Ministry of Environment and Food of Denmark
Environmental Protection Agency

Smart Cities og Vandet:

Digital transformation i vandsektoren

17. september, 2019
Henrik Dissing

De tre hovedspørgsmål

Hvordan øger vi den strategiske merværdi af de store investeringer i klimatilpasning?

- Afgørende at få etableret et velfungerende, digitalt økosystem
- Fælles forståelse af begreber, muligheder og udfordringer ift en digital transformation

Hvilke nye løsninger og tilgange er på vej?

- Nye løsninger inden for sensorteknologier, analyser, anvendelses-værktøjer
- Smart Cities: mange tiltag, men måske for data- og teknologidrevet

Hvordan skal vi udvikle på organiseringen og samarbejdet?

- Afgørende at få styr på rolledeling, rammevilkår, incentives
- Meget store forskelle på beslutningstagning ved multi-aktør sammenhænge

Optimization or Transformation?

Digitization – the levels

The Value Chain – 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

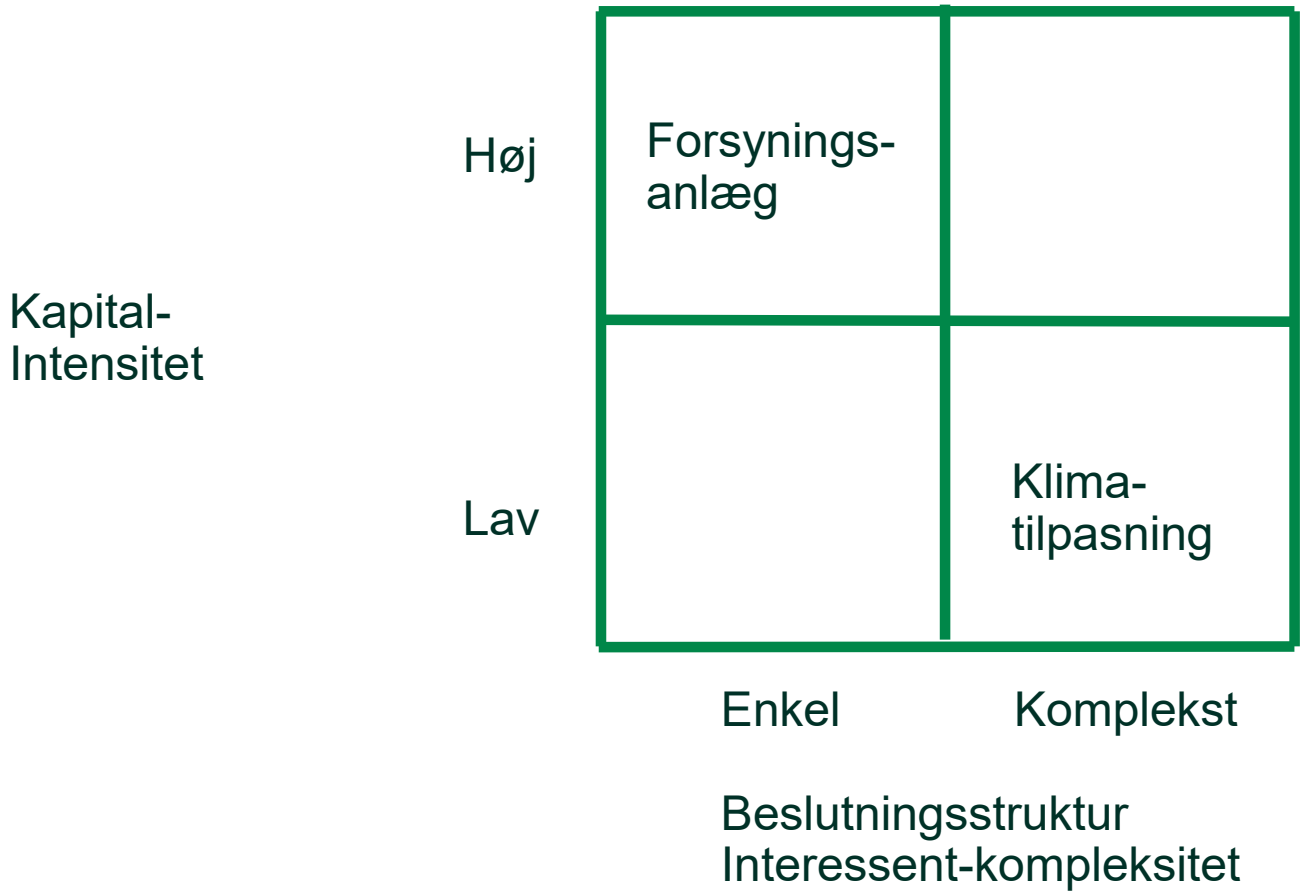
Tools, Tech Solutions
- Analysis
- Modelling
- Prognosis
- AI

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

Framework Conditions
- Incentives
- Pricing; Water, Energy

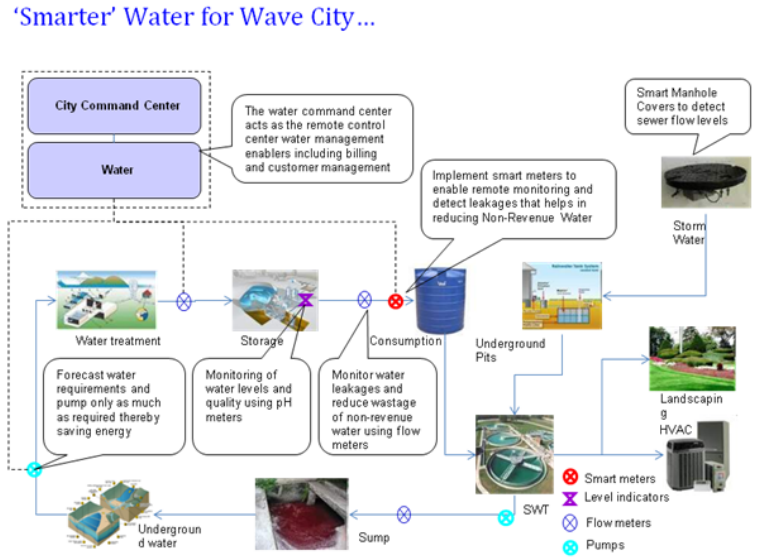
System Boundaries
- Management
- Monitoring
- Planning
- Operational

Digital Transformation vil ske i forskellige tempi



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

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 in which this can be achieved.

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.

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 econom**ic** benefits in terms of energy reduction and lower chemical usage.

Expectations – selected use cases # 2

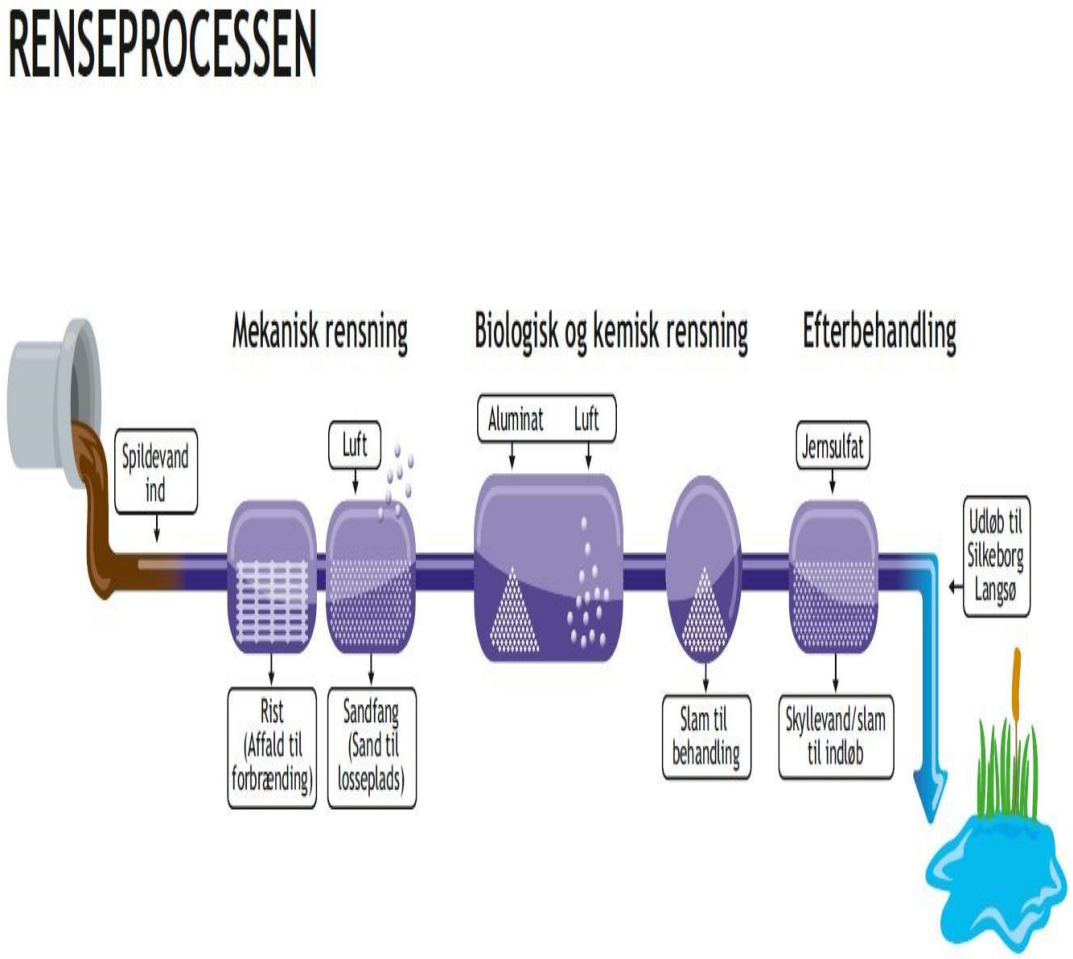
Increased automation – being able to save the amount of time that it takes for a problem to be dealt with in a treatment plant or network is a huge opportunity that monitoring and control systems can fill. This, together with a reduction of in-house expertise surrounding water management and the fact that end-users want to be able to focus fully on their core processes, is driving the uptake of more automated solutions that reduce human involvement.

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.

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**

Optimeret drift på forsyningsanlæg



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.

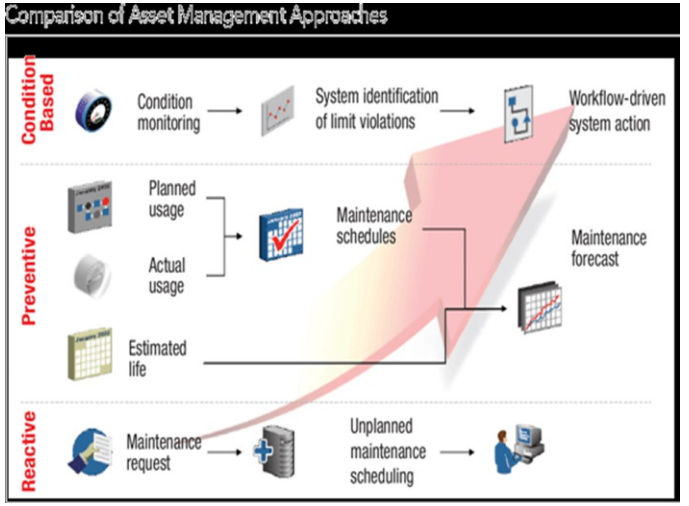
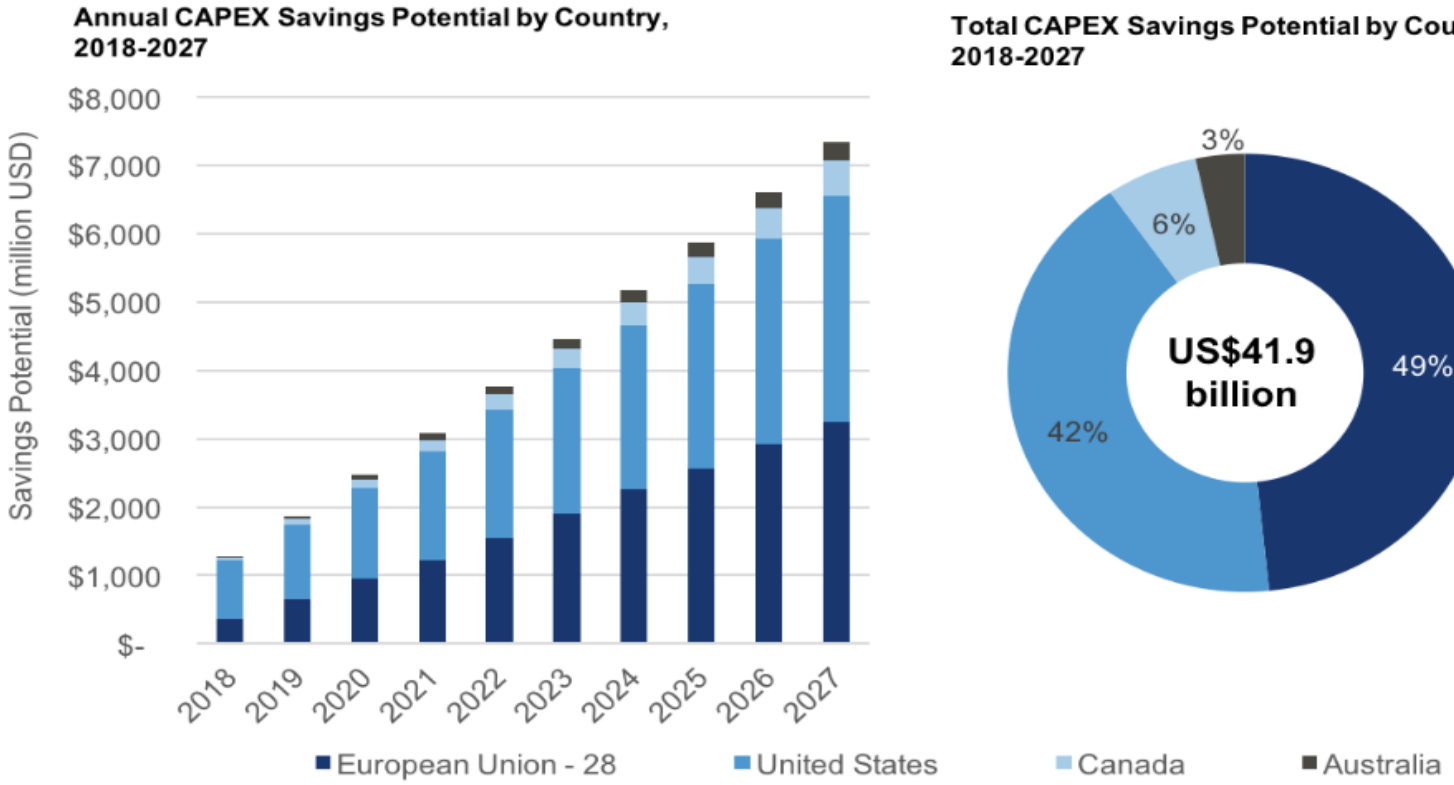


Exhibit: CAPEX Savings by Country, 2018-2027 (Annual and Total)

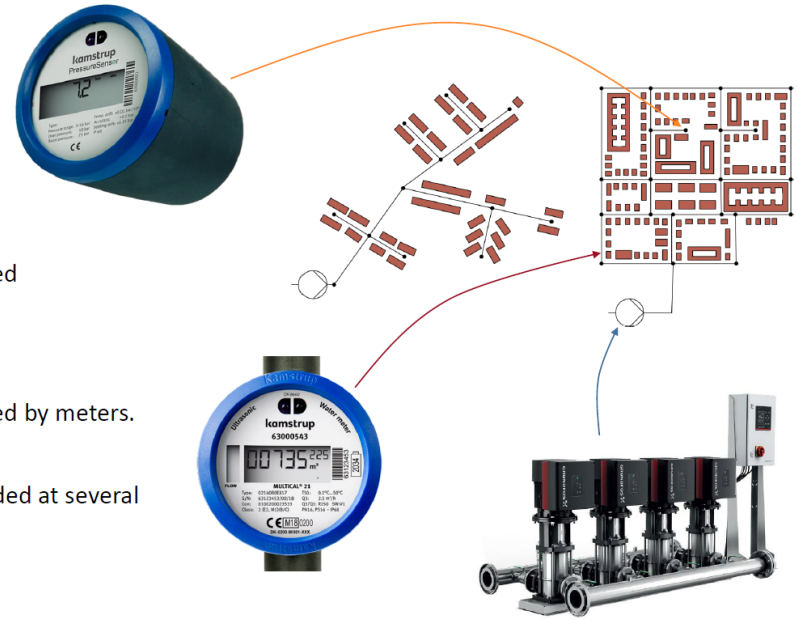


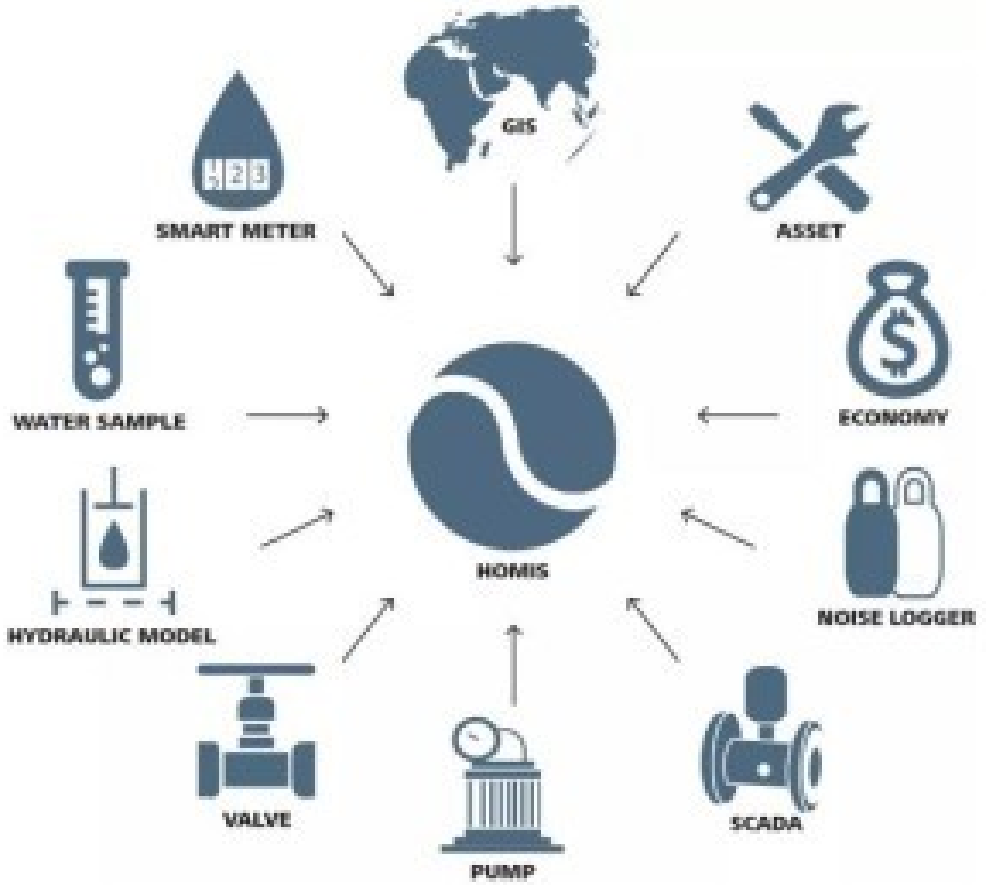
Source: Bluefield Research

Pressure Zone Management – Highly improved operations and maintenance

Motivation

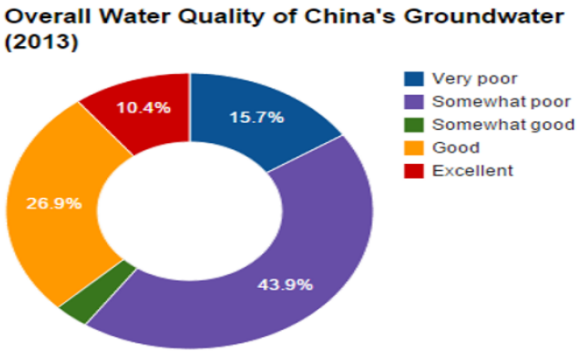
- Network assumptions:
  - One supply node.
  - Now elevated reservoirs.
- The flow into the DMA is measured by flow sensor at the pumping station or in a measurement pit.
- Flow at the consumers is measured by meters.
- Network pressure sensors are added at several points for leakage localization.

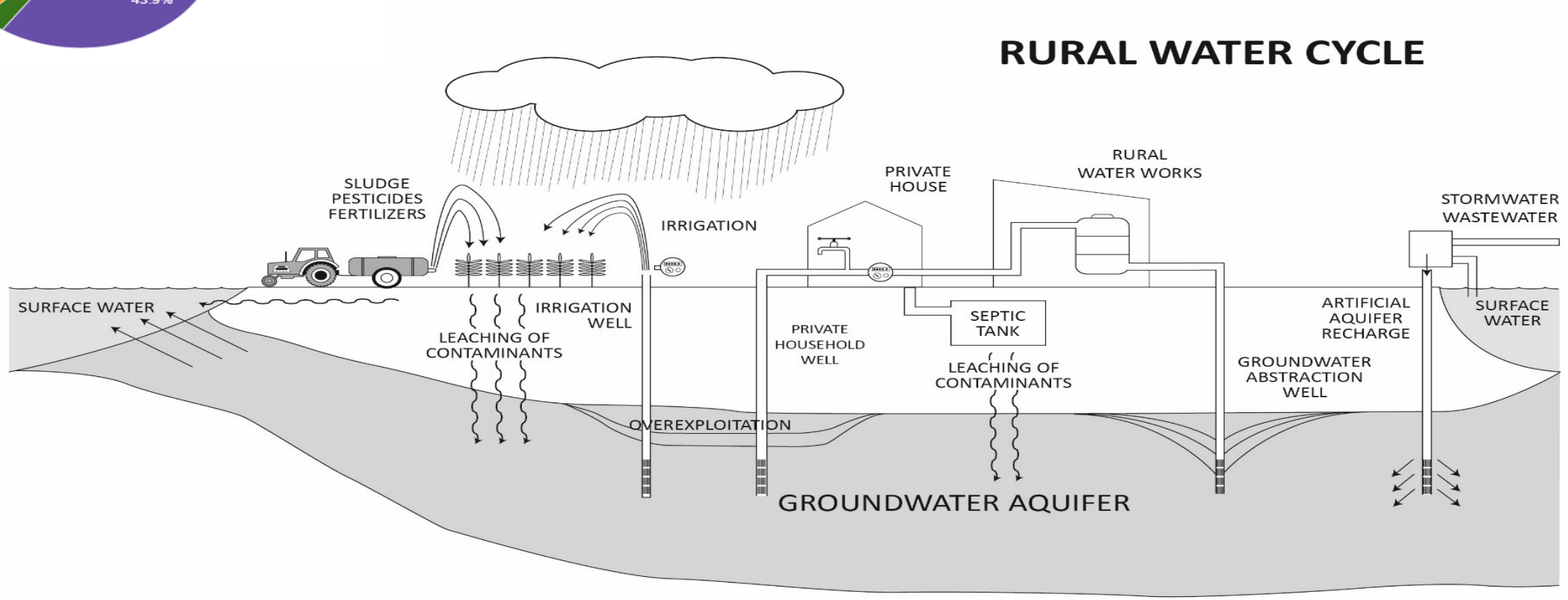




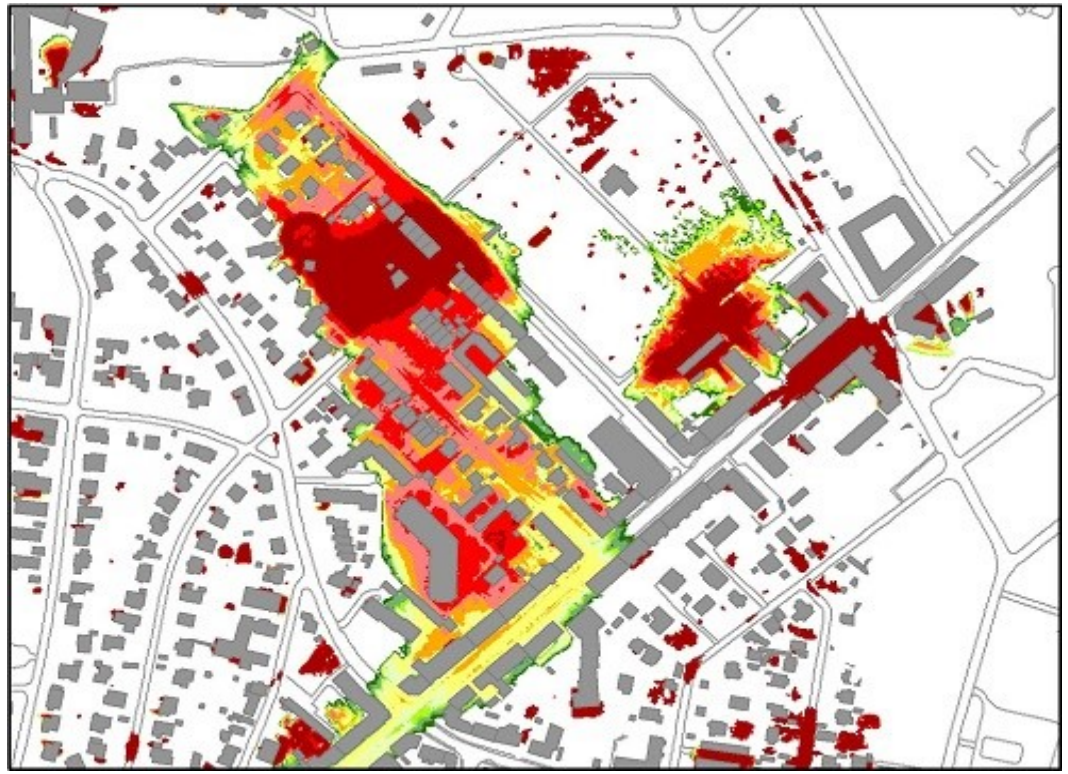
Planning of new measures e.g.
- River restoration, buffer zones, establishment of wetlands
- Climate Change Adaptation, water retention
- Water Resources Allocation

Context


Overall Water Quality of China's Groundwater (2013)
Very poor
Somewhat poor
Somewhat good
Good
Excellent
15.7%
43.9%
26.9%
10.4%


RURAL WATER CYCLE
SLUDGE
PESTICIDES
FERTILIZERS
IRRIGATION
PRIVATE
HOUSE
RURAL
WATER WORKS
STORMWATER
WASTEWATER
SURFACE WATER
IRRIGATION
WELL
LEACHING OF
CONTAMINANTS
PRIVATE
HOUSEHOLD
WELL
SEPTIC
TANK
LEACHING OF
CONTAMINANTS
ARTIFICIAL
AQUIFER
RECHARGE
SURFACE
WATER
GROUNDWATER
ABSTRACTION
WELL
OVEREXPLOITATION
GROUNDWATER AQUIFER

Klimatilpasning i byerne – mange interesser, mange interessenter



Smart Systems

* Smart Industries

* Smart Utilities

* Smart Farming

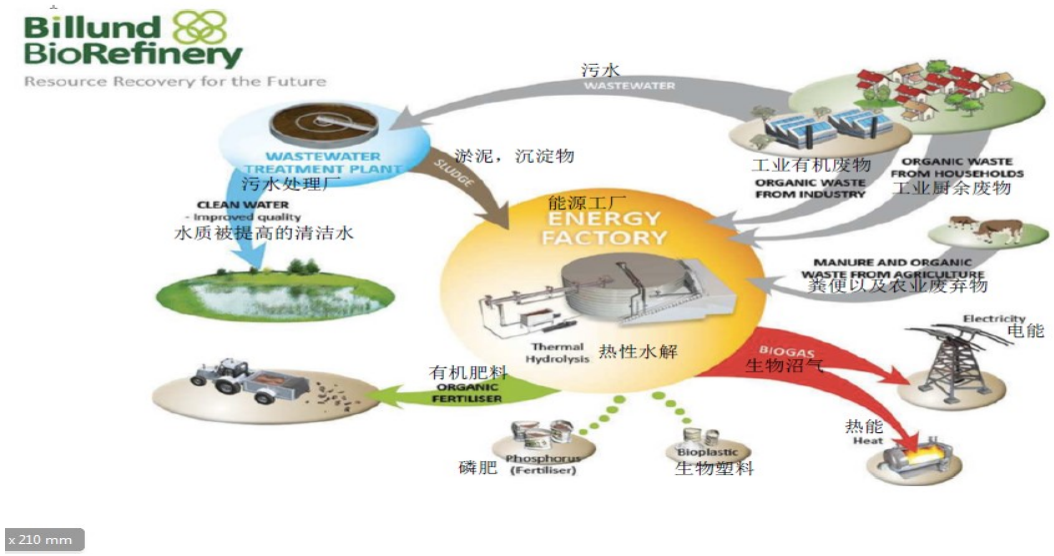
* Smart Water Management eg Groundwater Cycle

* Smart Monitoring Systems

* Smart River Basin Management

* Smart Cities

- Data will be key! - Imagineering!



x 210 mm

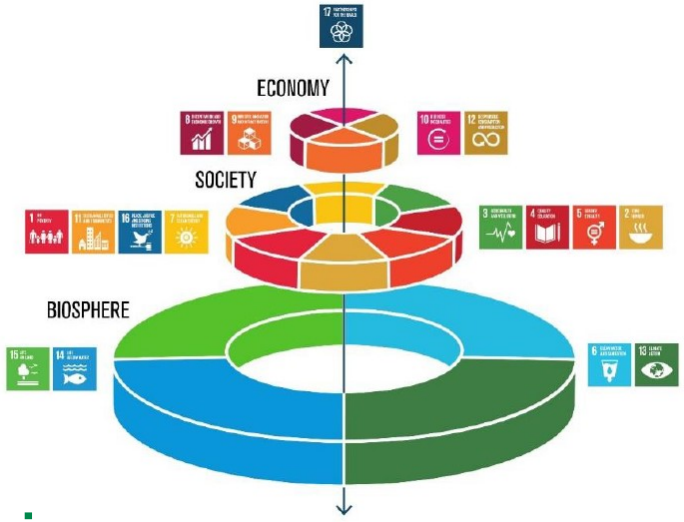
Water – the Global Perspective

* 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



* 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

Projektet – Branchedialog – Digitalisering i Vandsektoren

Formål:
- At skabe større sammenhængskraft i vandsektoren ift digitalisering; fælles forståelse, fælles forventninger, fælles retning – og få små og mellemstore med

Aktiviteter:
- Siden forår 2018 er der afholdt cirka 10 dialogmøder, workshops og seminarer
- Cirka 100 aktører har deltaget; virksomheder, forsyninger, kommuner, forskning
- Cirka 100 ideer identificeret, komprimeret sammen i inspirationskatalog med 30 forslag

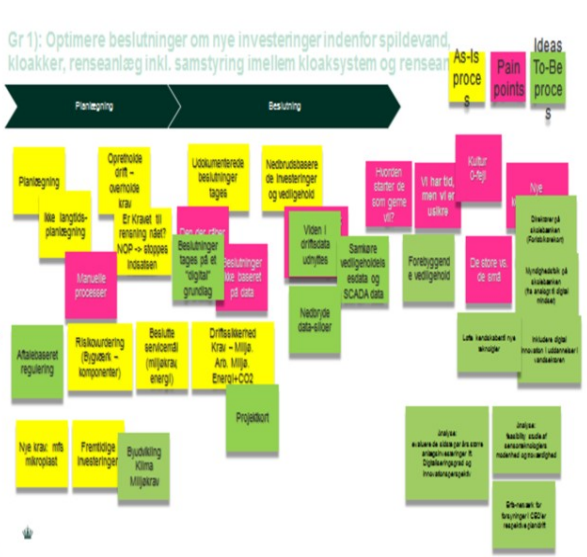
Afsluttende konferencen, 12. December 2019, AROS, Århus:
- Samle op på projektets resultater, drøfte perspektiver, komplettere kataloget
- Drøfte barrier for optimal værdiskabelse: det digitale økosystem

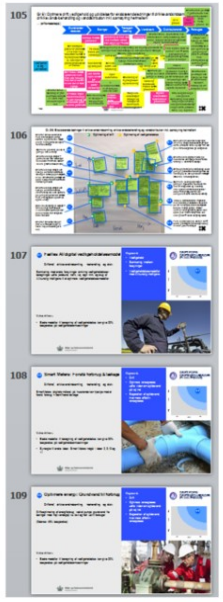
Perspektiver for MST:
- Hvilken rolle og tilgang ift opfølgning?

Perspektiver for VFS:
- Hvilken rolle og tilgang ift opfølgning? Involvering af fagteams ift primære use cases?

Projekt – Digitalisering i vandsektoren

* Få er rigtigt i gang
* Cost-benefit, hvordan?
* Muligheder for bedre planlægning, design, styring
* 20-40% driftsbesparelser
* Test, demo data-fangst
* Cloud-systemer, scope
* Simulere og udvikle storskala-løsninger (GVT)





3.1 Mere målrettet brug af LER i alle sektorer

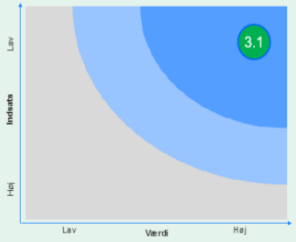
Ledelse, Smarter Cities

Mere målrettet brug af LER i alle sektorer. Der er stort potentiale i at bruge LER (Lednings Ejer Register), hvor al anlægsarbejde registreres, som man sammen bedst muligt planlægger fremtidigt arbejde

Value drivers
- Bedre modeller til beregning af vedligeholdelse kan give 20% besparelse på vedligeholdsomkostninger

Keywords
- Vedligehold
- Samkøring imellem forsyninger
- Vedligeholdelsesmodeller med AI/kunstig intelligens

LEDELSE/ DIREKTØR/ PLANLÆGNINGSCHEF



Text or image

4.1 Hvad er der i spildevandet?

Driftchef, spildevand og renseanlæg, gruppe 4

Sensordata placeret strategiske steder i kloaknettet måler og fortæller hvilket spildevand, der er på vej ind til renseanlægget, så den rette bakteriebeholdning mm. kan forberedes til renseprocessen (eksempel fra Assens og ølproduktion).

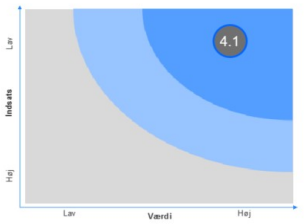
Med denne viden kan man også optimere på processen omkring separation af spildevand der er på vej ind fra forskellige kilder og f.eks undgå at bestemte typer spildevand blandes og der fremkommer en kombineret mængde spildevand som er mere kompleks at rense i forhold til at adskille de forskellige typer spildevand der er på vej ind til renseanlægget.

Value drivers

– Renseprocessen optimeres ved at man dels ved hvilken type spildevand der er på vej ind til renseanlægget og dels ved at man kan separere forskellige typer spildevand som nemmere kan renses individuelt
– Hurtigere renseproces fordi forskellige typer spildevand adskilles
– Reduktion af kemikalier i renseproces

Keywords
- Drift
- Optimere renseproces udfra viden om spildevand på vej ind
- Separation af spildevand, hvor mere effektiv renseproces

DRIFTLEDER/ DRIFTSMEDARBEJDER (PLANLÆGNING)



3.6 Asset management værktøj på tværs af hele systemet

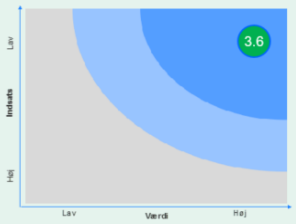
Ledelse, Smarter Cities

Asset management værktøj på tværs af hele systemet – samme datastruktur og fælles datamodeller

Value drivers
- Bedre modeller til beregning af vedligeholdelse kan give 20% besparelse på vedligeholdsomkostninger

Keywords
- Vedligehold
- Samkøring imellem forsyninger
- Vedligeholdelsesmodeller med AI/kunstig intelligens

LEDELSE/ DIREKTØR/ PLANLÆGNINGSCHEF



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Availability of sensors – DRAFT

	WWTP	Sewer System	Surface Water	Drinking Water
Level				
Flow				
Precipitation				
Temperature				
Pressure				
pH				
Conductivity				
Salinity				
Redox				
Dissolved Oxygen				
Tuebidity				
Dissolved Solids				

Mature sensors
Analyzers
Limited experience
Not available
Not relevant/mentioned

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

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

Mature sensors
Analyzers
Limited experience
Not available
Not relevant/mentioned

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

Availability of sensors – DRAFT

	WWTP	Sewer System	Surface Water	Drinking Water
Ammonia				
Nitrate				
Chloride				
Sodium				
Calcium				
Phosphate				
Total-N				
Total-P				
Suspended solids				
Sludge blanket				
H_2S				
N_2O				
Methane				
CO_2				
BOD, COD, TOC				
Chlorophyll a				
E. coli				
Phenols				
Cyanide				
Hydrocarbons				
Heavy metals				
PAH				
Micro plastics				

Mature sensors
Analyzers
Limited experience
Not available
Not relevant/mentioned

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

	WWTP	Sewer System	Surface Water	Drinking Water
Ammonia				
Nitrate				
Chloride				
Sodium				
Calcium				
Phosphate				
Suspended solids				
Sludge blanket				
H_2S				
N_2O				
Methane				
CO_2				
BOD, COD, TOC				
Chlorophyll a				
E. coli				
Phenols				
Cyanide				
Hydrocarbons				
Heavy metals				
PAH				
Micro plastics				

Mature sensors
Analyzers
Limited experience
Not available
Not relevant/mentioned

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

Gode intentioner bliver til bunker af ubrugelige data

Smart city: Kommuner snubler i datakaos

Teknologien fungerer, men mange kommuner bøvler fortsat med at skalere de intelligente datadrevne løsninger, der skal gøre danske byer til 'smart cities'.

Af Laurids Hovgaard Følg @LauridsHov 14. apr 2018 kl. 14:00

FØLG

Intelligent trafikstyring, rottebekæmpelse, tilstandsbaseret vedligehold af veje, lyskryds og infrastruktur. Alt sammen såkaldte smart city-løsninger, der skal gøre driften af byer mere effektiv, miljøvenlig og enkel ved hjælp af sensorer, der indsamler data om alt fra skraldespande til bilister.

De seneste knap ti år har storbyer som Aarhus og København arbejdet med at gøre byerne 'smarte'. Men rigtig mange pilotprojekter kommer aldrig videre end pilotfasen og bliver aldrig skaleret op til almindelig drift.

En større kortlægning af kommunale smart city-projekter viste for to år siden, at de danske projekter alt for ofte dør, før de bliver opskaleret. Danske smart cities lider af pilotsyge, lød konklusionen.

Den udfordring præger stadig billedet i dag – men det er ikke længere teknologien, der volder problemer, men måden kommuner håndterer og analyserer bydata på:

»Byer er formodentlig det mest komplekse område inden for Internet of Things, fordi der er tale om åbne miljøer, hvor en uendelig række faktorer spiller ind. Det er meget nemmere at udvikle Industri 4.0-løsninger til lukkede produktionsmiljøer, hvor

Annonce

Kan noget så blødsødent som ansvarlighed bane vejen til et globalt marked

Jobfinder

RELATEREDE JOB

Vil du bringe den di

Ingeni motork

Labora

Kalibre

SCAD Lead

User E Desig

SE FLERE INGENIØR

Mest læste

Spørg

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

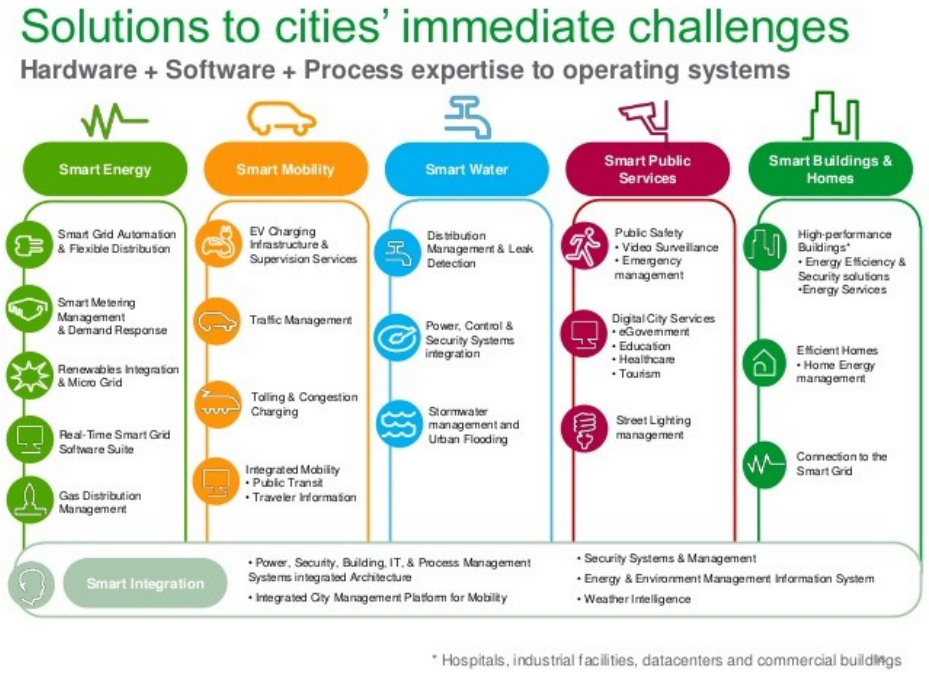
Smart cities report forecasts trillions in e...
smartcitiesworld.net

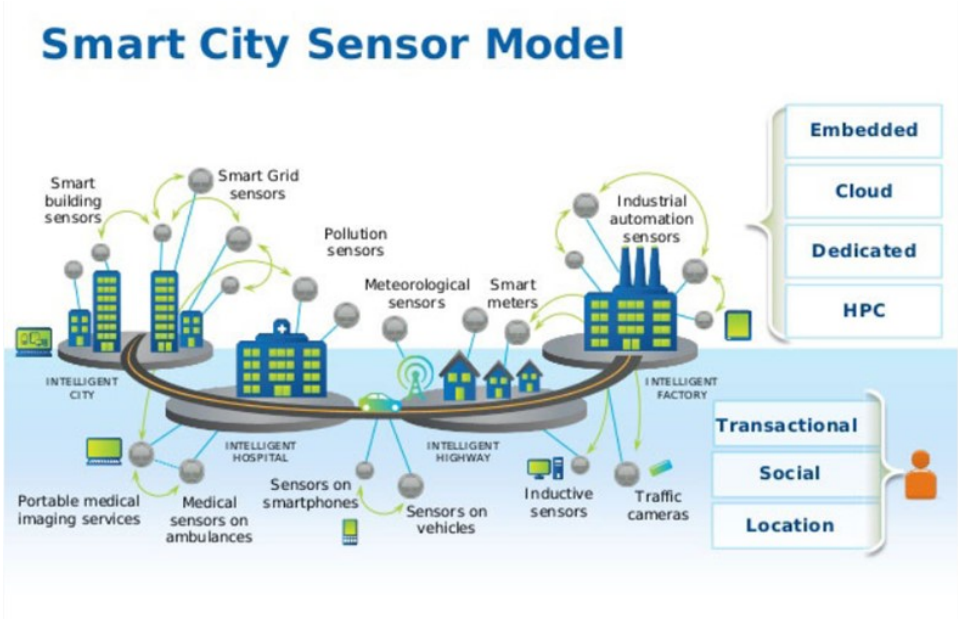
What is a smart city?
gemalto.com

How to Outsmart the Smart City
securityintelligence.com

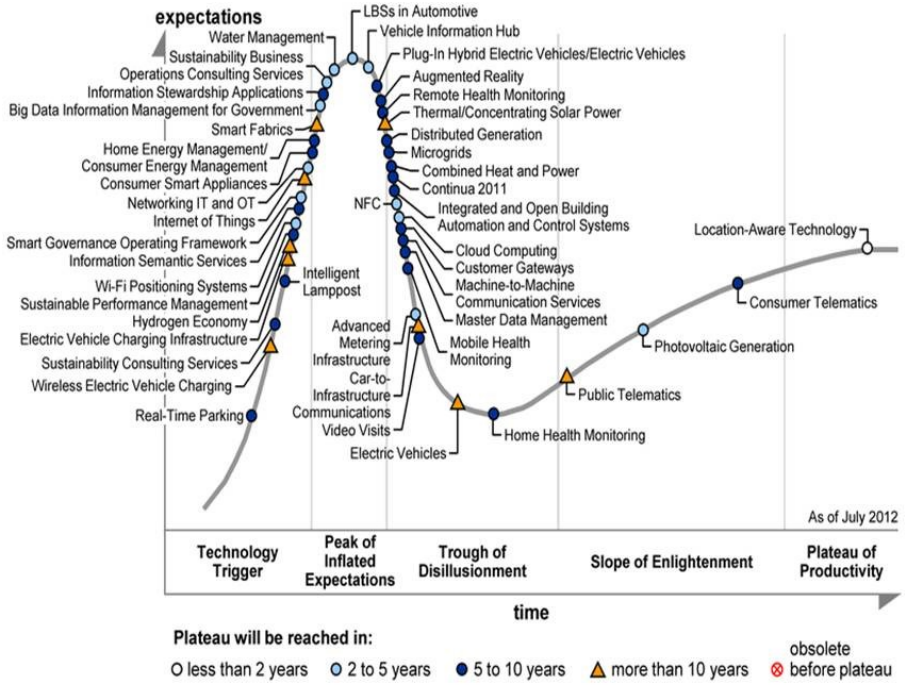
Home | Marketplace of the European Innovation P...
eu-smartcities.eu

Smart Water – Element of Smart City



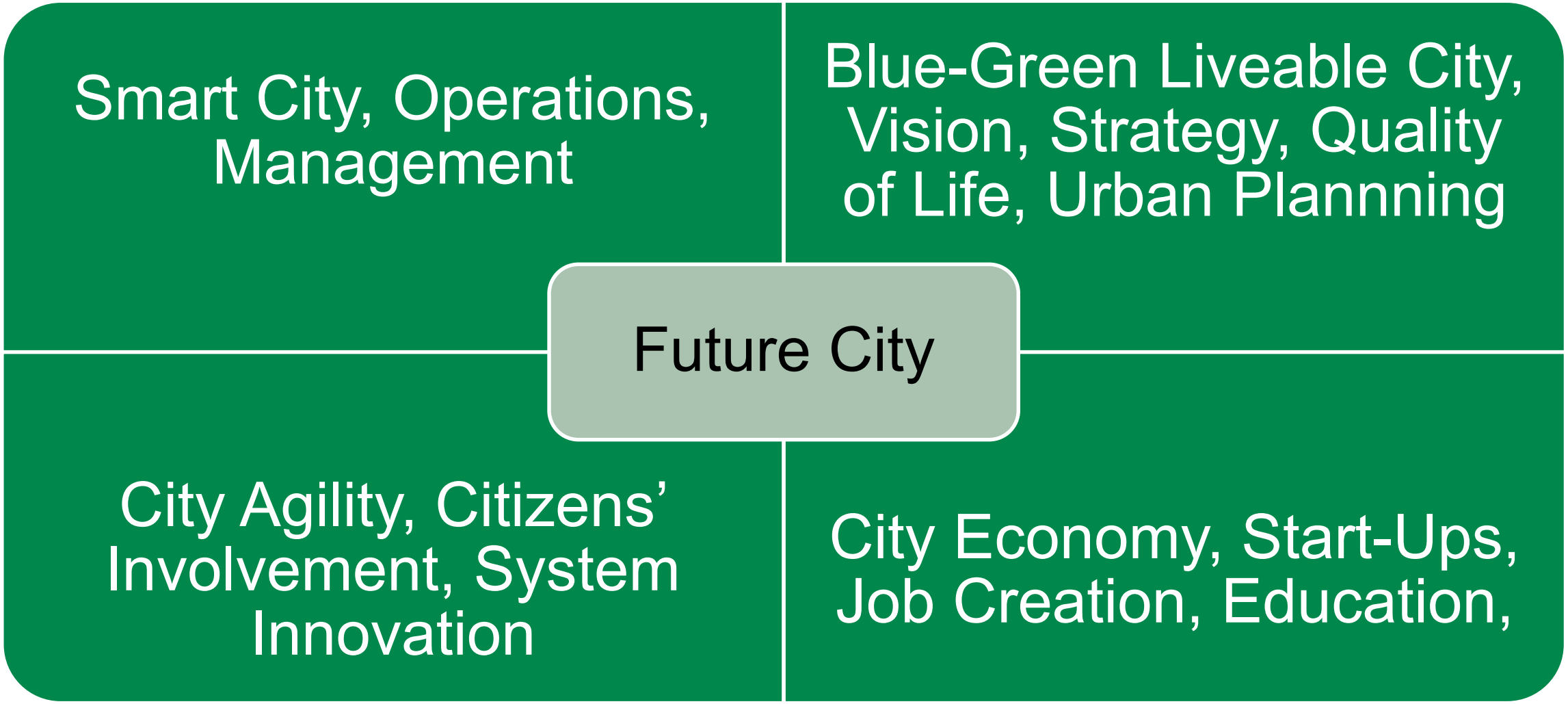


Smart City Technologies – Hype Cycles Urenio 2012 and Gartner 2018

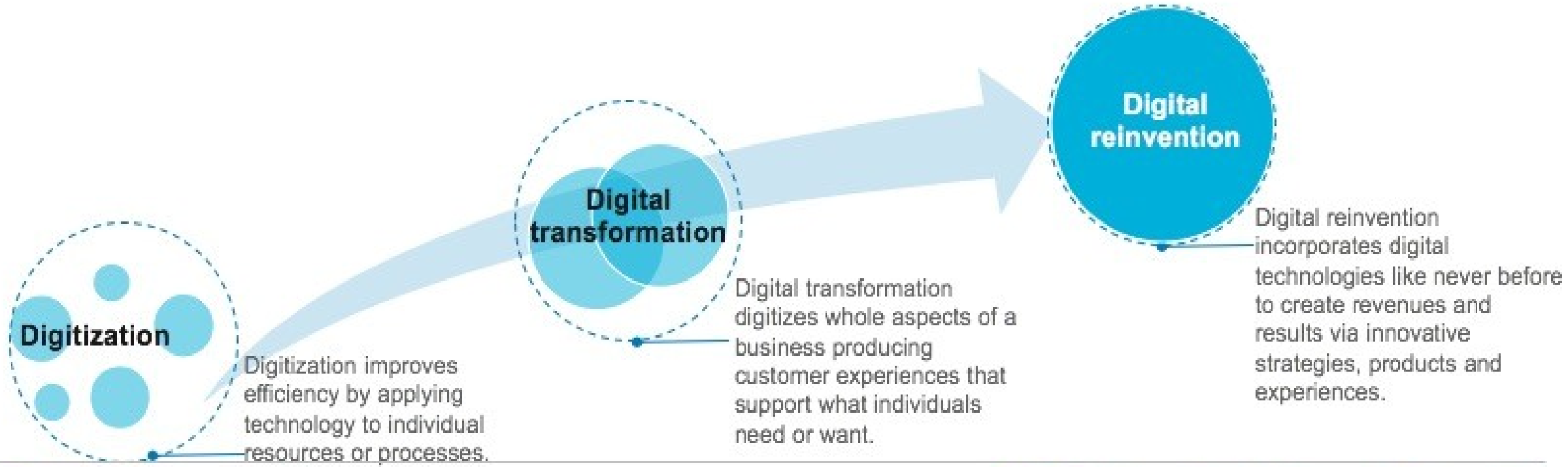


Source: Gartner (August 2018)

Smart Cities – et element i Future Cities



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

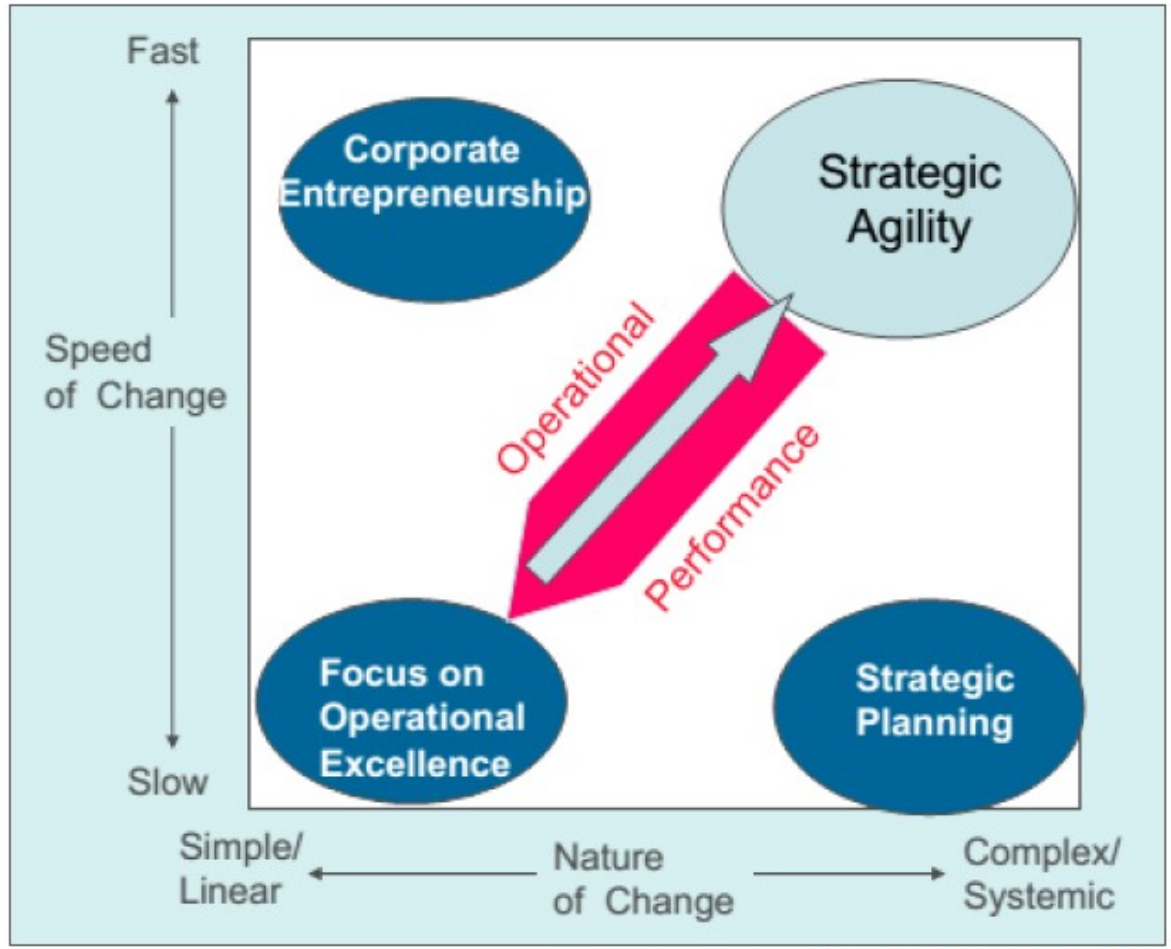


Digitization *in banks involves translating analog processes into digital processes such as online banking or electronic funds transfer*

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*

Strategic agility



Yves Doz and Mikko Kosonen, Fast Strategy, 2007

- Thank you for your attention
- 感谢您的关注

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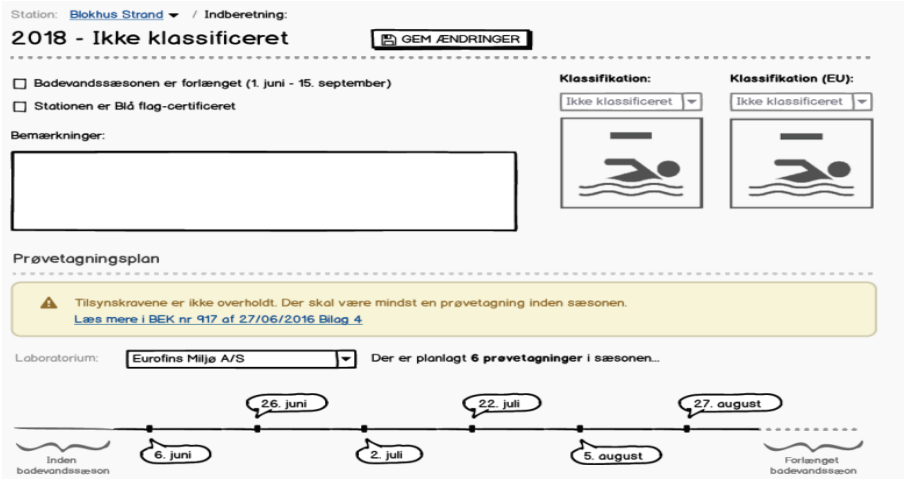
Implementing PULS 2.0 – database for public water data

- Close Co-operation with the Danish Portal for Environmental Data
- Co-operation with a range of organisations incl for the Utilities and Municipalities
- Involving software-companies and Orbicon ao.



Action Plan

- Distribution database February 2019
- Bathing Water April 2019
- WWTPs June 2019
- Aquaculture July 2019
- RBU (Rainwater) September 2019

Development Projects with involvement / lead by Danish EPA

- The National Digitalization Strategy (FODS 6.1), a common platform for all data related to Terrain, Water and Climate
- Danish Meteorological Institute Climate Change Atlas
- GEUS Denmark-Model for Groundwater Management will be developed to include Climate Change Adaptation
- Feasibility Studie Assessing Sensor Technologies, the degree of Matureness and Readiness for widespread Implementation
- Storing of Water and Re-infiltration of GroundWater
- Reforming the ”Jupiter” Database for Groundwater

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.

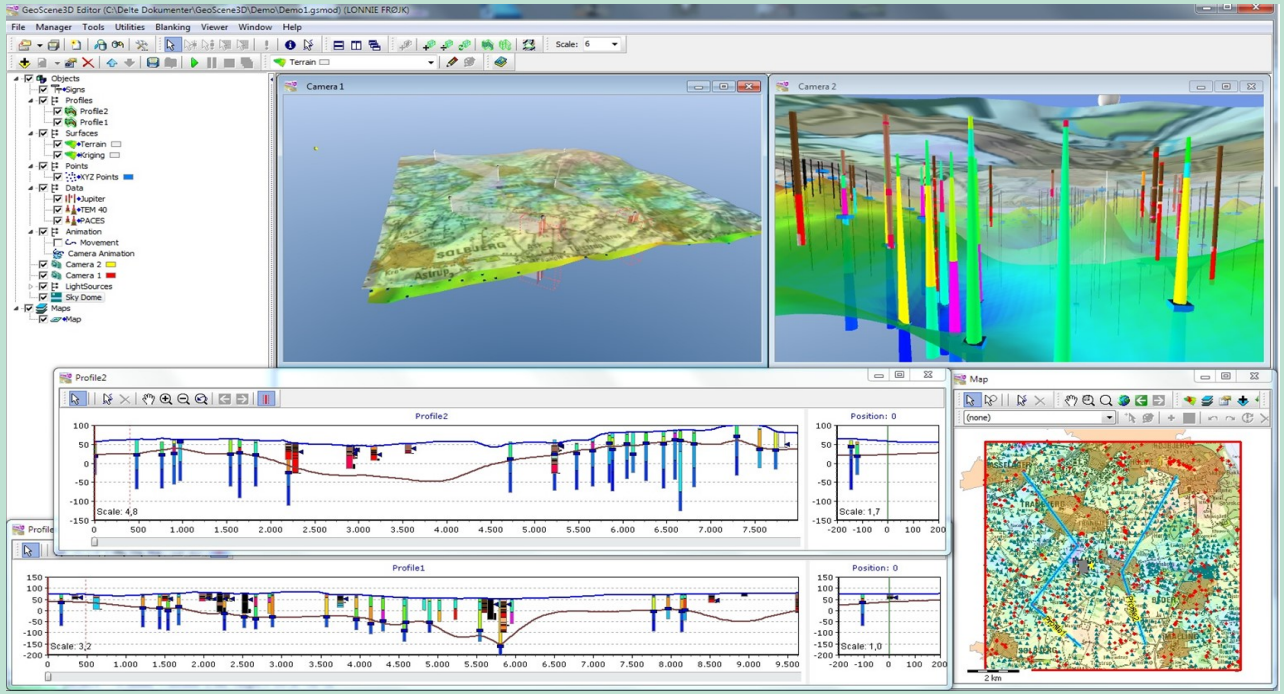
Partners: DTU Environment, DTU Space, Copenhagen Region, South Denmark Region, Vejle Municipality, DHI, Orbicon, Drone Systems, Photrack AG

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

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.

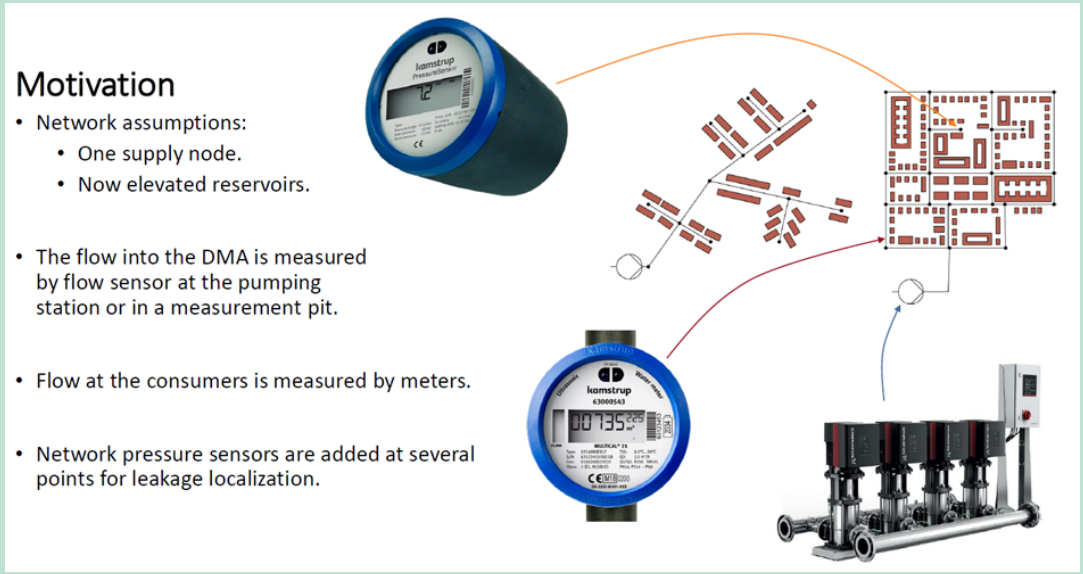
Partners: DHI, Alexandra, Envidan, Kamstrup, Aarhus Water Utility, Skanderborg Water Utility.

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.

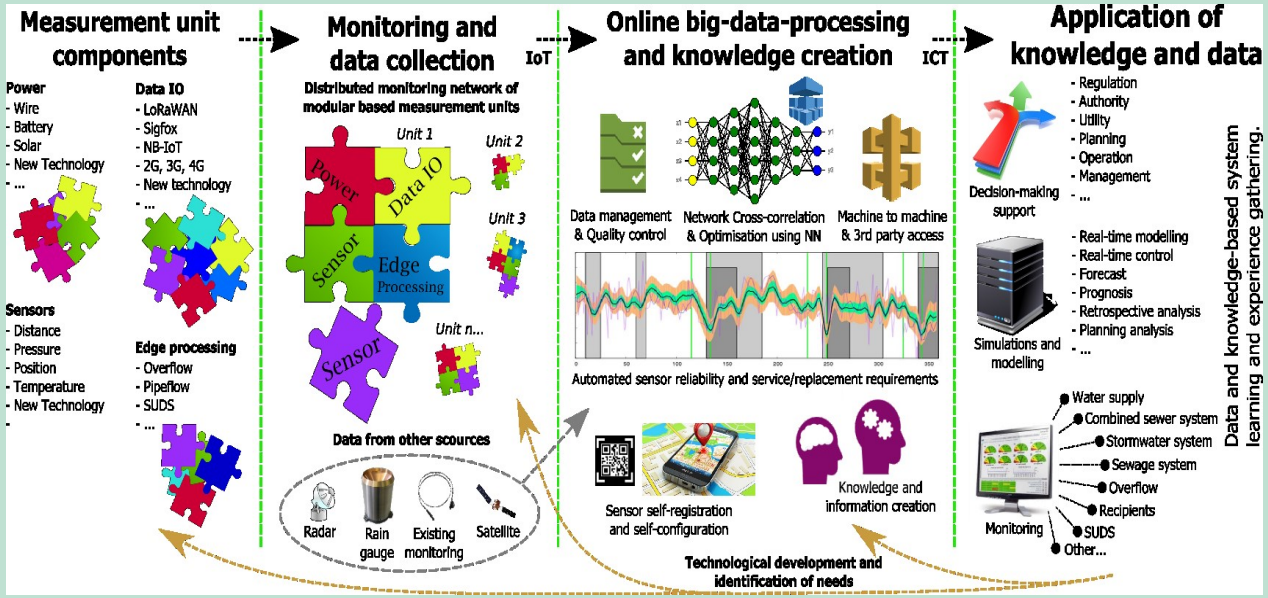
Partners: DTU, DHI, Krüger A/S, Rambøll Danmark A/S, DMI, 3 Vand, Innovation og Udvikling, HOFOR, , AArhus Vand, Vandcenter Syd, BIOFOS, Forsikring & Pension

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

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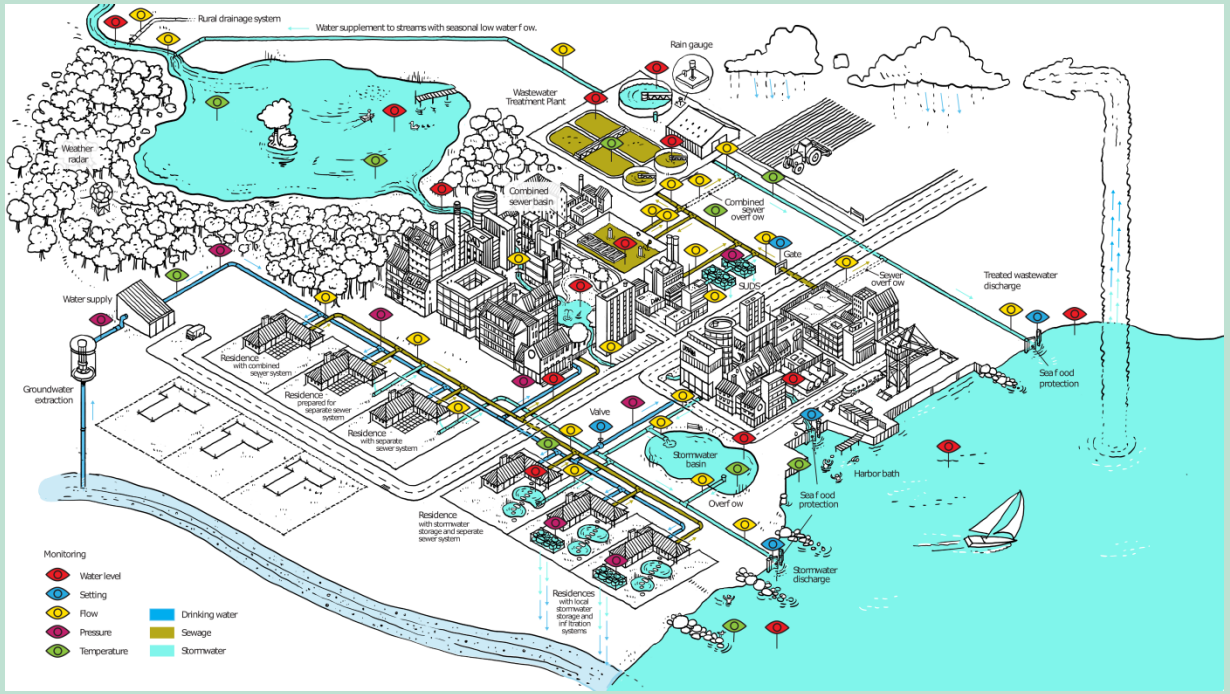
DONUT

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

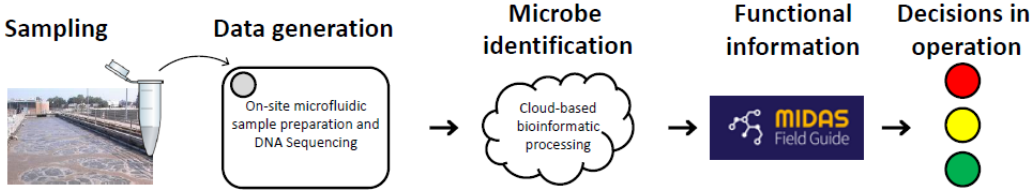
Partners: Aarhus Water Utility, Water Center South, Aalborg University, Montem A/S, Informetics Aps, Aarhus Municipality

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