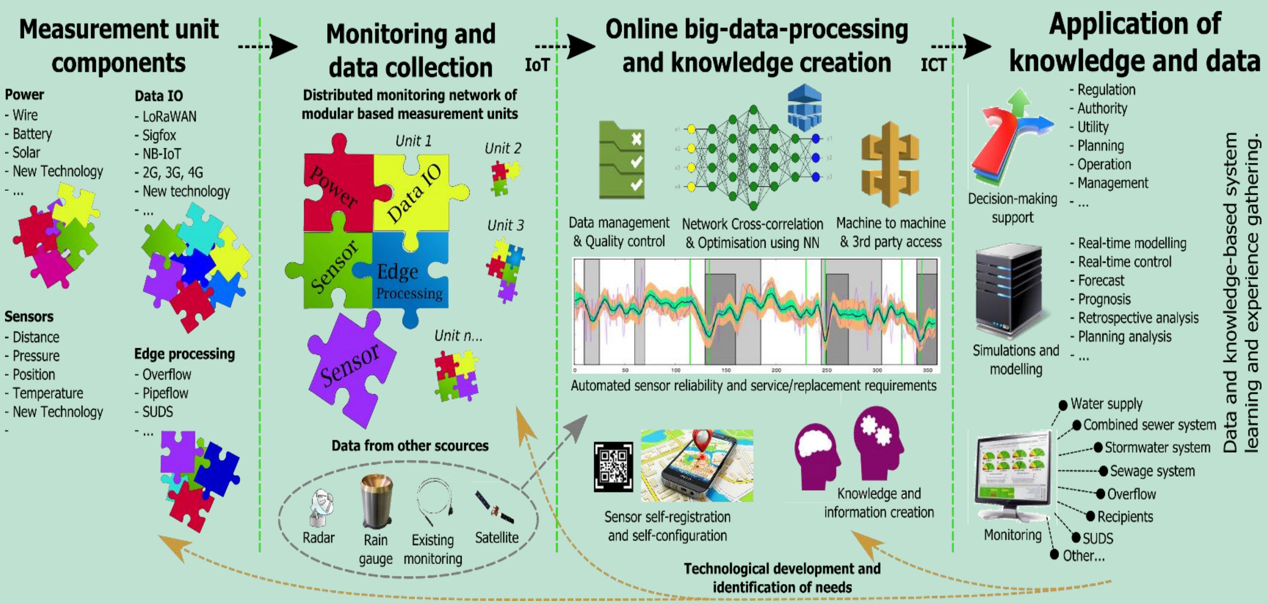
Partners: DTU, DHI, Krüger A/S, Rambøll Danmark A/S, DMI, 3 Vand, Innovation og Udvikling, HOFOR, , AArhus Vand, Vandcenter Syd, BIOFOS, Forsikring & Pension

Budget: Total 28,3 mio. kr. IFD: 12,3 mio. kr.
Periode: 2016-2019

https://innovationsfonden.dk/da/case/smart-vandhaandtering-til-smarte-byer/

OrEO

Cost-efficient Monitoring of Spill-overs and LAR-solutions with Smart Meters



The Objective of the project is to develop a solution, which enables monitoring of spill-over constructions and LAR Solutions by use of Smart Meters. Data is connected wireless via IoT (Internet of Things)-Technology and online cloud-based IKT (Information- and Communication) Technologoy for realtime monitoring of the response of the infrastructure to various situations.

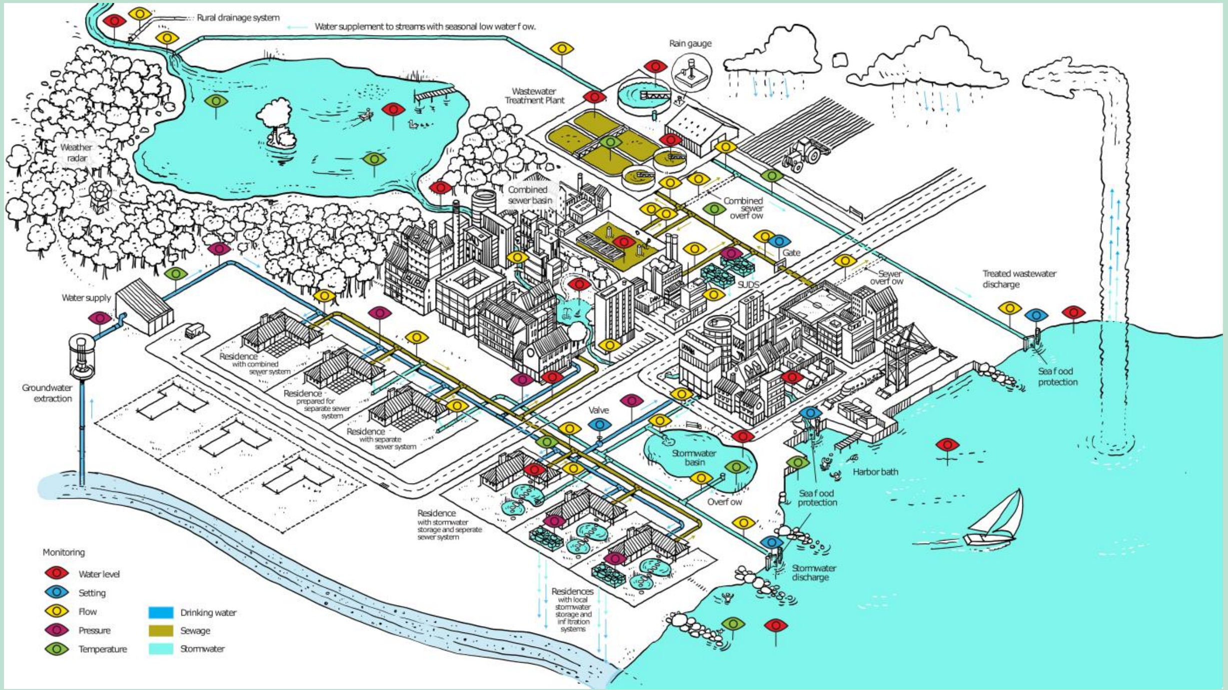
Partners: Informetics Aps, Aarhus Vand A/S, Aalborg Universitet, Montem A/S, Informetcs Aps.

Budget: Total 6.709.192 mio. kr., Contribution from MUDP: 4.198.241 mio. kr.
Period: 2018-2020

mudp

DONUT

Dansk vandteknologi i front med intelligent styring og overvågning



Målet med projektet er at udvikle og kommercialisere en løsning, som kan foretage målinger i vandkredsløbet omkostningseffektivt og omsætte disse data til viden, som vandselskaber og myndighed aktivt kan anvende i deres beslutninger

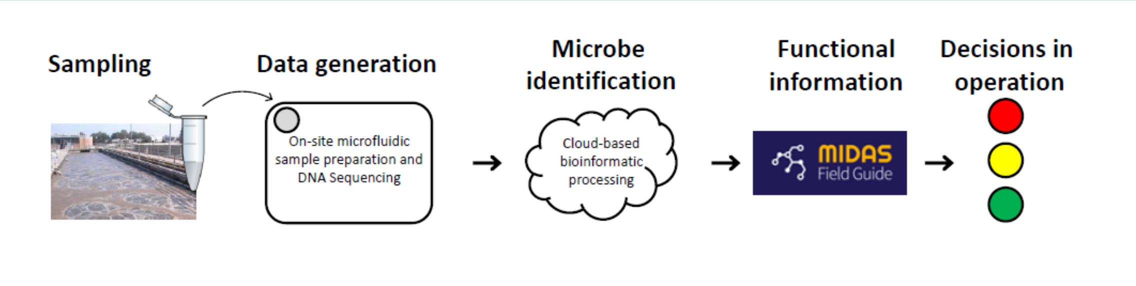
Partners: Aarhus Water Utility, Water Center South, Aalborg University, Montem A/S, Informetics Aps, Aarhus Municipality

Budget: Total 23,6 mio. kr. IFD: 14,6 mio. kr.
Period: 2018-2021

https://innovationsfonden.dk/da/presse/dansk-vandteknologi-i-front-med-intelligent-styring-og-overvaagning

Online DNA – Optimezed Cleantech Systems with online Monitoring of micro-biological content

Online-DNA-analysis to manage bacteriae in WWTPs



Online-DNA will map the several thousand different types of bacteriae, which are found in WWTPs in order to identify those approximately 1-200 of particular importance to the wastewater treatment processes.

Partners: Aalborg University, Krüger AS, BIOFOS, Water Center South, Aalborg Utility, Aarhus Utility, University of Vienna,

Budget: Total 17,3 mio. kr. IFD: 7,5 mio. kr.
Period: 2016-2019

https://innovationsfonden.dk/da/case/online-dna-analyser-skal-holde-styr-paa-bakterier-i-renseanlaeg