Deliverable 5.3 –
Quadruple helix brief on market opportunities

digital-water.city has received funding from the European Union's H2020 Research and Innovation Programme under Grant Agreement No. 820954.

Deliverable N° D5.3	Quadruple helix brief on market opportunities
Related Work Package	5
Deliverable lead	Ecologic Institute
Author(s)	Gerardo Anzaldúa, Ariel Araujo Sosa, Benedict Bueb, Lorenzo Felicetti
Contact for queries	Gerardo Anzaldúa
Grant Agreement Number	n° 820954
Instrument	HORIZON 2020
Start date of the project	01 June 2019
Duration of the project	42 months
Website	www.digital-water.city
Abstract	The ongoing trends of rapid population growth, urbanization and climate change are bringing about a series of pressures upon Europe's waters. As the one responsible for managing this vital resource, the water sector faces increasing challenges to deal with this task. Against this background, digital technologies open up a variety of opportunities for the different stakeholders involved in the water sector to take action. This document is inspired on the Quadruple Helix Model adopted by the European Union in its Open Innovation 2.0 policy approach. It follows the notion that the most adequate and operable solutions to the key challenges the water sector faces will emerge from the active involvement and collaboration between public administration, academia, business and civil society. Ultimately, this quadruple helix brief aims to expose fields of opportunity in which these four stakeholder types (helices) can get involved in ensuring a smooth and reasonable digital transition.

Dissemination level of the document

X	PU	Public
	PP	Restricted to other programme participants
	RE	Restricted to a group specified by the consortium
	CO	Confidential, only for members of the consortium

Versioning and Contribution History

Version	Date	Modified by	Modification reasons
D1	2019-12-05	Gerardo Anzaldúa, Ariel Araujo Sosa, Benedict Bueb, Lorenzo Felicetti	First full draft by Ecologic
D2	2019-12-06	Ulf Stein	Internal review by Ecologic
D3	2019-12-10	Gerardo Anzaldúa	Final draft for review by Eva Martínez Díaz (Aqualia / DWC Advisory Board member) and Nicolas Caradot (KWB)
R	2019-12-16	Gerardo Anzaldúa	Edited final draft after internal review.
S	2019-12-20	Gerardo Anzaldúa, Ariel Araujo Sosa, Lena Aebli	Final draft for submission.

* The version convention of the deliverables is described in the Project Management Handbook (D7.1). *D* for draft, *R* for draft following internal review, *S* for submitted to the EC and *V* for approved by the EC.

digital-water.city
digitalwater_eu

digital-water.city has received funding from the European Union's H2020 Research and Innovation Programme under Grant Agreement No. 820954.

Table of content

digital-water.city has received funding from the European Union's H2020 Research and Innovation Programme under Grant Agreement No. 820954.

Scope and intention of this document

This brief aims to provide a backdrop for the exploitation activities of DWC by outlining the current position and perception of key representatives of the water sector towards the digital transition of the sector. This will primarily serve to inform internal efforts within our project, but also intends to contribute our view to open innovation processes taking place at EU level and within the Member States.

The authors have conducted a review of academic and grey literature as well as industry reports and press releases documenting the water sector's stance towards digital solutions. The results of this review fed into the preparation of a semi-structured questionnaire that was then used to interview key industry representatives from the EU. The interviewees included representatives from a trade union, an NGO, a farmer's association, a business association, a utility, a university, a technology transfer office, a water board, a river basin authority and a national level public administration. The countries in which the interviewees operate include Austria, France, Germany, Italy and Spain.

This document is inspired on the Quadruple Helix Model taken up by the European Union in its Open Innovation 2.0 policy approach. It follows the notion that the most adequate and operable solutions to the key sectoral challenges the water sector faces will emerge from the active involvement and collaboration between public administration, academia, business, and civil society. Ultimately, this quadruple helix brief aims to expose **fields of opportunity** in which these four stakeholder types (helices) can get involved in ensuring a smooth and reasonable digital transition.

digital-water.city has received funding from the European Union's H2020 Research and Innovation Programme under Grant Agreement No. 820954.

Digital Water: outlook and opportunities for academia, business, civil society and public administration

Digital Water .City

SUMMARY

The ongoing trends of rapid population growth, urbanization and climate change are bringing about a series of pressures upon Europe's waters.

As the one responsible for managing this vital resource, the water sector faces increasing challenges to deal with this task. Against this background, digital technologies open up a variety of opportunities for the different stakeholders involved in the water sector to take action.

This document is inspired on the Quadruple Helix Model adopted by the European Union in its Open Innovation 2.0 policy approach. It follows the notion that **the most adequate and operable solutions to the key challenges the water sector faces will emerge from the active involvement and collaboration between public administration, academia, business and civil society.** Ultimately, this quadruple helix brief aims to expose fields of opportunity in which these four stakeholder types (helices) can get involved in ensuring a smooth and reasonable digital transition.

Key findings and fields of opportunity

Academia

Academia can contribute by enhancing modelling capacities to develop new and more powerful applications, including artificial intelligence, big data and semantics.

By hosting and leading capacity building programmes for workforce and civil society, they can effectively establish stronger links between the different water sector stakeholders and streamline the need for ICT skills across all levels of society.

By clarifying the benefits of going digital and raising awareness among decision-makers and the general public, they can smoothen the transition process.

Business

Businesses can get involved by exploring public-private partnerships that leverage investments on infrastructure and on new digital technologies.

By accounting for current limitations of data protection laws and ensuring investment remains reasonable, they can seek a balanced and responsible deployment of ICT solutions that ensures sustained growth.

By collaborating with academia, end users, and paying customers, they can develop, test and demonstrate novel products & services and the new business models needed to sustain them.

Civil Society

Civil society can get actively involved by assuming a more informed position regarding the accountability of public authorities and decision-makers in the private sector.

Through participation in specialized trainings or updated career profiles they can maximize their contribution to- and benefit from the water sector's digital transformation.

By engaging in the digitalisation process and achieving a good understanding of the costs associated with water supply and sanitation services, they can improve their management of the water resource and save costs.

Public Administration

Public Administrations can engage by strengthening regulatory frameworks, facilitating compliance monitoring, and increasing standardisation to prevent cyberattacks and unlawful data use.

Through adequate policies, they can clarify obligations as regards installation of ICT solutions and reward positive environmental and social impact.

By (co)funding training schemes on ICT, digital processes and digitalisation at utilities, schools, vocational schools and universities, they can support digital literacy.

digital-water.city has received funding from the European Union's H2020 Research and Innovation Programme under Grant Agreement No. 820954.

Context setting:

The digital transition of water

Water in a changing environment

Europe's waters are under mounting pressure. Agricultural and industrial activities as well as increased urbanisation trigger pollution, over-abstraction and modification of water bodies. Today, almost three quarters of Europeans (EU and non-EU countries) live in urban areas, with an increasing trend that is projected to reach 83,7% by 2050.[1] Hence, population growth in the EU will be concentrated in cities and accompanied by increased water demand both within and beyond the urban spheres. The main drivers will be agricultural production, as well as industrial (energy & manufacture) and domestic water use in cities.[2]

Water scarcity, broadly defined as a mismatch between water availability and water consumption, is driven by increases in water demand and reductions on availability. Water scarcity has long been an issue in arid and semi-arid areas of Europe.[3] With the onset of climate change, it is slowly becoming a widespread concern across the region. Climate change is also generating pressures at the other end of the spectrum, with floods and extreme precipitation events increasing in frequency and intensity, placing social and environmental systems under stress.

"The main drivers of change will be agricultural production, as well as industrial and domestic water use in cities.[2]"

Both the scarcity and the abundance of water can have detrimental effects on water quality. For instance, the overexploitation of aquifers can result in seawater intrusion and increased salinity, while extreme rain events can wash agricultural pollutants out of the farms and into rivers and lakes.[3] Reduced water quality also means reduced availability of water for human consumption and for the sustenance of ecosystems.

Ultimately, all these factors lay a burden on the water cycle and have implications for the functioning and management of urban water systems.

Challenges for the water sector

Against this background, water cycle management and its associated systems for planning, development and operations are also undergoing change. This concerns the entire water sector and all the stakeholders involved in it, particularly in the urban context. These agents can influence water availability and quality, predominantly via measures to reduce water loss and contamination during distribution, to curb inefficient resource use,[4] and to ensure adequate wastewater treatment. Hence, sector-specific challenges arise in dealing with the macro-environmental changes mentioned above. Some examples of these are:

- **Ensuring good policy fit:** policy and regulation set the standards and boundaries within which water cycle management is conducted. For instance, the EU Water Framework Directive (WFD) defines objectives as regards the quality of Europe's water bodies. To date, only about 40% meet the objectives set for 2015.[5] The WFD also includes provisions for public participation and cost recovery of water services.
- **Overcoming institutional limitations:** the institutional architecture governing water varies across and within EU Member States. Cases exist where limited capacities and resources result in inadequate monitoring and enforcement action, leading to substantial levels of illegal abstraction or use.[6]
- **Dealing with aging infrastructure:** at the local level, water service provision is often monopolized. This often creates a lack of incentives to renew outdated infrastructure, leading to water leakage and contamination.[5,7]
- **Addressing slow innovation rate:** the very long investment cycles in the water sector create a barrier for innovation. With technological advances moving fast, this is leading to an information, communication and technology gap, for instance regarding the monitoring of water quality and use. [2,5]
- **Reverting low awareness and engagement of users:** in developed regions, the nature of water

as a common resource often results in disregard of what uninterrupted access to clean water actually entails. Inadequate water pricing combined with insufficient action to raise public awareness, promote education on water issues and build capacity on water management can lead to a widespread inefficient use of the resource.[8,9]

In light of these challenges and the global trend of an increasing overlap between the physical and digital world, it is highly relevant to examine the possibilities of applying novel information and communication technologies (ICT) in the water sector, as well as to identify what the barriers to do this might be. The process of digitalisation in the water sector has already begun and it is generally recognised as a trend that will not be reverted.[6]

However, the most pressing question is how to incorporate it to ensure it contributes towards addressing the future challenges of the sector. Integrated water management has to cope with a complex interplay of political, economic and social actors, all with different needs, wants and fears regarding digitalisation in the sector. This is currently opening market gaps that, if understood timely and correctly, can ensure that efforts in technology development result in solutions that are fit for purpose.

"The process of digitalisation in the water sector has already begun and it is generally recognised as a trend that will not be reverted.[6]"

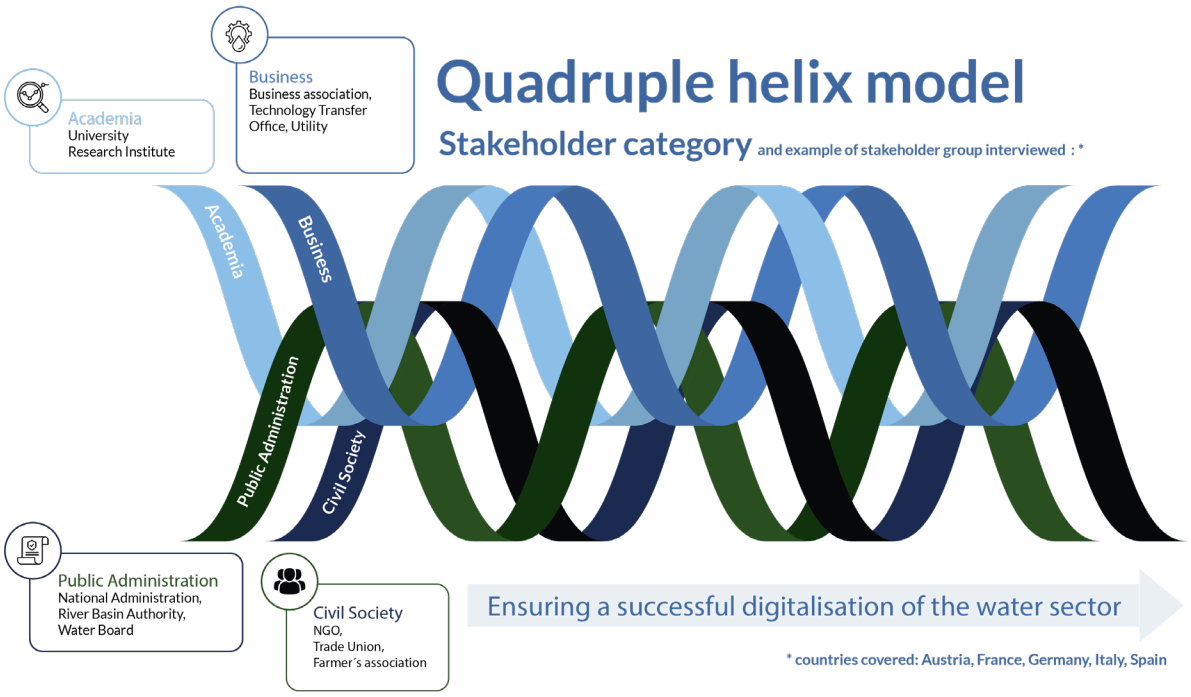
Open innovation:

Collaborating to ensure practicable outcomes

This document is inspired on the Quadruple Helix Model introduced by Carayannis and Campbell[10] and taken up by the European Union in its Open Innovation 2.0 policy approach.[11] It follows the notion that the most adequate and operable solutions to the key sectoral challenges the water sector faces will emerge from the active involvement and collaboration between public administration, academia, business, and civil society.

Ultimately, this quadruple helix brief aims to expose ways in which these four stakeholder types (helices) can become active in ensuring a smooth and reasonable digital transition. Using this as a frame, a review of literature produced by academia, business, policy and civil society organisations was carried out and complemented with a series of ten stakeholder interviews. The overall aim was to gain a better understanding of different key stakeholder group's positions and perceptions towards the trend of digital water, and present them in a way that highlights potential fields of opportunity for all involved stakeholders (see outlook on p.9).

Figure 1: Quadruple helix model and breakdown of the stakeholder groups studied and consulted



Source: Own elaboration based on Carayannis & Campbell (2009)[10] and McIntosh & Gebrechorkos (2014)[7].

Here, a stakeholder's position represents its formal stance based on personal and professional sphere of experience, whereas its perception is a general impression of the viewpoints prevalent in its stakeholder group. As the core component of this document is the literature review, the conducted interviews were intended to fill the gaps of the desk-based research. Thus, they did not cover the entire spectrum of stakeholder groups nor the exact geographic scope of the DWC project. The clustering of stakeholder groups into four different categories follows the typology of McIntosh & Gebrechorkos (2014)[7], who categorise these according to the roles they play in the digitalisation of the water sector (see Figure 1). The sampling of interviews was oriented at covering all these four stakeholder types as balanced as possible, with at least one interviewee per type.

Through action in the fields of opportunity presented below, the different stakeholder groups can positively influence the digital transformation of the water sector. This will contribute to the achievement of potential benefits and the mitigation of risks and barriers.

Positions and perceptions:

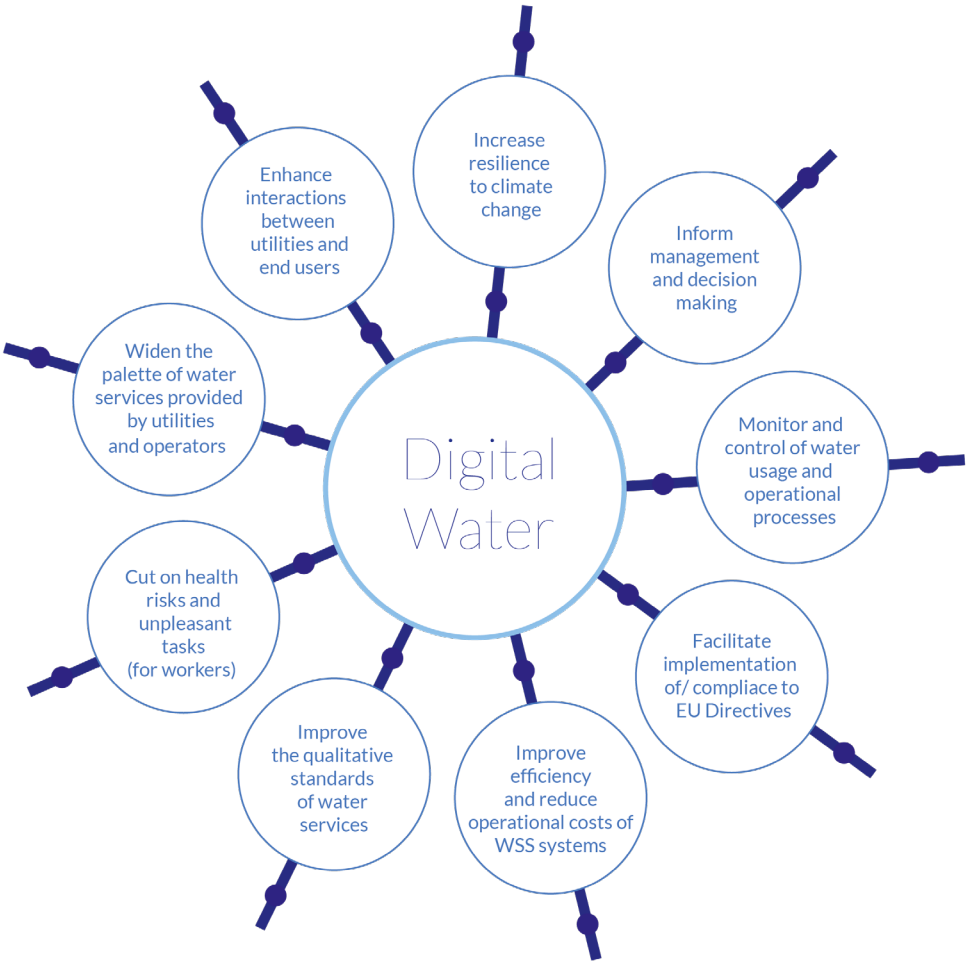
What are the advantages and challenges of digitalisation in the water sector?

For most stakeholder groups consulted, the potential benefits of digitalisation outweigh its associated risks. It represents an unprecedented opportunity whose successful exploitation hinges on the ability of the overall sector to adapt.

Different stakeholders have distinct experiences and impressions regarding the potential benefits of the digital transition of the sector:

Potential benefits identified	Relevant for
Digital systems hold great potential to **enhance the control of water use in domestic**, agricultural and industrial contexts	Utilities and public administration (e.g. river basin authorities and water boards)
Digital systems also (1) **facilitate the monitoring** of ecological flows in water bodies, as well as (2) operative processes in water supply and sanitation systems	(1) Public Administration and researchers (2) Utilities
The improved monitoring and control enabled by digital solutions can **contribute to the implementation of and compliance with EU directives** like the Water Framework Directive or the Drinking Water Directive	Utilities, public administration, researchers, user associations and NGOs
The possibility to work with a large quantity of data in real-time and to integrate it with other automatic information systems (such as weather and remote sensing) can **facilitate management and decision-making** both in ordinary and extraordinary conditions and help reduce costs	Utilities, public administration and farmers
The integration of data streams and improved decision-making has the potential to **increase the resilience of socioeconomic systems** to floods, droughts and extreme weather events[3]	Public administration, citizens, and farmers
Integrated systems combining various digital technologies can **improve the efficiency** of water supply and sanitation systems, inter alia by enabling leak detection or predictive maintenance (relevant for utilities and tech developers)	Utilities, and technology developers
Digitalisation can **widen the palette of services** offered, moving beyond water supply, sanitation and maintenance of water assets. The potential is substantial, ranging from sensing, to governance, to billing and using artificial intelligence applications, cloud computing and smart home environments	Utilities, technology developers and end users
Digital technologies can help **to cut on the most unpleasant tasks** in the sector, such as sewer inspection and flushing, which also has the potential to minimise health risks for the relevant specialists	Utilities
The use of digital interfaces can improve and **increase the frequency of interactions between service providers and their customers**, which can help raise awareness of water issues and lead to active stakeholder involvement	Utilities, technology developers and end users

Figure 2: Potential benefits of digitalisation in the water sector.



Source: own elaboration based on interviews with water sector stakeholders.

Challenges along the digital transition

Cybersecurity

The 2019 World Economic Forum (WEF) Global Risks Report points out that the vast majority of decision-makers sees cybersecurity as a major risk for the 21st century.[12] As the water sector begins to embrace digitalisation, this emerges as one of the primary concerns.[13] Especially since the water sector is regarded as critical infrastructure. Some utilities are already experiencing an increasing number of cyberattacks. Related to this is a greater vulnerability to (deliberate) power outages as additional elements of the operation become digitalised.

"The 2019 World Economic Forum (WEF) Global Risks Report points out that the vast majority of decision-makers sees cybersecurity as a major risk for the 21st century.[12]"

Long investment cycles in waterworks result in outdated equipment operating side to side with innovative applications. The greater integration of digital solutions without standardisation potentially creates 'gaps in the wall' that allow hackers to breach the security of water systems.[14] In addition, the current regulatory framework in many countries is still insufficient to ensure the cybersecurity of critical water infrastructure. These unsolved issues make utilities averse to the introduction of ICT technologies.[15]

One of the main challenges ahead is to close these gaps by strengthening regulatory frameworks and increasing standardisation to prevent cyberattacks and unlawful data use. In addition, utilities have to take security aspects carefully into consideration when digitising existing systems.

Data protection

The widespread use of ICT solutions by water utilities will increase the amount and the quality of data gathered, making the protection of operational and end-user data increasingly relevant. Data generated will be collected more effectively and will become more accessible.

However, there is a general agreement across stakeholder groups that current legislation and privacy policies are not fit to regulate the access and use of the real-time information flow generated by smart devices. Water utilities are collecting more and more data, but it remains largely unclear how they will be handled and for what purpose.

"At the operational level of utilities, digitalisation is often associated with job loss. While technologies indeed may reduce or even substitute human intervention in some cases, it is still recognized across all stakeholder groups consulted that human action will still be required."

There are also concerns about ICT solution providers appropriating water data to then resell them to the utility. Once data is being collected through ICT solutions by external providers, utilities could lose access to and ownership of this data vital to their operations. Thus, questions of data access and ownership have to be addressed, taking the fears and needs of both utilities and the providers of external ICT solutions into account.

Lastly, the idea of digitalisation as a driver for the centralisation of data is another relevant concern in the sector. Some stakeholders fear that smart metering and other digital solutions are creating a privacy issue, a so called "Big Brother problem".

Regulatory uncertainty

The time lag between technological development and updated regulatory frameworks is generally acknowledged to hinder digital innovation.[16] The difficulty in setting up appropriate regulatory frameworks in a timely manner will reside in balancing between required updates of the latter to increase cyber security and data protection while maintaining enough leeway for the testing and rollout of digital innovations. Some interviewees fear that data protection laws could impose overly strict limitations, curbing the developers' and utilities' margin for manoeuvre to explore the potential of digital technology.

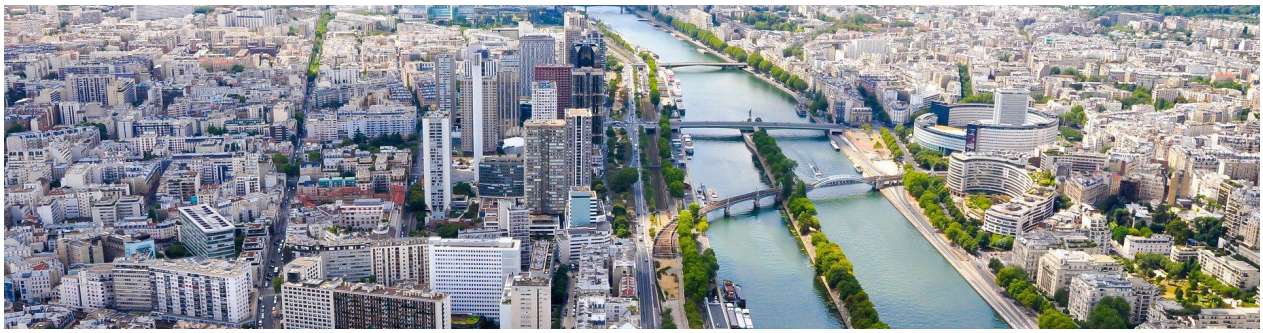
Investment

Research and development provides the water sector with advanced ICT solutions in increasingly shorter periods. This is poles apart from investment cycles in the water industry, which are oriented towards large-scale, long-term expenditure. Often, plants are in operation for 20 to 30 years before being updated. Transformation occurs sporadically through large capital investments.[17] This gap between short- and long-term cycles constitutes a major hindrance for innovation uptake.

Several of the stakeholders interviewed for this brief consider the level of public investment in the water sector inadequate. Further, a higher share of public funds is seen as a fundamental prerequisite for the digital transition to take place. The World Economic Forum estimates that from 2010 to 2030, $26 bn worth of investment will be necessary to modernise existing water infrastructure. Public-private partnerships could boost the digital transition without widening the investment gap on ageing infrastructures.

An additional constraint to investment in digital solutions is the cost recovery principle of the WFD. Regardless of the structural changes they may bring to water management, expenditure in smart devices, citizens apps or monitoring systems has to be covered by current operations. Thus, investments in digitalisation can be justified only if they bring clear economic advantages in the short term, or if costs are covered by users' fees.

In this sense, farmers' and consumers' associations fear that higher costs of enhanced management by digital techniques could, at least in the short run, result in higher water prices. In certain cases, such as large irrigation communities, investments have paid back as the data generated through digital solutions enhances water management. However, smaller irrigation communities have been reluctant to invest in digital systems due to large initial costs. The lack of willingness among end users to pay higher water rates further presents an important constraint to take into account. In the case of long-term infrastructures, service fees do not rise excessively as a result of new infrastructure developments or updates due



to amortisation. For digital solutions, this might not always be the case. Ideally, investments in digital innovation should be cost-effective and not place the burden on end users. This will require tech providers and end-users to conceive and operationalize novel business models that ensure financial sustainability without overburdening the paying customer. ICT solutions have spread at a different pace among wider society than they have in industrial settings,[18] so for these new business models to emerge, the benefits of going digital must be evident and understood by all stakeholders involved.

Capacity-Building, Employment and Digital Literacy

Unlike the energy sector, water utilities have not substantially changed their business model through ICT over the past century[14] and the sector is generally characterised by a low maturity in the application of these technologies.[6,19,20] Often, utilities are still lacking skilled staff to handle this unprecedented amount of data that comes with increased reliance on digital solutions. Many older managers are open to innovation but often struggle to see the benefits of new digital solutions in the long term, partially because their own ICT skills are limited. In addition, data law specialists are not common in water utilities.

At the operational level of utilities, digitalisation is often associated with job loss. While technologies indeed may reduce or even substitute human intervention in some cases, it is still recognized across all stakeholder groups consulted that human action will still be required. Once technologies such as sensors, real-time networks and robotics take over tasks previously done by technicians, qualification and training measures are needed to ensure that they can control and operate them. Utilities have shown willingness to lead capacity-building programmes, as they perceive enhanced efficiency from digitalisation outweighs the costs of training.[7]

Although training programmes have found their way in the digital transition, career profiles are lagging behind. Trade unions argue that the future involvement of workers needs to be assessed before the introduction of digital solutions in order to reap the benefits of digitalisation in the water sector.

There exists a general understanding that training schemes should be partly funded by the state, in particular for some categories of workers directly affected by digital water management, such maintenance workers in waterworks and irrigators in farms.

Moreover, there is a knowledge and capacity gap, which can be found in many European countries with an ageing population and is characterized by the older generation's struggle to keep up with technology.

"Ideally, investments in digital innovation should be cost-effective and not place the burden on end users."

The issue of innovation acceptance does not only imply professionals and workers, but also the end users. Some digital solutions allow the number of interactions between utilities and users, involving the latter more directly. Nevertheless, some concerns have emerged among users regarding the application of these new technologies. These concerns often go hand in hand with a lack of information and the need of transparency on the use of these technologies.

Therefore, efforts to disseminate information and to offer advice to users can have a positive effect in this response. Furthermore, general digital literacy of users has to be supported so that the full digital transition can be reached, in urban as well as in rural areas. To this respect, most interviewed experts agreed that achieving a high level of transparency, e.g. by promoting a multi-stakeholder dialogue including civil society is an important step.

Outlook:

Fields of opportunity for each stakeholder type

The following info boxes distil the main fields of opportunity identified where each of the different stakeholder types could get involved to ensure a smooth and reasonable digital transition of the water sector.

Academia

The digital transition of the water sector will enhance the capacity for monitoring and control of natural and socioeconomic systems as well as industrial processes. The increasing volume of data that will become available can enable universities and research institutes to:

- Enhance modeling capacities to develop new and more powerful applications, including artificial intelligence, big data and semantics
- Habilitate capacity development and/or strengthening in data access, handling and processing within the utilities
- Host and lead capacity building programmes on digital technologies for workforce and civil society
- Streamline the need for developing ICT skills across all levels of management and operation within the companies
- Raise awareness among decision-makers, as well as the general public, regarding the economic, environmental and social benefits of digitalisation in the water sector
- Raise awareness among decision-makers, as well as the general public, regarding the economic, environmental and social benefits of the digitalisation in the water sector

Business

The digital transition of the water sector will allow service providers to pursue and achieve efficiency gains on known processes, but it will also uncover new needs on both ends of the market or raise the priority given to known ones via increased interaction between parties. Business groups and tech developers can:

- Expand existing business by widening the palette of services offered, leveraging novel applications and data products
- Explore public-private partnerships to avoid competition between (overdue) investments on assets and infrastructure and the implementation of new digital technologies
- Persuade the balanced deployment of innovative solutions and data protection legislation (e.g. by deploying smart meters on a building-level)
- Collaborate with universities and research centres to develop, test and demonstrate novel applications, products and services incorporating the data generated
- Engage in dialogue with end users and paying customers to conceive novel products & services that address their needs better, and develop the new business models needed to sustain them
- Ensure compliance with data protection regulation, including user access to the information gathered by digital technologies

Civil Society

The digital transition of the water sector brings potential to access relevant information (e.g. on water quality, water quantity, costs, efficiency) and with it increase the awareness and engagement of the public. Members of civil society can:

- Assume a better, more informed position regarding accountability of public authorities and decision-makers in the private sector
- Avoid unpleasant activities which can be done using digital technologies (for industry or utility employees)
- Improve their usage of water services and save costs, provided they have access to smart meters and the information collected is fed back in a way they is easily actionable
- Engage in the digitisation process, for instance through specialized trainings or updated career profiles. This is highly relevant for a successful transition (that maximizes benefits for the majority of stakeholders).

Public Administration

The digital transition of the water sector brings potential to boost implementation of EU regulations and to improve management and decision making in ordinary and extraordinary periods. In order to capitalise on this, public administration groups can:

- Develop concrete policies to clarify obligations regarding the installation of technologies such as digital flowmeters, including provisions on responsibilities and cost bearing
- Strengthen regulatory frameworks and increase standardisation to prevent cyberattacks and unlawful data use
- Once the necessary regulatory frameworks are in place, ensure law enforcement to achieve concrete results and increase stakeholder buy-in.
- Ensure that users (e.g. domestic users, irrigators) can access the information gathered by digital technologies so that they can better understand their benefits, creating buy-in
- (Co)fund training schemes on ICT and digital processes for water utility employees and other stakeholders that could be directly affected by digital water management
- Support digital literacy and specific capacity building programmes for farmers, who tend to have a higher average age and are therefore less familiar with digital technologies, but at the same time could potentially gain the most benefits from their use, e.g. through improved irrigation
- Promote and roll out education programmes on digitalisation at schools, vocational schools and universities, in order to have better prepared future employees and users in the water sector
- Generate the space and conditions for a multi-stakeholder dialogue, including utilities, administration representatives, businesses and citizens, ensuring transparency and openness

References

1) United Nations, Department of Economic and Social Affairs, Population Division (2018) *World Urbanization Prospects: The 2018 Revision*, Online Edition. Retrieved from https://population.un.org/wup/Download/
2) Water Europe (2017) *Water Europe Water Vision 2030*, Brussels: Water Europe. Retrieved from https://watereurope.eu/wp-content/uploads/2019/07/Water-Europe-Vision_English.pdf
3) European Commission (2019, August 7) *Water Scarcity & Drought in the European Union.* Retrieved from https://ec.europa.eu/environment/water/quantity/scarcity_en.htm
4) Mutchek, M. & Williams, E. (2014) Moving Towards Sustainable and Resilient Smart Water Grids, *Challenges*, 5, 123-137. doi:10.3390/challe5010123
5) EEA – European Environment Agency (2018) European Waters: Assessment of status and pressures 2018, p.23. Luxembourg: Publications Office of the European Union. doi:10.2800/303664
6) IWA – The International Water Association (2019) *Digital Water – Industry leaders chart the transformation journey.* Retrieved from https://iwa-network.org/publications/digital-water/
7) McIntosh, A. & Gebrechorkos, S. H. (2014) *Partnering for Solutions: ICTs in Smart Water Management*, Geneva, Switzerland: ITU.
8) Silva Pinto, F., Tchadie, A.M., Neto, S., Khan, Sh. (2018) Contributing to water security through water tariffs: some guidelines for implementation mechanisms. *Journal of Water, Sanitation and Hygiene for Development*, 1 December 2018, 8 (4), p.730–739. doi: https://doi.org/10.2166/washdev.2018.015
9) Dige, G., De Paoli, G., Agenais, A.L., Strosser, P., Anzaldúa, G., Rouillard, J., Tröltzsch, J., Hinzmann, M., Ivarsson, M., Wallentin, E., Garrido, A., Blanco, I., Stroia, A. (2017) *Pricing and non-pricing measures for managing water demand in Europe.* Technical Report. Service Contract No 3415/B2015/EEA.56130 for the European Environment Agency.
10) Carayannis, E.G. and Campbell, D.F.J. (2009) ''Mode 3' and 'Quadruple Helix': toward a 21st century fractal innovation ecosystem', I*nt. J. Technology Management, Vol. 46, Nos. 3/4*, pp.201–234.
11) European Commission (2019, September 30) *Open Innovation 2.0.* Retrieved from https://ec.europa.eu/digital-single-market/en/open-innovation-20
12) WEF – World Economic Forum (2019) *Global Risks Report 2019*, 14th Edition. Geneva Switzerland: WEF
13) Ntuli, N., & Abu-Mahfouz, A. (2016). A Simple Security Architecture for Smart Water Management System, *Procedia Computer Science:* 83, 1164–1169. doi: https://doi.org/10.1016/j.procs.2016.04.239
14) The Source Magazine (November 5, 2018) *The rise of digital water.* International Water Association. Retrieved from https://www.thesourcemagazine.org/the-rise-of-digital-water/
15) Jimenez, M. (2018, August 7) *The impact of digitalisation on the water sector – An interview with Rebekah Eggers.* IWA. Retreived from https://iwa-network.org/the-real-impact-of-digitalisation-on-the-water-sector/
16) EIP Water (2014) *Barriers and Bottlenecks for Innovation in the Water Sector. Identification of Non-technological Barriers and Definition of Priority and Intervention Measures.* Final Report, Brussels.
17) Markard, J. (2011) Transformation of Infrastructures: Sector Characteristics and Implications for Fundamental Change. *Journal of Infrastructure Systems 17:3*, 107–117. doi:10.1061/(ASCE)IS.1943-555X.0000056
18) Anzaldi Varas, G.A. (2018) *Digital Single Market for Water Services Action Plan*, Final Report. ICT4Water. Retreived from https://ec.europa.eu/futurium/en/system/files/ged/ict4wateractionplan2018.pdf
19) Ler, L. G. (2016) Analysis of current ICT solutions in Water Business Processes, *Procedia Engineering 154 (2016)*, 3 – 10. doi: https://doi.org/10.1016/j.proeng.2016.07.410
20) Goubersville, P. (2016) Key Challenges For Smart Water, *Procedia Engineering 154* (2016), 11 – 18. doi: https://doi.org/10.1016/j.proeng.2016.07.412

Imprint

Authors: Gerardo Anzaldúa, Ariel Araujo Sosa, Benedict Bueb & Lorenzo Felicetti (Ecologic Institute)

Contributors: Eva Martínez Díaz (Aqualia), Nicolas Caradot (Kompetenzzentrum Wasser Berlin), Ulf Stein (Ecologic Institute).

The interviewees consulted chose to be kept anonymous. The authors extend their sincere thanks for their time and contributions.

Contact: gerardo.anzaldua@ecologic.eu

Layout: Lena Aebli (Ecologic Institute)

Pictures: Icons on p. 9 & 10:"Academia" by mynamepong, www.flaticon.com; "Public Administration" and "Business" by Kiranshastry, www.flaticon.com; and "Civil Society" by Freepik, www.flaticon.com, p.8 paris-4627143_1920: Image by DUOTONE from Pixabay, p.1 Copenhagen: Credits_Kontraframe

Date: December 2019

Digital Water .City

Arctik
Communication for sustainability

Berliner Wasserbetriebe

BIOFOS

GRUPPO CAP

DHI

eco logic

fluidion
fluidic intelligence

irstea
LA SCIENCE AU CŒUR DE L'ENVIRONNEMENT

ICRA
Catalan Institute for Water Research

ICATALIST

IOTSENS
GRUPO GIMENO IoT Division

iPEK

ISTITUTO SUPERIORE DI SANITÀ

kando
Clear Upstream

KOMPETENZZENTRUM WasserBerlin

PARTNERS4URBANWATER
Langeveld | Liefting | Schilperoort | De Haan | Post

SINTEF

Sofiyska Voda
operated by VEOLIA

SCIENCES SORBONNE UNIVERSITÉ

Strane Innovation

SIAAP
Greater Paris Sanitation Authority

UNIVERSITÀ DEGLI STUDI DI MILANO

UNIVERSITÀ POLITECNICA DELLE MARCHE

VRAGMENTS

digital-water.city
digitalwater_eu

digital-water.city has received funding from the European Union's H2020 Research and Innovation Programme under Grant Agreement No. 820954.

Annex

Digital-water.city – Task 5.3.1
Interview Questionnaire

1. Please tell us a bit about yourself, your position and briefly about the involvement of your company/sector in the digitalisation (transition) of the water sector?

2. What is the position of your organisation towards the trend of digitalisation in the water sector? (rather positive, negative, no clear position yet taken)

3. Do you think there is a general perception in the sector your organization is involved of such a digitalisation trend?
4. How would you evaluate the current and future potential for the rollout of digital/ICT technologies in the water sector? (rather low – high)

5. What main risks/concerns do you perceive regarding the digitalisation/ digital transition of the water sector?

6. Which challenges do you think that digitalisation in the water sector is currently facing?

7. What framework conditions (e.g. political, economic, financial, technical, social, …) do you think are necessary to ensure a sensible and efficient digitalisation of the water sector?

8. How can your sector/branch contribute to facing/solving these challenges?

9. In your opinion, how does the water sector look like in terms of digitalisation by 2030 (in your city/country/region/globally)?

10. Is there anything else you want to tell us that you think could be of interest for our research?

11. Can you think of contacts in your professional network that might be interesting for us talking to?

Terminology

- Position: The official stance of an organization/ group of stakeholders towards digitalisation in the water sector as communicated externally to the public.

- Perception: The informal, personal stance of the interviewee towards digitalisation in the water sector based on personal experience and expectations about the development of the sector.

digital-water.city has received funding from the European Union's H2020 Research and Innovation Programme under Grant Agreement No. 820954.

- Digitalisation: the process of employing data and digital technologies to transform, restructure and enhance business operations. In the water sector, relevant digital technologies include data collection devices and equipment such as sensors, monitors and satellites; data processing systems such as geographic information systems (GIS) and modelling software, and data sharing tools such as cloud computing, among others.

- Water Sector: The water sector is referred to here as the water supply and sanitation system and all its stakeholders. This includes the authorities responsible for the governance and management of water resources; the public and private entities directly or indirectly involved in the abstraction and distribution of water supplies, the treatment and disposal of residual waters and the operation and maintenance of water supply and sanitation infrastructure; and the users (divided into domestic, industrial and agricultural users).

digital-water.city has received funding from the European Union's H2020 Research and Innovation Programme under Grant Agreement No. 820954.