Technological and non-technological dimensions of Digital water

Fiware4Water has received funding from the European Union's Horizon 2020 research and innovation programme under Grant agreement No. 821036.

3 years
2019-2022

4 Demo cases

- Water Supply and Sewerage (Athens , GR)
- Water Distribution System (Cannes, FR)
- Amsterdam Wastewater Treatment (NL)
- Smart metering (Great Torrington, UK)

3 Demo networks

- Municipalities
- River basin organisations
- SMEs and innovators

Consortium

- 14 partners (experts in ITC, water and social sciences)
- coordinated by OiEau

Fiware4Water story has started in 2018, when partners from digital and water fields decided to build a project to further explore innovative digital solutions applied to water management and provide evidence based tools and methods.

Reaching the final lane, Fiware4Water partners would like to present digital water as explored through the progress of the 4 Demo cases and 3 Demo networks. This updated version following the one named *Digital Water for non experts* provides specific scientific and technological focusses.
The project's overview, a scientific presentation and focus on digital water, the European perspective for digital water and Fiware4Water contribution to EU water related policies are still available.
In addition, partners propose details on the technological solutions developed at the scale of the Demo cases.

Social innovation to combine technological solutions with the governance, capacity building and economic dimensions remains one key driver of Fiware4Water, which is highlighting by

Enjoy your journey and feel free to contact Fiware4Water partners !

Natacha Amorsi
Communication and dissemination leader

Content

Addressed to non-experts

- Fiware4Water Overview
- Tour of Fiware4Water Demo cases and technological solutions
- Fiware4Water scientific dimension
- Up-take from Fiware4Water Demo networks
- Learn about Digital Water
- Socio-political and citizens engagement
- European perspective on digital water

Scientific and technological focus

- Water supply system real time operational management
- Intelligent control for wastewater treatment
- Smart meters and customers
- Drinking water supply system improvement

Materials and references

Fiware4Water overview

Sonia Siauve
OiEau
Fiware4Water
coordinator

General objective of the project

In Fiware4Water, you can hear “FIWARE”. FIWARE is a smart solution platform developed in 2011, thanks to an European funding. It is currently the main ecosystem used by smart cities to exchange and use data, mainly for transport and building. In Fiware4Water project, our main objective is to demonstrate the feasibility to also use it for the water sector.

What are the challenges addressed by Fiware4Water?

As highlighted by the ICT4Water cluster in its action plan, **a first challenge** is that the water sector remains fragmented. Moreover IT solutions exist but are often licensed and not standardized which is restraining the digitalisation of the water sector and doesn’t ease cross-domain management.

A second challenge that our society is currently facing is the acceleration of climate change. Water is hence even more a resource to manage smartly in order to avoid any waste. Supporting water stakeholders in managing water resources smartly is exactly what we intend to do in F4W project.

What are the expectations in terms of impacts on the water sector?

In terms of impacts, I would like to point out the F4W platform itself which is a free of charge, open source and interoperable IT platform that could be plugged everywhere in the world and that could integrate seamlessly any legacy system. This platform allows to collect, process and analyse data to develop smart water models and applications answering a water manager need. As for example estimating the present and future availability of raw water to produce drinking water thanks to both historical and real-time data about weather and water river levels.

FIWARE 4 WATER

Back to content

Fiware4Water scientific dimension

Lydia Vamvakeridou-Lyroudia
KWR, University of Exeter
Scientific and Technical Manager

What are the scientific challenges addressed by Fiware4Water?

The water sector, the water utilities are a conservative industry. Consequently, it is hard for them to follow the quick evolution and the changes brought in the digital water sector. One of these changes for the digital sector is the use of Internet of Things (IoT). Internet of Things is a fancy word for including real time operational management of systems. One such type of system is a water system, a system managed by water utility. This system may involve water supply or water distribution, or wastewater, or even the communication with the consumers, which is being done through Smart Water. Our vision as Fiware4Water was to bring this advanced technology, the IoT technology to the water sector and help for the transition. The European Commission has started this with a big project where they created a platform for different sensors and different devices to talk to each other, which is called the FIWARE platform. So in Fiware4Water, we are bringing the FIWARE platform to the water sector.

What are the excepted impacts on the water sector?

The main scope of Fiware4Water is to demonstrate to water utilities a way of transition to real time operational management using advanced IoT, Internet of Things platforms. And this is what we expect that the impacts will be, they will see the cases we have in Fiware4Water as paradigms of this transition.

Back to content

Scientific dimension of the project

Lydia Vamvakeridou-Lyroudia
KWR, University of Exeter
Scientific and Technical Manager

How can Fiware4Water contribute to these expected impacts?

The best option for us is to cover as many types of use cases of usefulness of the FIWARE platform as we can covering hopefully the whole water cycle: water supply, water distribution, wastewater treatment, and also the communication with the customers with Smart Water applications. This is what we're trying to do by looking into the way our demo cases have operated with new technology, managed to communicate, and collaborate with the legacy systems (systems that the utility already has in place). This rush is the best contribution to demonstrate a possibility and a way of transition to digital water for the water utilities.

What are the project's key scientific innovations?

The main innovation of this project is technical. It is related to the information technology, and the population of the FIWARE platform with data models for the water sector. Fiware4Water is a new foundation for using real time operational management within the internet of things era.

For the utilities, we are very happy that we managed to develop a lot of data models with the help of the FIWARE platform, thanks to the innovative work of all our partners and the cooperation of the water utilities, all parts of Fiware4Water consortium.

The key scientific innovation has been recognized by the European Commission. In the latest publication in May, for the working staff documents, Fiware4Water is the only model project for digital water included for their own staff. And this, for me is a very, very happy end. It helps the reputation, and also the impact of the Fiware4Water project.

Back to content

Learn about digital water

Lluís Echeverria
EURECAT
Work Package 3 leader

The concept of digital water

Digital water is a novel concept completely aligned with the current Industrial Revolution. It covers the digital transformation of the whole water sector, from wastewater management to water distribution systems, or other aspects at the water customer level, for example. The key of this concept is the access to digital data, which contains critical information about the water infrastructure and its underlying complex processes, and will be used to provide a competitive advantage to the water sector for improving management and smart decision making. It is based on five pillars. First, the Cyber-physical systems, commonly known as sensors, used to transform the physical world into the digital world. Then, the Internet of Things (IoT), a network of sensors (cyber-physical systems) deployed throughout the water infrastructure. Third, Internet Services, which refers to the online access to the information and its process via, for example, Cloud Computing technologies. The fourth pillar is Big and Small Data Analytics which, based on novel methodologies and algorithms from Data Science and Artificial Intelligence domains, for example, processes the water data to generate valuable insights for improving decision making. And, finally, the Cyber security pillar. Nowadays, it must be present in any Digital Water Solution, since the water infrastructure is digitally operated, and online attacks may result in catastrophic situations involving climate risks or humans losses.

What are the expected impacts on the water sector?

The Digital Water concept is already impacting the Water sector. Nowadays, we can see how the whole water infrastructure is under a critical and necessary digitalization process, which is establishing the basis for the actual Digital Water revolution. In this line we will see, for example, a bunch of smart Decision

Back to content

Lluís Echeverria
EURECAT
Work Package 3
leader

Support Systems, or even end to end automation of complex and complicated processes in the Water sector, such as those carried out in a wastewater treatment plan. It will enable the Water sector to successfully cover critical issues such as the water system performance, better water quality, efficient use of the resources, pollution reduction or associated operational cost savings, in such a way that global sustainability aspects are satisfied in compliance with regulations and future economical, social and environmental needs.

How can Fiware4Water contribute to these expected impacts?

In the FIWARE4Water project, we are focused on each of the five digitalization pillars I have explained before. First, we are working on new advanced sensors for improved water data gathering. Second, we are promoting the use, in the Water sector, of an open and advanced digital solution, the FIWARE ecosystem, which is widely used in other domains. We are actually extending its capabilities and functionalities via the development of new components including Big Data and Artificial Intelligence tools, or new data models for standardized and interoperable communication between services, IoT sensors or external legacy systems, among other actors in the water infrastructure. We are also working on new Smart Applications which, based on novel Machine Learning and other advanced technics, will process the Water data to provide an improved water lifecycle management. And, finally, the cybersecurity aspects, which are always present in our developments.
All these aspects, altogether, will contribute towards the Digital Water concept materialization and its continued evolution.

Back to content

European perspective on digital water

Overview

The EU plays a leading role in enhancing smart water management [a]. The quality and quantity of water provisions from the Water Framework Directive, including Drinking Water, Floods, Water Reuse, Urban Wastewater Treatment and Groundwater, have been decisive to start the ball rolling with regards to integrated water management at both a national and local level. Further provisions concerned with Data Protection, Access to Environmental Information and Open Data have played the same role on the digital side. More importantly, initiatives such as the EIP Partnership on Smart Cities and the Digital Single Market for Water Services Action Plan have shown the increasing ambition and interest of the EU in digital water governance.

As described by the Policy Action Group of ICT4Water [b], digital solutions provide support to water managers when controlling the general cost of operation but requires investments so planning, simulation and digital decision support can be deployed. The role of digitalisation in achieving a more effective relationship with water end-users is also highly relevant i.e. for citizen engagement, seeking to channel the citizen's enhanced awareness into a proactive involvement both in the co-creation and subsequent implementation of water-based policies.

Digital water solutions support integrated water resource management by providing science-based information and knowledge, employed by water managers both for management and forecast tasks and the raising of citizen awareness and engagement. They provide new mechanisms for water governance, widening the possibilities for stakeholders to understand water and societal challenges, and to interact, co-design and co-implement the solutions.

References
[a]https://zenodo.org/record/4320526#.YfEqx_jjKUl
[b]https://data.europa.eu/doi/10.2826/4352

Back to content

FIWARE 4 WATER

European perspective on digital water

Fiware4Water contribution to EU water related policies

F4W has experienced these different levels. The development of digital water solutions brought together different profiles of stakeholders both at the level of the Demo Cases and Demo Networks. The policy and social engagement approach is providing a layer which enlightens the overall process, all delivering specific water and environmental services that can be linked to EU policies.
The following figure is attempt to show how F4W digital water solutions can contribute to the water related as well as the EU strategy on Adaptation to Climate Change and the EU Green deal.

Water Framework Directive

Drinking water directive

- Real-time monitoring water quality
- Detection of leakages in distribution network
- Improvement of raw water conveyance
- Development of an innovative low cost multi-parameter sensor

Urban Wastewater Treatment Directive

- AI-based models to optimise WWTP operations: decrease of energy and chemicals use

EU Strategy on Adaptation to Climate Change

- Citizen education to water savings
- Forecast of water demand

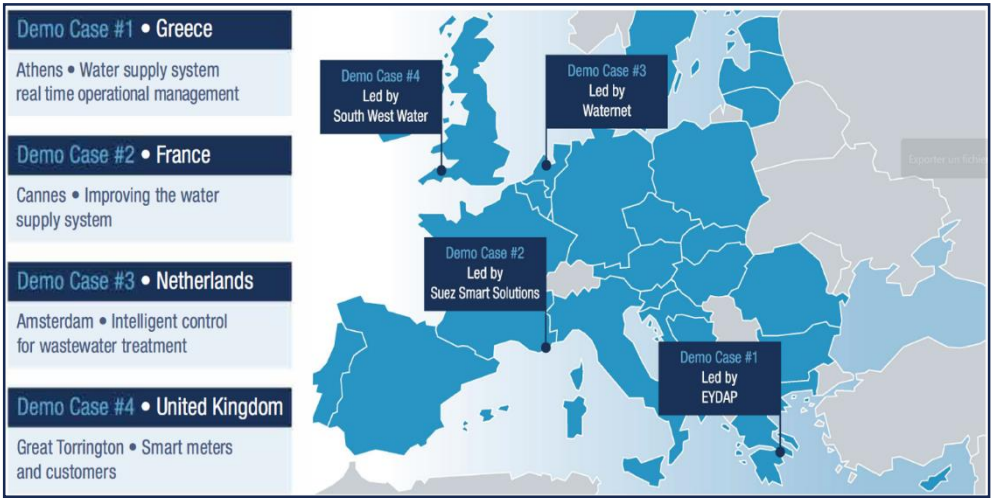
EU Green deal

- AI models based on real-time data: water demand and availability, abnormal quality forecast, dashboards development

Back to content

FIWARE 4 WATER

Tour of Fiware4Water Demo cases



Back to content

Demo case #1
Water supply system real time operational management
Athens • Greece

Vasiliki Polychniatou
EYDAP
Demo case 1 leader

Key challenges

EYDAP uses raw water mainly from 4 surface water resources that is being transferred to the Water Treatment Plants via an extensive external aqueduct system with a total length of 485 km. Currently the on-line monitoring of the external aqueduct is performed via installed sensors, controlled by SCADA.
In Fiware4Water, EYDAP is responsible for the demonstration of FIWARE integration with existing operational sensors and other (novel) surveillance methods into a common operational picture (in real time) in a suitable part of the external water supply system. The challenges that we had to face were:

- The integration of different sensors from different vendors into a unique operational system.
- The development of different applications (models, analytics) that will interface seamlessly with and provide added value to the legacy systems (sensors and online control systems).

Support from Fiware4Water and digital water

F4W provides FIWARE-enabled smart applications that will improve the real-time operation and management of the raw-water conveyance system of EYDAP.
Specifically, two web applications are being developed focusing on the flow and quality aspects of raw water. These applications will comprise analytics for the processing, analysis and visualization of flow and quality data from the sensors in the conveyance system. Additionally, modules for the early detection

Back to the list of Demo cases
Back to content

Demo case #1
Water supply system real time operational management
Athens • Greece

Vasiliki Polychniatou
EYDAP
Demo case 1 leader

of unusual events (e.g., high-turbidity events), warning alerts, as well as scientific models to provide estimations and forecasts on important aspects of the system (e.g., water demand, turbidity) are being developed.
Now, regarding the real-time management of flow conditions in the conveyance system, special focus has been given in the development of a what-if hydraulic simulation tool to provide advice on the optimal settings of sluice gates of the system, depending on the needs for water supply.

Key innovation developed by the Demo case #1

The key innovations that are being developed in our case study is the integration of different sensors into one unique operational system and the development of the operational decision support system for the improvement of the raw-water flow and quality management

Back to the list of Demo cases

Back to content

Demo case #2
Improving the water supply system
Cannes • France

Stéphane Deveughele
SUEZ Smart Solutions
Demo case 2 leader

Key challenges

SUEZ Smart Solutions is a subsidiary of the international SUEZ group, dedicated to digital solutions and a leader in the field of smart water. The French demo case is located in the Cannes region, in the south of France, on the shores of the Mediterranean Sea. This is the drinking water supply system of the public water union SICASIL, operated by SUEZ under a public service delegation contract. Four business issues are associated with the French demo case:

1. **Forecast water resources availability:** estimate, each year at the end of spring, if some water resources are likely to be under water stress during the summer, given the rainfalls observed during the past autumn and winter
2. **Forecast water demand:** to ensure the supply of drinking water demand for each water consumption area, several days in advance, to avoid any water shortage
3. **Detect water leaks:** as early and reliably as possible to improve distribution network efficiency
4. **Detect abnormal water quality events:** as early and reliably as possible to monitor water quality in the distribution network from the measurements of 4 multiparameter probes installed in the network

Back to the list of Demo cases

Back to content

FIWARE 4 WATER

Demo case #2
Improving the water supply system
Cannes • France

Stéphane Deveughele
SUEZ Smart Solutions
Demo case 2 leader

Support from Fiware4Water and digital water

It allows SUEZ Smart Solutions to move faster and stronger on advanced subjects that would otherwise have been dealt with at a later stage. The interoperability of systems is a key technical issue for the Fiware4Water project. The FIWARE technology, based on the NGSI-LD standard, enables information to be exchanged in a simple, standardised, reliable, high-performance and cyber-secure manner between the various players in the water sector (local authorities, water utilities, companies, the general public, etc.) but also with technical objects (IT applications, sensors, actuators, etc.).

Key innovation developed by the Demo case #2

Models developed by SUEZ Smart Solutions, addressing the four business issues, were all developed using Machine Learning techniques fed by field measurements, without using any water physicochemical equations or deterministic models. At last, the French pilot site illustrates the systems interoperability, key project topic: data are exchanged between AQUADVANCED Water Networks (software product published by SUEZ) and the scientific platform in charge of running the models, through the Fiware4Water computing platform. All these data exchanges will soon be fully compliant with FIWARE technology.

Back to the list of Demo cases

Back to content

Demo case #3
Intelligent control for wastewater treatment
Amsterdam • Netherlands

Alex van der Helm
Waternet
Demo case 3 leader

Key challenges

Wastewater treatment plant Amsterdam West has a capacity of 1 Million population equivalent and serves the city of Amsterdam. In quite unique research we measure nitrous oxide emissions from the wastewater treatment plant. Nitrous oxide is a potent greenhouse gas formed during the biological nitrogen removal. With online measurements in the off-gas we have measured these emissions for more than 5 years now. We found that the emission of nitrous oxide is larger than expected and accounts for a substantial part of our climate footprint. In addition, a substantial amount of energy is consumed for the aeration of wastewater. For improving our sustainability, we want to reduce nitrous oxide emissions as well as the energy use.

Support from Fiware4Water and digital water

After discussions with leading experts in the field, we came to the conclusion that the best option for trying to reduce nitrous oxide emissions in practice is through data driven control strategies based on newly developed Artificial Intelligence models. Therefore one of the seven treatment lanes of wastewater treatment plant Amsterdam West is made available as research lane, where we introduce and test additional sensors to gain more insight in the processes and test smart apps for example for screening of data by real-time anomaly detection and correction and for AI based control. For

Back to the list of Demo cases

Back to content

Demo case #3
Intelligent control for wastewater treatment
Amsterdam • Netherlands

Alex van der Helm
Waternet
Demo case 3 leader

interoperability and for coordination of streaming data between smart apps the FIWARE platform is used within the Waternet IT architecture.

Key innovation developed by the Demo case #3

The key innovation is in the combination of technologies. A full-scale research lane where we have the combination of a unique sensor set up with AI techniques used for cleaning data, for virtual sensors, a digital twin and a control algorithm together with the use of FIWARE for which a number of wastewater treatment data models have been newly developed.

Back to the list of Demo cases

Back to content

Demo case #4
Smart meters and customers
Great Torrington • United-Kingdom

Josh Pocock
SouthWestWater
Demo Case 4 leader

Key challenges

In the UK demo case, we have installed smart meters in a town called great Torrington in North Devon. And the goal is to use these smart meters and the data that's collected from them to show customers their daily water use. And we plan to do this through a customer application. The real challenge for us as a company at the moment is that customers only really get their meters read twice a year. And this doesn't give them a good sense for what they're using on a daily basis for water. And it makes it quite difficult for Southwest water to engage these customers as well.

Support from Fiware4Water and digital water

So we think that customers are much more likely to adopt and stick to water saving practices, if they can engage with their data. And actually we are going need to start that one again. Start that one again. Sorry. No, no, that's, that's, that's good. I'll just start again from the start from now. Okay. Yeah. So we think that customers are much more likely to stick to, and no one ever again, let me try again, I'm not reading from a sheet. But I just want to make sure I get the key points across, say, starting again, now. We think the customers are much more likely to adopt and stick to water saving practices, if they can see the immediate benefits from doing so. The natural choice for showing this data to them is through a customer application, where they can see the very next day how their efforts

Back to the list of Demo cases

Back to content

Demo case #4
Smart meters and customers
Great Torrington • United-Kingdom

Josh Pocock
SouthWestWater
Demo Case 4 leader

yesterday impacted their water consumption. And from a utility point of view, we can prompt the customers to keep them going on their water saving efforts. We can give them virtual pat on the back and tell them well done. So reducing their water consumption. And of course, we can highlight how much water and how much money they're actually saving off their water bill.

Key innovation developed by Demo case #4

Water uses really vary between customers and really depends on your household size, how many children you've got at home and whether your property has a garden or not. So one of the things we're developing this project on machine learning models that provide personalized water saving targets for our customers, and the hope is that these personalized targets will be achievable and realistic for the customers and really help them to reduce their water consumption and their water bill. Perfect. In one, take everything out right now.

Back to the list of Demo cases

Back to content

Up-take from Fiware4Water Demo networks

Demo Network #1
MUNICIPALITIES

LOWER DANUBE, THE MIDDLE EAST & NORTH AFRICA LED BY BUSINESS DEVELOPMENT GROUP

Assessment of the potential for uptake of the Fiware4Water portfolio of smart devices and Apps in the area, based on the ConCensus approach

Demo Network #2
WATER AUTHORITIES

INTERNATIONAL NETWORK OF BASIN ORGANISATIONS LED BY INTERNATIONAL OFFICE FOR WATER

Organisation of 6 workshops to showcase the benefits of Fiware4Water smart applications and devices for managing water in an integrated way

Demo Network #3
TECHNOLOGY PROVIDERS

FIWARE INNOVATION HUBS LED BY FIWARE

Implementation of a technology transfer program to support water management-oriented SMEs, based on Fiware Mundus programme (incl. SMEs challenges)

Back to content

FIWARE 4 WATER

Demo Network #1
Municipalities
Lower Danube

Ciprian Nanu
BGD
Demo network 1 leader

Key challenges

The Danube River is the second longest river of Europe, but our focus is on Lower basin, consisting mainly of 4 countries with very different cultural and economic backgrounds. The water sectors in Lower Danube river is public, meaning that all organizations in water sector (including several hundred of water utilities) are owned by public bodies as the local or regional councils. Their main challenge is to consider working together, as the current legislation and past activities do not support such common activities (including innovative technology implementations of the digital solutions). Being public bodies, the interaction with their market (mainly citizens) is very low and inconsistent. The services offered to the citizens are at the minimum, including only constant water delivery at certain quality, but not considering citizens as potential market partners.

Support from Fiware4Water and digital water

Digital water is a hot topic for all water utilities. Considering my understanding, for example in Romania, the digital services provided to contractors, market partners and citizens are at low quality, reflecting the low performance of the departments in the water organizations all over the market (not only the water utilities, but also river basin administrations, local governments, etc.). Introducing digital services like priority topic in water

Back to the list of Demo networks

Back to content

Demo Network #1
Municipalities
Lower Danube

Ciprian Nanu
BGD
Demo network 1
leader

sector will be only as a result of partnership cooperation between different types of stakeholders at local and regional level.

Key innovation transferred to municipalities

With a well-known historical background of centralized decisions, the majority of water stakeholders all over Danube Lower River basin have no ability, skills or trend to involve innovative technologies and solutions in their activities. What we innovate within the Fiware4Water project is the introduction of a new concept of ''bottom-up decisions '' within water sector, as an innovative way to implement environmental policies.
The creation of several pro-active Local Water Forums, as part of the global network of Local Water Forums, will help the decision makers, politicians and water sector in each country, in developing complementary voluntary programs run by the citizens, as a good example of partnerships at each region level.

Back to the list of Demo networks

Back to content

Demo Network #2
River Basin Organisation Network

Eric Tardieu
INBO
Demo Network 2

Key challenges

River Basin Organisations are facing the challenge of collecting accurate data on water and being able to use these data to improve water management. As digital water still appears to be a new topic, the preliminary step is to inform the actors of its multiple benefits to help managing water. In November 2020, a first webinar with INBO took place. It was a very good occasion to raise the awareness of river basin organisations about digital water and to present how Fiware4Water's outcomes can support their missions.

Support from Fiware4Water and digital water

The F4W consortium started with developing digital water solutions such as the FIWARE reference architecture for the water sector. This part is dealing with IT development. But non-technological solutions such as capacity development and socio-political engagement have also been developed. All these solutions, being technical or not, could represent as a whole a real support for river basin organisations in their missions related to water resources management.

Back to the list of Demo networks

Back to content

Demo Network #2
River Basin Organisation Network

Eric Tardieu
INBO
Demo Network 2

Key innovation transferred to River Basin Organisation

All the outcomes of the Fiware4Water project will be showcased to our members during workshops that will occur in the 7 regional branches of INBO from now until the end of the project. In December 2021, for example, a dedicated session on the smart applications and devices for managing water smartly will take place at the INBO general assembly in Malta. It will not just be about key IT innovation but also on the demonstration of the multiple benefits of digital water solutions.

Back to the list of Demo networks

Back to content

Demo Network #3
Technology providers

Angeles Tejado
FIWARE Foundation
Demo Network 3 leader

Key challenges

Our demo network supports real innovation helping companies to stay relevant; turning their ideas into ready-to-use smart solutions that create new markets and make a meaningful impact in the society. Global challenges, such as climate change, demand flexible and adaptive governance approaches to deal with risk and uncertainty, moving from reactive managements, to preventive and predictive ones based on a real-time informed decision support system. The so-called Digital Transformation also brings fundamental challenges to industries and cities that need to move from isolation to globally connected systems that work together effectively. In short, becoming 'Smart' is not just about installing digital interfaces or smart sensors in traditional infrastructures or streamlining systems' operations. It is also about using technology and data purposefully to make better decisions and deliver better services. In this respect, the lack of common standard APIs and data models, as well as system integration has demonstrated to have an important impact in terms of agility of the processes and business productivity. Our role here is to bring these common standards to the water sector. In particular, the FIWARE ihubs network help companies to make an effective and better usage of 'data' with FIWARE, playing also a fundamental role in our ecosystem acting as an enabling force for inter-city and inter-country collaboration, making possible real innovation and the development of sustainable markets in different domains.

Back to the list of Demo networks

Back to content

Demo Network #3
Technology providers

Angeles Tejado
FIWARE Foundation
Demo Network 3 leader

Support from Fiware4Water and digital water

The FIWARE iHub network is helping SMEs to face global and concrete challenges from different angles. As regional focal points they serve and help companies to become more competitive in their regions and outside their regions thanks to multi partner cooperation. As competence centers, they provide access to knowledge and expertise on FIWARE. FIWARE allow water sector companies and other relevant stakeholders and industries to select the most appropriate combination of tools and data provided by different content information providers ensuring that all connected systems can talk to one another. They will also benefit from our Smart Data Models Program, a global and collaborative initiative supported by FIWARE, India Urban Data Exchange (IUDX), OASC and TM Forum that is driving the adoption of data models for Digital Twin types as 'de facto' standards across a wide range of domains.

Key innovations transferred to technology providers

With strong technology assets and a close collaboration with members and partners, FIWARE is uniquely positioned to build Smart Ecosystems, which can be the end goal in the operationalization of digital and smart strategies. It is simple, powerful, Open, standard, domain agnostic and globally adopted; accelerating go-to-market.

Back to the list of Demo networks

Back to content

Socio-political and citizens engagement

Richard Elelman
Head of Politics
EURECAT

Fiware4Water social and political role

Fiware4Water project explores very much the links between the digitalization of water and the involvement of what is called in politics, the quintuple helix, which is the public sector, the private sector, the citizens, the research center, and even the cultural sector of society.

We believe that science has an important social political role to play. And we believe that projects such as Fiware4Water are answering vital questions, not only with regards to water management and the digitalization of water, but also with regards to how we can make the general public aware of the need to become involved in the global issues of the environment, at a local level. This is based on a hypothesis were supranational agencies (who develop strategies) have a lot of problems being able to contact the person in the street. So what we try to do is to translate supranational strategy into municipal implementation involving the citizen and the local and regional governments and administrations supported by the local water utilities supported by research centers, and also supported by cultural means of communicating and creating an emotional response.

Within Fiware4Water, we are also extremely interested to investigate how this can support the advancement of digital methodologies to be employed by water utilities. We believe that there should be a public demand and we want to involve the public in developing this.

Back to content

Socio-political and citizens engagement

Richard Elelman
Head of Politics
EURECAT

Fiware4Water demonstration: Local water forum

For example, in the case study in Great Torrington, we have created a local water forum. This is a group of citizens who are simply interested in the issue of water, at a global level, but also at their local level in the southwest of England. Citizens also have become involved with the utility South West Water to help develop the application, which will help to digitalize the management of water in their region.
At the same time we have had similar activities in Amsterdam, and others are being planned for both Athens (Greece) and for Cannes (France).

The theory behind

The theory is become further developed as a result of the work of Fiware4Water. It is also being applied by the United Nations. So that we can honestly say that the Fiware4Water methodology for citizen engagement and the creation of a greater awareness regarding the importance of digitalization of water has been taken up by the United Nations, and is now being used not only in Europe, but also in Africa, South America, North America, Australia, and of course, Asia.

Back to content

Richard Elelman
Head of Politics
EURECAT

The World Water Quality Alliance of the United Nations

The case studies that Fiware4Water has demonstrated, principally in the United Kingdom, and Holland, and soon as well to be explored in Eastern Europe, where the approach of water utilities is different to Western Europe, will be fully optimized, and then disseminated around the globe.
So we have created within the World Water Quality Alliance of the United Nations, a movement of social engagement, where we are creating these local water forums based on the model that was developed by Fiware4Water in Great Torrington. This is now being applied in 50 local communities in the aforementioned continents.
We believe that this is the only way forward, that for far too long the water sector itself has been very hermetic about its methodologies and its approaches to management. It requires a broader, more open social political dialogue in order to guarantee the policy continuity, which is necessary in order to ensure that water management can answer the challenges of the 21st century.

Back to content

Scientific and technological focus

- Water supply system real time operational management
- Intelligent control for wastewater treatment
- Smart meters and customers
- Drinking water supply system improvement

EU added value in a nutshell

- From a Architecture/Data/Ontology /API/Legacy links/Standards perspective
- From a Smart Applications and Devices perspective
- From the demonstration of Fiware4Water in the Real (Water) World perspective
- From a socio-political impact and end-user engagement perspective

Back to content

FIWARE 4 WATER

Demo Case #1 Athens Greece

Vasiliki Polychniatou
EYDAP
Demo case 1 leader

Christos Makropoulos
KWR

Panagiotis Kossieris
NTUA

Back to the list scientific focus

Back to content

Water supply system real time operational management

Athens Demo Case aimed to deploy and demonstrate Fiware-enabled applications and services in the raw-water external conveyance system that serves the greater metropolitan area of Athens (Greece). The system, composed by more than 495km of aqueducts, is operated by Athens Water Supply and Sewerage Company (EYDAP S.A.), the largest water utility in Greece. The key target within Fiware4Water, was to upgrade the real-time operational management of the raw-water supply system by integrating data sources from different sensors and vendors, into a common information system, taking advantage of the data portability and integration functionalities of Fiware.

NTUA and EYDAP designed and implemented a new Fiware-enabled platform, along with a series of analytics, for the demo part of the aqueduct, Giona to Dafnoula (131 km), integrating data from more than 60 sources, associated with both hydraulic (e.g., flow, water level) and quality (e.g., turbidity, temperature) system parameters. The web platform enables EYDAP to process, analyse and visualise data from the integrated sensors, allowing combined monitoring of flow and quality characteristics of raw water via a single web portal, on real-time basis. For this purpose, the Nessie system (Web Server and Data Analysis & Archiving Engine, developed by NTUA) was customised to the specific needs of Athens demo case.

@EYDAP, External aqueduct of EYDAP

FIWARE 4 WATER

Demo Case #1 Athens Greece

Vasiliki Polychniatou
EYDAP
Demo case 1 leader

Christos Makropoulos
KWR

Panagiotis Kossieris
NTUA

Back to the list scientific focus

Back to content

Water supply system real time operational management

The platform was integrated with several new applications, aiming to provide decision support on optimal sluice gates (flow regulation structures) settings, early warning for high turbidity events, forecasts on turbidity level, and estimations of water supply volumes.

The optimal operation and scheduling of the sluice gates was supported by an application following a “grey-box” approach that estimates the sluice gates openings for a target flow.

Furthermore, two deep neural network models were built to forecast the turbidity level at the two most downstream sensors of the system under study, using as predictors turbidity measurements from the most upstream sensors.

Finally, an application was developed that provides one-day ahead forecasts of the total daily water supply volumes, with focus on the annual and weekly seasonality of water outflows, during periods of exceptional demand.

Fiware4Water delivers a fully functional Fiware-enabled system architecture, which can easily be extended to cover other applications, taking advantage of the connectors developed. Similarly, third-party applications, models, tools and services can take advantage of the installed Fiware-enabled infrastructure to communicate seamlessly in a bi-directional way, following Fiware standardization protocols and not ad-hoc approaches, which lead to fragmented and isolated solutions.

FIWARE 4 WATER

Demo Case #3 Amsterdam Netherlands

Alex van der Helm
Waternet
Demo case 3 leader

Intelligent control for wastewater treatment

Waternet's wastewater treatment plant (WWTP) Amsterdam West has a capacity of 1 Million population equivalent and serves the city of Amsterdam. Almost half of the Waternet climate footprint is determined by nitrous oxide emissions from the WWTPs. Nitrous oxide is a potent greenhouse gas formed during the biological nitrogen removal. Thus, minimising of nitrous oxide emissions is considered to be of key importance in reaching climate goals.

The objective of the demo case is to demonstrate the integration of the Fiware4Water architecture (F4W) using FIWARE in the legacy system with better use of real-time plant data and the use of data-driven Artificial Intelligence (AI) smart applications in practice, to achieve a more optimal plant control with respect to its nitrous oxide emissions and energy consumption.

To meet the objective, one of the seven parallel treatment lanes at WWTP Amsterdam West is made available as a full-scale research lane for the F4W project. In this research lane additional sensors are deployed and integrated, and an on-site research facility is built to gain more insight in the wastewater treatment process. Furthermore the F4W architecture is deployed and integrated in the WNT legacy system, including real-time F4W WWTP AI smart applications and F4W data models. Finally intelligent real-time AI control is implemented. The F4W AI smart applications deployed are software (soft) sensors for determining the influent flow per

@Waternet

Back to the list scientific focus

Back to content

FIWARE 4 WATER

Demo Case #3
Amsterdam
Netherlands

Alex van der Helm
Waternet
Demo case 3 leader

Intelligent control for wastewater treatment

lane, for prediction of the influent flow and for determining the airflow per lane. The soft sensors are virtual sensor, whose output is based on (AI) calculation of multiple observed measurements. Next to the soft sensors an AI smart application for (near) real-time data validation is deployed. The implemented AI control model has a control objective to minimize nitrous oxide emissions and energy consumption whilst meeting effluent water quality targets. From the Amsterdam demo case it can be concluded that F4W architecture can be integrated in a water utility legacy system with AI smart applications running in (near) real-time. Furthermore it is possible to use real-time AI control for optimizing nitrous oxide emissions and energy for wastewater treatment plants in practice. The methodologies, approaches, and developed technologies in the Amsterdam West WWTP demo case present a successful baseline to guide other water utilities for future digitalization processes. The demo case has also boosted the knowledge and research about the formation and reduction of nitrous oxide emissions from WWTPs. It is therefore directly contributing to the acceleration of the twin – green and digital – transition, which is seen as a necessity in order to reach the climate goals by 2030.

Back to the list scientific focus

Back to content

Demo Case #2 Cannes France

Stéphane Deveughele
SUEZ Smart Solutions
Demo case 2 leader

Franck Le Gall, EGM

Benoit Orihuela, OGM

Drinking water supply system improvement

The management of the drinking water supply system of SICASIL (Mixed Water Union of Municipalities Supplied by the Siagne and Loup Canals) which covers eight municipalities, including Cannes, is delegated to SUEZ, a private water utility. Cannes is located in the south east of France and is a touristic city known for its sunny climate, beaches and its famous Film Festival. Cannes basin has a population of 181,000 permanent inhabitants but reaches 500,000 during the peak season – making water management in this water scarce environment very challenging.

@ Suez Smart Solutions

The objective of this demo case was to improve the whole system management by developing these services:

- Forecast water resources availability
- Forecast water demand
- Detect water leaks
- Detect abnormal water quality events

For these four business issues, scientific models have been developed, based on Machine Learning (ML) techniques; therefore, no water physico-chemistry equations were used. The TRL of these four models is at least 8 because they have been successfully tested on several areas of interest of the French Demo Case, but they still need to be tested on other territories to justify a TRL of 9. Nevertheless, the scientific models developed in the Fiware4Water project are of industrial quality.

Back to the list scientific focus

Back to content

FIWARE 4 WATER

Demo Case #2 Cannes France

Drinking water supply system improvement

Stéphane Deveughele
SUEZ Smart Solutions
Demo case 2 leader

Franck Le Gall, EGM

Benoit Orihuela, OGM

Multi-parameter probes (nano::stations) have been installed in the drinking water distribution network to monitor water quality and develop the abnormal water quality detection model.

The four services have been developed by integration of Big Data models where the deployment of Machine Learning models, based on the Big Data tool Spark, uses FIWARE components, Orion Context Broker and Cygnus (figure below).

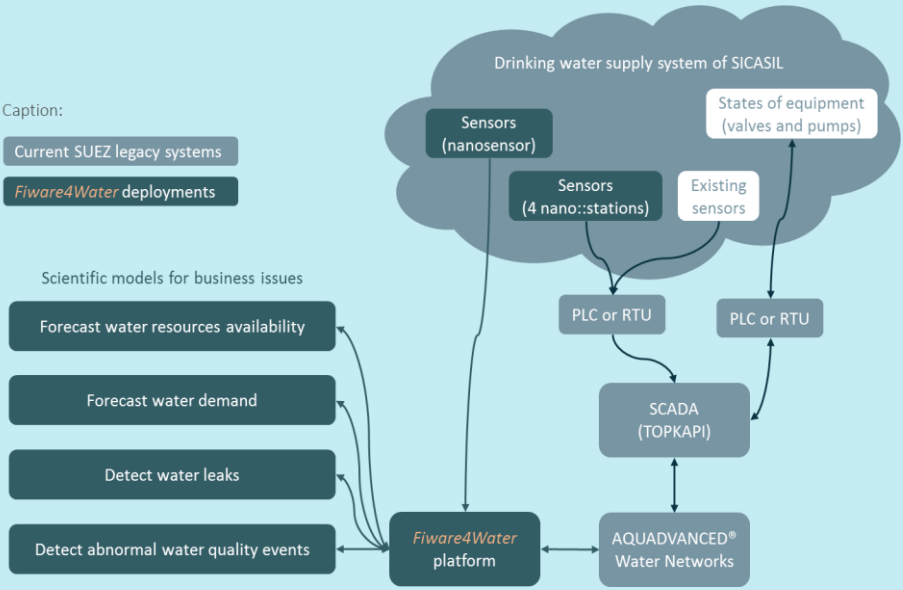


Figure: Online implementation of the functional architecture

Back to the list scientific focus

Back to content

FIWARE 4 WATER

Demo Case #2
Cannes
France

Stéphane Deveughele
SUEZ Smart Solutions
Demo case 2 leader

Franck Le Gall, EGM

Benoit Orihuela, OGM

Drinking water supply system improvement

Perspectives beyond F4W project life:

Some possible perspectives of the functional architecture implemented for the French Demo Case:

- Use of a context broker to ensure data exchanges between the numerous IT applications existing within the IT system of an operator managing a drinking water supply system: SCADA, data historian, hydraulic model, clients complaints, interventions management, GIS, etc.
- Data exchanges between a public client (municipality or water union) and its private delegate. For example, the municipality provides open data that its delegate can use; conversely, the operator sends the municipality data related to the operation of the site.
- Data exchanges between different stakeholders involved in the functioning and operation of a Smart City IT application: e.g. a municipality and its various delegates, a water utility, a street lighting operator and a parking operator.
- Data exchanges between a local agency of a water utility and the sites (i.e. the contracts) it manages. Data from the different sites are consolidated at the local agency level.
- Data exchanges between a regional agency of a water utility and the local agencies it covers. Data from the different local agencies are consolidated at the regional level.

Back to the list scientific focus

Back to content

FIWARE 4 WATER

Demo Case #4
Great Torrington
United kingdom

Josh Pocock
SouthWestWater
Demo Case 4 leader

Smart meters and customers

South West Water (SWW) provide cleaning drinking water for 1.5 million customers across the South West of England; treating water from large impounding reservoirs and rivers and pumping this supply across a vast network to the customers tap. The stewardship of water resources has always been paramount but is increasingly challenging with Covid-19 and climate change. One of the best ways to do this is by helping customer use less water and also by reducing leakage from the network. The benefits also include lower customer water bills and reduced energy usage from treatment and pumping.

From previous studies, SWW understand that making customers more aware of their day-to-day water consumption drives positive behavioural changes and reduces overall consumption. A customer who is billed for water based on a meter will use on average 45% less than a customer who does not have a meter. However, even with a meter a customer can only view their water use over a 6-month period which if the typical meter read frequency. Smart meters provide a daily read-out present an opportunity to increase this frequency and give customers a near real time view of water use. Although prevalent in the energy utility market, smart meters are scarcely using in the water industry due to technology constraints such as battery life (no energy at source) and signal strength.

Back to the list scientific focus

Back to content

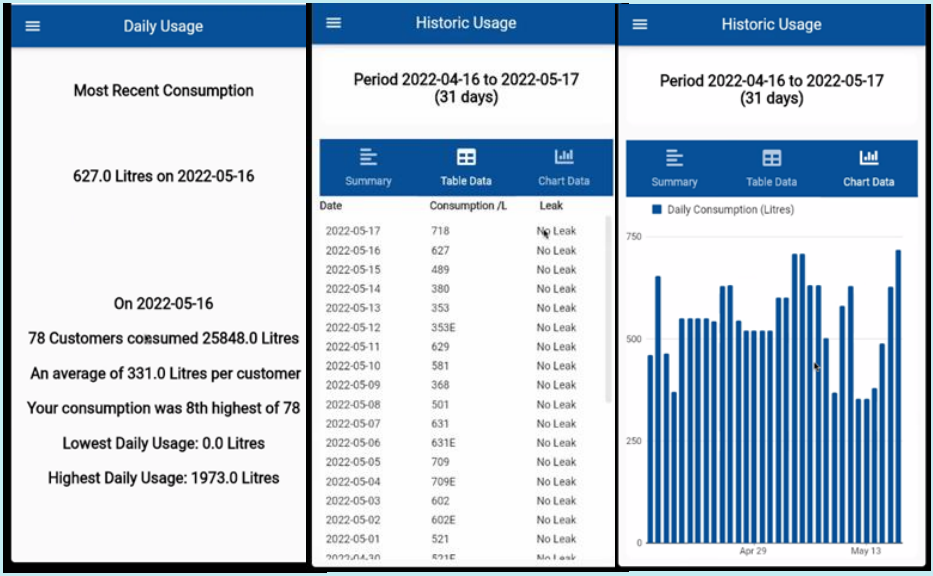
FIWARE 4 WATER

Demo Case #4
Great Torrington
United kingdom

Josh Pocock
SouthWestWater
Demo Case 4 leader

Smart meters and customers

Recognising the potential smart meters can offer, South West Water initiated a pilot and installed over 100 domestic smart meters and a sigfox mast were installed in a region called Great Torrington. Fiware enabled technology was built to collect, store, and analyse water consumption data and a number of micro-services were developed including:
A customer smart phone application allowing customers with a smart meter to view their daily usage, compare their use against others and set consumption reduction targets,
An automated leakage detection and high consumption tool which presents SWW with sensor and data driven alarms,
A machine learning tool to cluster customers into groups of similar water use behaviour to help SWW target customers with water efficiency campaigns



Back to the list scientific focus

Back to content

FIWARE 4 WATER

Demo Case #4
Great Torrington
United kingdom

Josh Pocock
SouthWestWater
Demo Case 4 leader

Smart meters and customers

The smart phone application was co-designed with the Great Torrington Water Forum which includes local residents in the area engaged with the pilot. The prototype app can be see in the figures below.

SWW expect that increased visibility of water use behaviour will help reduce water consumption, reduce overall demand on resources and treatment requirements, and help our customers reduce their annual water bill. We will also use the data to manage our water distribution system more efficiently by responding faster to events on the network (e.g. bursts, and discoloration events), predicting short term water demand, and better understanding leakage at household and area level.

Back to the list scientific focus

Back to content

European added-value in a nutshell

From a Architecture/Data/Ontology/API/Legacy links/Standards perspective

Fernando López
FIWARE Foudation

- There is a huge demand of standardization of data models in the water sector.
- FIWARE architecture can be translated into the water sector without major work in an easy way.
- We observe an increased demand of ML/AI services in the water sector and integrated in FIWARE.
- Digital twin is another key factor to be considered in the future water sector.
- The security management in critical water infrastructure us a MUST but can be managed through the adoption of Data Space architecture.
- The ETSI NGSLI-LD a well as the Smart Data Models program have consequently improved the excellence and capacity building of the European partners involved in.
- F4W-RA is free to use, open interoperable an data harmonized of water management services at both European and pan-European level.
- F4W-RA leads a cost reduction as well as a prevent the redundancies in the Smart Water services

Back to the list EU added value

Back to content

FIWARE 4 WATER

European added-value in a nutshell

Lluís Echeverria
EURECAT

From a Smart Applications and Devices perspective

- More than 25 scientific models based on different mechanism, technologies and approaches have been developed, tested and demonstrated
- New water quality monitoring devices have been tested
- Several FIWARE-enabled digital solutions have been developed
- Data driven solutions enable the development if novel smart application for an improved water cycle management
- The digitalisation of the water infrastructure takes time and resources
- Data validation, curation and reconciliation are mandatory steps that need to be performed in each data-based solutions
- The combination of classical approaches with data-driven solutions can boost the potential of the smart applications
- FIWARE technology provides the requited mechanisms to develop, deploy and maintain such digital services
- FIWARE support and simplifies the integration of different technologies
- Nanosensors technology is not ready and further research needs to be done
- Printed sensors present an effective, low cost solutions to develop water quality measurement devices
- Data driven solutions can be also used to improve the sensor's performance

Back to the list
EU added value

Back to content

FIWARE 4 WATER

European added-value in a nutshell

Alex van der Helm
Waternet

From the demonstration of Fiware4Water in the Real (Water) World perspective

- The feasibility to implement FIWARE-enabled solutions for the water sector, and moreover, in a variety of diverse, demanding, real world situations, covering a wide range of water challenges and contexts.
- The implementation of FWARE-enabled solutions fully operational conditions, integrated with the existing operational systems of water utilities.
- The solutions serve as living paradigms of fully operational systems where legacy system, new sensors and new smart applications are fully integrated under the umbrella of FIWARE technology (a framework initiated and supported by the EU).
- The benefits for water utilities are also enormous: (a) integration of new sensors and other part of legacy systems in a straightforward way, (b) integration of new services, tools and applications with the legacy system using the operational FIWARE-enabled systems delivered by the project.
- The use f the soft sensors and AI control model were well received by WaterNet wastewater technologists and process operators.
- The integration od new application in the existing legacy systems (used by the operators on a daily basis) allowed the operators to get familiar with new application easily an without additional training.
- The work on the AI digital twin and AI control model will be continued by WaterNet with a number of projects partners after the end of F4W.

Back to the list
EU added value

Back to content

European added-value in a nutshell

From a socio-political impact and end-user engagement perspective

Richard Elelman
Head of Politics
EURECAT

- Supranational digital water solutions are most effectively employed when interacting with local communities
- Policies based in digital data are always fairer, better explained and achieve grater levels of acceptance. Digital solutions extend the transparency and efficiency of the decision making process
- Citizen scientists would be far more relevant if, before being asked to contribute to the collection of data, they were actively engaged in the issue at hand
- Knowledge transfer, cooperation and collaboration between local communities in numerous member states of the EU and beyond.
- The dissemination of supranational challenges and solutions to a hitherto uninformed public.
- Enhances the role of local communities in international issues.
- Due to it international nature, F4W has contributed to the achievement of SDG 6.3 within the framework of the United Nations Environment Programme.

Back to the list
EU added value

Back to content

FIWARE 4 WATER

Materials & references

F4W General Presentation, Sonia SIAUVE, OiEau
F4W Scientific Presentation, Lydia VAMVAKERIDOU-LYROUDIA, KWR
F4W What Is Digital Water?, Lluis ECHEVERRIA, EURECAT
F4W DemoCase 1 Athens, Vasiliki VASILOPOULOU, EYDAP
F4W DemoCase 2 Cannes, Stéphane DEVEUGHELE, SUEZ
F4W DemoCase 3 Amsterdam, Alex VAN DER HELM, Waternet
F4W DemoCase 4 Great Torrington, Joshua Pocock, South West Water
F4W DemoNetwork 1 Municipalities, Ciprian NANU, BDGroup
F4W DemoNetwork 2 River Basin Organisations, Eric TARDIEU, INBO
F4W DemoNetwork 3 Technology providers, Angeles TEJADO, FIWARE
F4W Social and political engagement, Richard Elelman, EURECAT

Websites

Aqua3S
Digital Water City
Fiware4Water
ICT4Water cluster
INBO
NAIADES
NGSI-LD ETSI specification
Score Water

Abbreviations

AI	Artificial intelligence
F4W	Fiware4Water
IoT	Internet of Things
INBO	International Network ok Basin Organisation

Design OiEau

May 2022

FIWARE 4 WATER

Quote

Amorsi N., Deveughele S., Echeverria L., Elelman R., Kossieris P., Lopez F., Makropoulos C., Nanu C., Pocock J., Polychniatou V., Siauve S., Tejado A., Vamvakeridou-Lyroudia L., van der Helm A. (2022), *Fiware4Water, technological and non-technological dimensions of Digital water*, E-Book, Deliverable No.6.8, Horizon 2020 research and innovation programme under Grant agreement No.821036, May

Disclaimer

Intellectual Property Rights

Project Consortium

Fiware4Water has received funding from the European Union's Horizon 2020 research and innovation programme under Grant agreement No. 821036.