D10.6 – Market Analysis Report v1

WP10 – Impact Creation, Dissemination and Exploitation

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ABSTRACT	In the current document we are going to examine the water management market, which is the overall domain in which aqua3S belongs to. More specifically, we are going to examine the market size and trends, the growth rate of the market, the various stakeholders, the existing business models and the competitive landscape. We are going to dive into the specifics of aqua3S solution and examine which are the strengths and weaknesses of the proposed solution, while we are also going to examine the political, environmental, social and technical drivers. We are also going to address other aspects, such as the customer segmentation and the existing economic models.		

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ABBREVIATIONS/ACRONYMS

AMR	Automatic Meter Reading
AI	Artificial Intelligence
AMI	Advanced Metering Infrastructure
APAC	Asian-Pacific
API	Application Programming Interface
CAPEX	Capital Expenditure
CIS	Customer Information System
COVIRI	Committee for the Supervision of the Water Resources Use
EC	European Commission
EU	European Union
EUR	Euro
GAGR	Compound Annual Growth Rate
GDP	Gross Domestic Product
ICT	Information and communications technology
IoT	Internet of Things
MDM	Meter Data Management
OECD	Organization for Economic Co-operation and Development
RO	Regional Operators
SCADA	Supervisory Control and Data Acquisition
SWM	Smart Water Management
UK	United Kingdom
UN	United Nations
US	United States
USD	US Dollar
WRD	Wastewater and Re-use Division

1. Executive summary

United Nations defines Water Security as "*the capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being, and socio-economic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability* [1]." Contaminated water and poor sanitation are linked to transmission of diseases, while inadequate management of urban, industrial, and agricultural wastewater means that the drinking-water of hundreds of millions of people can be dangerously contaminated or chemically polluted. At the same time all drinking water systems have some degree of vulnerability to contamination, and analysis shows that it is possible to contaminate drinking water at levels causing varying degrees of harm.

According to the Organisation for Economic Co-operation and Development (OECD) water demand will increase by 55% compared with 2015 levels and this will mainly result from the growth of population. The above number highlights two issues: *1) the increasing complexity of managing water resources that has necessitated, both in the past and now, the need for transitioning from more traditional tools of water production, distribution and management to more automated ones*; and *2) the subsequent importance of those tools (and plans) being in place, to help responsible parties respond immediately and under any circumstance and especially under emergencies.*

Smart Water Management tools and more specifically water security tools can help in identifying security vulnerabilities and subsequently establishing security measures, to which aqua3S solution belongs. aqua3S will integrate a series of state-of-the-art technological achievements from multidisciplinary fields, namely of the era of sensors technology, IoT, semantic reasoning, high-level analytics, decision support systems, crisis management and situational awareness. The focus of aqua3S will be to help ensure safe and secure water for everyone, under various circumstance, including emergencies. aqua3S will help in enhancing the security and safety of existing water networks, establishing smart networks of dynamic entities to foster situational awareness and decision making, developing an early warning and decision support system, which is empowered with advance functionalities for visualization and crisis management, raising social awareness, populating warning messages and alerting the public, as well as deploying solutions and mitigation actions of first responders formulating the emergency response plans for the water sector. Practitioners from water, medical sector, first responders and utility providers will be enabled to employ the aqua3S to seamlessly access valid assessments of the crisis that may be caused by hazardous natural or manmade malicious actions and help them make the necessary decisions.

The current document provides an overview of the Smart Water Management market, which based on the evidence, seems to be a promising market. More specifically an analysis of the overall market, including its' current size and its' forecasted growth within the upcoming years, is provided. The market size confirms if a market is big enough to warrant an investment of time, and potentially investor/lender funding, into pursuing the opportunity. If the market is too small a reasonable return on investment cannot be guaranteed. Although the promise of the specific market was showcased before the project, further analysis is verifying those first findings. Furthermore, there is a global view of the market, but there is also a focus towards the European and Asia Pacific markets respectively. This is because the first one apart from promise in the growth rate, is where aqua3S solution is being developed and partners have already have established networks, which they can take advantage of, while the latter as a potential market that is evaluated as a rather promising one.

Likewise, market trends are also provided in the analysis, which showcase if the market is increasing or decreasing, and how the market is changing. In the current analysis a number of trends and triggers were identified. Those are the driving forces that point toward the further development of the Smart Management Water market, verifying the foreseen growth.

The competitors landscape provides a mapping of both the direct and indirect competition. This will help aqua3S compare to existing solutions, identify its' added value and position itself. A competitive analysis can also help in identifying potential opportunities within the market that may have been overseen prior.

On top of the above a SWOT and PESTEL analysis are also provided. Those help identify the strengths, weaknesses, opportunities and threats for aqua3S internally, while also the micro economic external factors that can act as multipliers or barriers for the uptake of aqua3S.

Finally, a market segmentation is also provided. Through that a grouping of the market into relatively homogenous segments was achieved. The detailed segmentation was done for the European market, which is the primary market of focus. The segmentation allowed for commonalities and patterns to be identified within the sector in Europe that will also help the positioning of aqua3S.

2. Introduction

The current document is an update of D10.4 Market Analysis V1, which was delivered in M12 of the project. As in the first version, an analysis of the water management market is entailed. An overview of the market size and trends, the growth rate of the market were included, while in this version a more detailed view of the European market, to which aqua3S is expected to penetrate firstly and the Asia Pacific market, which seems to have the most potential, is also provided. The various stakeholders, the existing business models and the competitive landscape, is also included from the first version.

The document showcases the specifics of aqua3S solution and examines which are the strengths and weaknesses of the proposed solution, while also examining the political, environmental, social and technical drivers for both the European and Asian Pacific markets. Other aspects are also addressed is the customer segmentation, which in this version is expanded outside the existing European countries, across Europe.

This second version is a more mature and extended version that includes an additional focus on the two potential markets that were identified as possible markets for the aqua3S solution. The market analysis along with the identification of the Intellectual Property Rights, are the stepping stone for the development of the exploitation plan, which will aim to ensure the commercialization and sustainability of aqua3S products and services during and beyond the project lifetime.

3. Water safety and security market overview

Water security is essential to humankind as it supports public health, economic growth, environmental sustainability, political stability and disaster risk reduction. It is apparent that the world needs flexible and resilient water systems that anticipate and monitor changes in circumstances. Sustainable management techniques need to be implemented to protect water cycles and reduce the impact of human activity (on purpose or by accident) and its' results on them.

Smart Water Management (SWM) aims at the exploitation of water, at the regional or city level, on the basis of sustainability and self-sufficiency. This exploitation is carried out through the use of innovative technologies, such as information and control technologies and monitoring.

Those technologies that are used within the SWM market can be divided into the following segments:

- Water Meters
  - AMR/AMR+ Meters
  - AMI Meters
- Solutions
  - Enterprise Asset Management
    - Asset Condition Monitoring
    - Predictive Maintenance
  - Analytics and Data Management
    - Meter Data Management
    - Supervisory Control and Data Acquisition (SCADA)
  - Security
  - Smart Irrigation Management
  - Advanced Pressure Management
  - Mobile Workforce Management
  - Network Management
  - Customer Information System (CIS) and Billing
  - Leak Detection
  - Others (Demand Side Management, Incident Management, and Outage Management)
- Services
  - Professional Services
    - Deployment and Integration
    - Consulting
    - Support and Maintenance
  - Managed Services

Within the Smart Water Management market, the security segment is an important part that still poses a global and growing challenge. As populations, cities and economies grow, and the climate changes, greater pressure is being placed on water resources, increasing the exposure of people and assets to water risks. On top of that there are also contamination threats and intentional water contamination incidents that are designed to disrupt the delivery of safe water to a population, interrupt fire protection, create public panic, or cause disease or death in a population. As the impacts of those water "insecurities" materialize, they can have negative and differential impacts on the well-being and livelihoods of populations and economies within nations, hence the need for more secure and safe water will become more and more evident.

Water security is also interlinked with economic growth, which means that now and, in the future, investments are necessary to help that segment grow even more. Investing in water security protects society and sectors from specific water risks and can have a profound positive effect in economic growth, inclusiveness and the structure of economies. On the other hand, as economies and populations grow, so are the assets, economic activities and populations, facing water risks, creating a "vicious circle". As a result, investments should be developed in order to be robust to uncertainties and to support adaptive management as risks, opportunities, and social preferences change.

3.1 Market size and growth

According to the Organization for Economic Co-operation and Development (OECD), between 2020 and 2050, water demand is expected to increase. To manage this high demand, there is a need to manage the current water resources, as well as to prevent water wastage. Although currently, the focus is high on the adoption of advanced water meters, MDM, and SCADA solutions for water utilities in many countries, this is expected to change gradually towards smart technology solutions, such as predictive maintenance, workforce management, and analytics. Additionally, the adoption of cloud-based solutions for distribution network monitoring, which does not require any Capital Expenditure (CAPEX) from utility's end, is expected to witness greater traction in the near future as well. In addition to the above, the mandatory government regulations are another parameter that comes into place to shape the Smart Water Management (SWM) market, since there are now pre-requisites, as far as the conditions of the infrastructure and the quality of water is concerned.

Within this framework, the global Smart Water Management market size is expected to grow from USD 11.7 billion in 2019 to USD 21.4 billion by 2024, at a Compound Annual Growth Rate (CAGR) of 12.9%. As showcased above, the key factors driving the growth of the market include the ***rising demand for quality water services***, ***need to replace aging water infrastructure***, ***rising digitalization of utilities sector***, and ***government regulations*** favouring the development of smart water management solutions [4]. Those trends and the reasons that led towards the growth of the market within those segments, are further analysed in the section 3.2Market trends. It should also be noted that by solutions, the enterprise asset management segment is estimated to hold the highest market share owing to the increasing adoption of real-time condition monitoring and predictive maintenance of assets.

In the sub-sections below we are taking a closer look to what we consider to be two prominent markets to which aqua3S solution will penetrate. The European through its' pilot cases first, as well as the Asia Pacific market, that although seems to face many difficulties, at the same time it seems to be from the most promising ones, in terms of investments and thus profits.

3.1.1 European Market

The European smart water management market is estimated to grow at a CAGR of 12.9% until 2025. In 2018, the European smart water management market was valued at nearly $2.1 billion to reach nearly $4.8 billion in 2025. Europe is a significant contributor to the global smart water management market owing to its government regulations coupled with increasing infrastructures. Europe has a water distribution network of around 3.5 million miles. The large water distribution network in the market has created a huge challenge for the government related to the management of this water distribution network.

The hefty investments done by the European Union for the improvement of water infrastructure are further anticipated to fuel the market of European Smart Water management. For example, as per the

EU Commission report, in April 2019, EU invested more than $150 million in better potable water and wastewater system in Timis County. Besides investments in hardware and infrastructure, in Digital Single Market for Water Services Action Plan the EU has laid out a vision for the future of the smart water system across Europe. This action plan will further support the growth of the European smart water management market. Amongst other the Commission mentions in the plan the following "*…the water domain is characterized by a* ***low level of maturity concerning the standardization of ICT solutions****, their business processes and the* ***related implementation in the legislative framework****. This is due to the* ***fragmentation of the sector****, no holistic vision being set out and* ***a lack of integration and standardization of the technology****. The development of system standards is essential for smart water solutions that should* ***ensure interoperability of solutions****, i.e.* ***adaptability of solutions*** *to new user requirements and technological change, as well as avoidance of entry barriers or vendor lock-in through promoting common meta-data structures and interoperable (open) interfaces instead of proprietary ones"* [5]. aqua3S's added value is already aligned with the abovementioned goal as showcased in the aqua3S added value section in detail.

3.1.2 Asian Pacific Market

As recognised in the first version of the market analysis the Asian Pacific market can be a potential market for the growth of aqua3S solution. The APAC market shows a rapid growth since it holds more than 50% of the worlds' population. More specifically according to the Asian Infrastructure Investment Bank ***"Continued population growth****,* ***rapid urbanization****,* ***industrial and economic growth*** *make Asia's water challenges more urgent than ever. At least half a billion people in the region currently face water shortages. More than a billion do not have access to drinking water supply and sanitation services. While demand for water will grow in line with population growth and urbanization (expected 30% increase in domestic water demand by 2030), many service providers already struggle to keep up with supplying basic services. Unless action is taken, this will deteriorate further. This is compounded by weak performance of water service providers, including very high levels of non-revenue water (water lost or unaccounted for in distribution systems), with predicted annual revenue loss in the order of USD 12 billion across Asia"* [6].

To rectify the current situation, the aim is investing in:

- Promoting sustainable infrastructure;
- Integrated resource management;
- Mobilising private capital efficiencies; and
- Adopting innovative technologies.

More specifically the adoption of technology can be a major contributor to increasing efficiency of water use, allocation, delivery and treatment. Effective monitoring, data management and analysis can significantly improve efficiency of governance, management and service delivery. Technology and data management are also critical to improving resilience, particularly disaster prediction, preparedness and management.

Such figures and data signify the need for water management and indicate the potential for market growth in the region. Significant initiatives, to develop smart water systems, are evident in the Asian countries, like Malaysia, Vietnam, and Thailand, among others, already indicating the scope for the growth of the market and the potential for the aqua3S solution.

3.2 Market trends

In the sections below we are examining the triggers that will create the responding upcoming trends of the water industry. It should be noted that all triggers seem to be fuelling the digitization of the sector in one way or the other, hence most of the upcoming trends, although may be triggered by other parameters, they are included under the technological triggers and trends.

Environmental triggers

The **effects of climate change** are related to water in one way or another and affect agricultural production, contribute to sea level rise, trigger wildfires, and bring about drought and flood events. For example, with more than half of the world's population living within 200 km of the coast by 2050, sea level rise and extreme storm surges will affect coastal communities to a large extent.

The **reuse of wastewater** to support a circular economy. Traditional investment, planning, design and operation are linear in nature. Water is extracted from the source, checked for quality, used as intended and then treated and discharged in a receiving water body. However, wastewater and its discharged sludge contains a great number of valuable resources, such as nitrogen, phosphorus, energy and other nutrients that can be recovered and reused in a circular economy to preserve threatened resources.

Population triggers

The **rise of the population**, which, according to the UN, is expected to reach more than nine billion people in 2050. To make sure there is enough food for everyone, it is estimated that global food production needs to be increased by 70%. This requires more arable land for crop production, with more extensive and efficient irrigation. All of this will challenge water resources and ecosystems.

It is not only the growth of population, but also urbanization, migration, and the number of households, which are some factors that are less commonly associated with demographic effects on water resources, although they are also important. Population size is fundamentally linked to water use. Although the relationship is nonlinear, in general the more people there are, the more resources, such as freshwater, humans will ultimately consume. In other words, population distribution and trends can affect water quality. The number of households is increasing worldwide, as the average household size is decreasing. It seems likely that the decrease in household size will affect future domestic water demand, due both to household-related economies of scale and to a decrease in the effectiveness of investments in technical water-saving measures. Additionally, a growth in the number of households will have indirect effects on water supply and quality. Furthermore, the redistribution of population by migration can shift pressures on water resources, primarily as a major contributor to urbanization [7].

Technological triggers and Trends

The **smart and intelligent network technologies** of physical water infrastructure by collecting and analysing data more efficiently. The use of Internet of Things (IoT) devices and data analytics not only help to better manage infrastructure and reduce non-revenue water losses, but also support important changes to the ways in which water utilities and companies operate. Smart end-to-end water networks offer businesses the opportunity to improve productivity and efficiency while enhancing customer service.

- **Technology trend**: Residential usage of water accounts for a large portion of water consumption, globally, as water is considered as one of the luxuries that need to be conserved efficiently. Technology will play a vital role in making people liable for misuse of water, since the trend from other domains is being transferred in the slower to adopt ones, such as the water domain. That will have a great impact as to the ways customers use the water and to the responsibility that each has towards it. In terms of water technology trends, there is a clear shift to making them cheaper and thus more accessible, while at the same time also making them more efficient.
- **Data trend**: Efficient and effective use of data and interoperability of data, are another trend. Up until now providers and companies typically used a small portion of data to perform tasks or to solve specific problems, but left the majority of data unexploited. In many cases, the inconsistency of data within or across organisations made it difficult to aggregate data for analysis and as a result extract useful information. But the trend seems to be for exchange and interoperability of data, from various sources, in order for more complete and complicated analysis to take place. The result of those will be the provision of insights across organisations and outside them (i.e. with customers).
- **Digitization trend**: Along with the adoption of connected technologies and interoperability of data, digitization of the sector is impacting all applications of smart water management solutions, by revolutionizing the way smart water management systems interact with the surroundings in the residential sector.

Consumer triggers and Trends

A customer-led revolution, since consumers are more than ever empowered by digital technology. As a result, they continuously expect more personalised products and services to optimise their work, improve their way of life and help them reach their goals. To meet these expectations, businesses must deal with the reality of an empowered customer.

- CONSUMERS TREND: ON TOP OF THE TECHNOLOGY TRENDS, THEY ARE CUSTOMERS ON THEIR OWN MERITS THAT ARE UPGRADING THEIR RESIDENCES BY ADOPTING SMART WATER MANAGEMENT SOFTWARE AND HARDWARE. THIS ADOPTION RATE IS RAPIDLY PROLIFERATING, AS SOFTWARE AND HARDWARE ARE BECOMING CHEAPER AND AFFORDABLE. AGAIN IN THIS TREND THE TECHNOLOGICAL ADVANCEMENTS IN OTHER, MORE CUSTOMER-ORIENTED SECTORS, ARE ALSO DRIVING CUSTOMER POWER AND GROWING CUSTOMER EXPECTATIONS.

Consumer Behaviours and psychographics

Water authorities are dealing with the challenge of ensuring that there is enough water to meet demand. In order to develop effective household demand management programs, water managers need to understand the factors that influence household water use or in other words the water consumers' behaviours and consumption patterns. In the recent literature there has been increasing recognition of the relationship between water-use behaviour and water-use technologies and the need for a greater understanding of the underlying psychological process that help determine water-use behaviour [7]. There is a growing body of research examining the determinants of water use and conservation. Factors that have been investigated include household and social demographic

characteristics such as number of occupants in a household, water-use practice, attitudes and values, water pricing and the installation of water-efficient appliances.

The identification of the parameters that affect the behaviour of consumers should also come into place to complement new technologies and efforts towards becoming more efficient water users.

3.3 Stakeholders

A stakeholder is a party that has an interest in a company and can either affect or be affected by the business [8]. Stakeholders can be internal, in which case there are people who have a direct interest in that company or external, in which case there are people who have no direct interest in the company. Below both direct and indirect stakeholders of the Smart Water Management market are showcased:

Direct stakeholders:

- **public-sector agencies** involved in water resources (water utilities, hydropower generation companies, water authorities, national and local environmental authorities);
- **private-sector organizations and companies** with water interests (hydropower generation companies, water companies, utilities companies);
- **representatives** of those people likely to be affected, specifically including people who may have little knowledge of the effects of strategy and who may lack the means to participate;
- SMEs that produce software or hardware for the water sector;
- An additional direct stakeholder for aqua3S that targets the security segment within the Smart Water Management market is that of **first responders**.

Indirect stakeholders:

- environmental and professional NGOs; and
- universities and research centres;
- river associations, water boards and irrigation boards;
- policy makers;
- Governmental and non-governmental organizations;

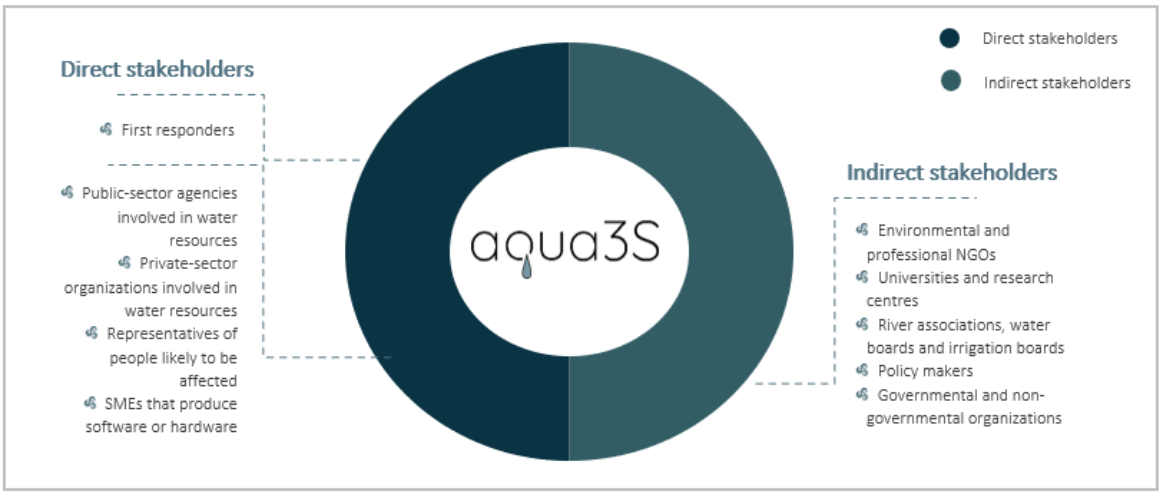


Figure 1. aqua3S stakeholders

But how are those stakeholders involved and in what extent in the water domain? On the one hand, legislations and policies in most countries derive from governments on a national or local level, as well as from agencies. On the other hand, public water authorities in most countries are responsible for

service operation, consumer relation management, electromechanical renewal, existing infrastructure renewal, main infrastructure extension and R&D.

At present, the water market mainly consists of public players in most EU Member States. However, the roles and responsibilities of the different bodies vary widely by country and during the last few years the decision-making power for some has been transferred to private operators as well. Those operators are a few private equity companies that operate on a country level or even multinational level, which implies that there is a major market potential there.

At the other end of the spectrum the software providers and water equipment manufacturer market is at the moment highly fragmented. Most software providers carry water management software as one product of a larger portfolio and create customary software for the different water services companies. Equipment providers tend to specialize in the water-related markets, but not limited to water services, but also working with industrial applications and agriculture. It is true, however, that there is a tendency towards outsourcing, as technological advancements, especially in metering, are very demanding and require some degree of expertise and specialisation. National water associations play an important consultative role and represent the interest of consumers, as well as provide information on the relevant water markets.

4. Competitive Landscape

According to the Cambridge dictionary competition is the situation, in which someone is trying to win something or be more successful that someone else [9]. In the case of aqua3S, the overall (direct or indirect) competition is going to be examined in respect to the products and solutions that already exists in the market. The competition analysis, along with the presentation of aqua3s in the next chapter, will allow for defining the added value of the solution in respect to the existing ones, as well as its strengths and weaknesses, the barriers to entering in the market and the opportunities and threats that result from the current status quo.

4.1 Overview of landscape

Water companies use software for water management, metering and other functions supplied by a local or software international expert. When researching the market share, many companies were found, however, it is not clear who are the leading companies. This may also be due to the fact that the software market is highly fragmented with most of the providers focusing on water and wastewater treatment technologies. Furthermore, more often than not it seems that most of the companies that offer water-related software solutions carry this software as smaller part of a wider portfolio of activities.

On the other end the market seems to be consolidated for a few dominant players. Those are usually big companies that have expertise both with hardware (equipment) as well as software. That growing number of international, mainly, companies have resulted in intensified competition and high initial investment. Those larger enterprises in the water-related sector still generate a greater share of value than the companies in the smaller size classes.

In the sections below we see how aqua3S fits within the existing market, which are considered as direct competitors and which as indirect.

4.1.1 Direct Competition

As direct competitors are considered the companies that provide software solutions. Those solutions may fall under the SWM market in general or address - completely or partially - the safety and security domains, under which falls **aqua3S**. The benchmarking is done based on the modules that will be provided by **aqua3S** for the specific segments mentioned above.

Before breaking down the competition an overview of the aqua3S is provided. The main objectives of aqua3S are: (i) ***to create strategies and methods in order a water supply facility to integrate solutions regarding water safety with ease***; (ii) ***to propose innovative sensor technologies to support water safety***; (iii) ***to create early warning methods for water authorities***; (iv) ***to create a complex collaborative system recording problems and finding new solutions***; (v) ***to allow easy engagement of different authorities in a water related crisis***; (vi) ***to create/use methods estimate the infrastructure resilience level***; (vii) ***to introduce bottom-up approaches such as citizen mapping initiatives, that can be an effective way to build large exposure databases***; (viii) ***to model and classify a crisis event.***

To that end, aqua3S platform combines novel technologies aiming to assist the water safety and security, as well as the standardisation of current existing sensor technologies. On the one hand sensors are deployed in several parts of the network and their main sources; on the other hand, sensor measurements are complimented by images and videos captured from UAVs, satellites or found at social media websites. Semantic representation and data fusion provides intelligent DSS

alerts and are able to generate effective notifications and social interaction, aiming also to engage first responders or agencies. Algorithms for threat detection and localization, as well as 3D representation of early warning systems are optimised and parallelised so as to offer a highly scalable solution to the potential stakeholders.

The following table provides an overview of the parties that stand to benefit from the implementation of aqua3S and the value it will add through its' various services.

Target groups	Need	Value proposition	aqua3S service
1. Public sector agencies	Compatibility with existing systems	Integration to legacy systems	Installation of aqua3S platform
	Improved communication channels with the public	Data mining from twitter	Social media crawlers
2. Private sector companies	Faster response from water authorities	Automated notification of relevant parties	Early warning component
	Ease to use interfaces	3D visualization methods	Visual analytics module
3. Enterprises that develop similar hardware and software solutions	Real time updates	Real time management capabilities	Real time management components
	All in one solution	Modular nature of the platform	aqua3S platform
	Constant updates to the software		

Table 1. aqua3S Value proposition

The paragraphs below are an oversimplified analysis with information on the competition of **aqua3S** to help us create the competition matrix and to draw some conclusions in respect to the competitors' landscape.

Innovyze is a US based company, with offices in Europe, Middle East, Africa, India and Asia Pacific, that provides a number of products for the water domain:

i) Asset Management;
ii) Drainage Design and Analysis;
iii) Artificial Intelligence and operational Analytics;
iv) Stormwater, Sewer and Flood Modeling and
v) Water Distribution Modeling and Management.

Figure 2. Innovyze products

The above are bundled in products that are provided through different platforms and are focused more on the Enterprise Asset Management section of the market.

DIH is a US based company, with offices in Asia Pacific, Europe, Middle East and Africa and North and South America. The companies provide various services/ solutions to various sectors:

- Consulting Services in a number of domains including
- Agriculture,
- Aquaculture,
- Climate Change,
- Energy,
- Mining, etc;
- Business Applications including but not limited to:
- ClimADAPT,
- Coastal Screener,
- FloodRisk,
- GlobalSEA Oil Spill, etc;
- Operational Services including but not limited to:
- Future City Flow,
- MIKE Mine,
- Seaport OPX, etc; and
- Data Portals including but not limited to:
- Global Hydrological Model,
- MetOcean Data Portal,
- Marine Animal Movement Portal, etc.

Figure 3. DIH group domains of expertise

DIH touches upon a number of different areas of expertise connected with water, but is positioned directly within the Smart Water Management with some of those applications that address specific issues (i.e. flood risks, leakages).

Delartes is a Netherlands based company and its' areas of expertise revolve around:

i) Flood Risk;
ii) Adaptive Delta Planning;
iii) Infrastructure;
iv) Water and Surface Resources; and
v) Environment.

Some of the products related to the Smart Water Management domain are the following:

i) WANDA: Pump & Line sizing, Flow distribution, Pressure surge analysis, Surge vessel design & sizing, Operational control, Heat transfer analysis;
ii) Delft-FEWS: Delft-FEWS is an open data handling platform initially developed as a flood forecasting and warning system;
iii) iMOD: iMOD is an easy to use Graphical User Interface; and
iv) DAM: DAM (Dike strength Analysis Module) is a software package for the automated calculation of the strength of dikes.

Deltares services are bundled in Simulation Products, Solutions, Serious Games and Apps, Web and Touch Table Applications Toolboxes addressing different needs of potential customers and positioning it in different segments of the Smart Water Management market (including security).

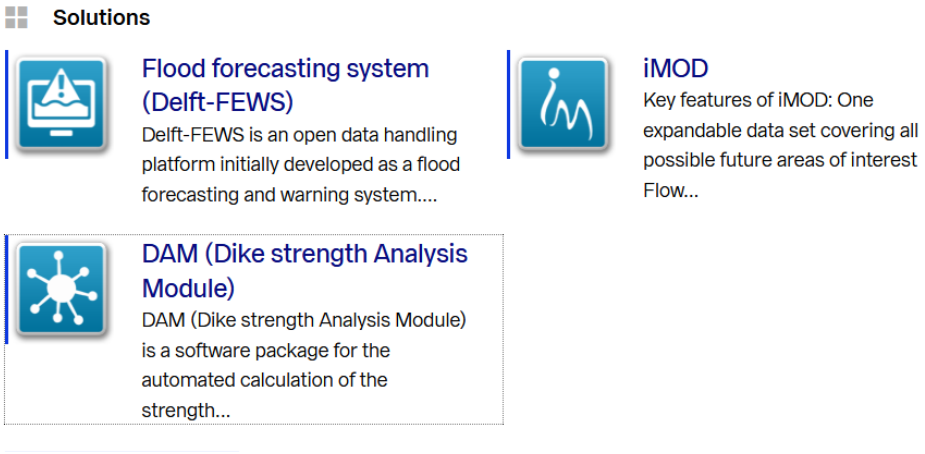


Figure 4. Delartes products

Terra Marra is a US based company that is active as **a systems integrator** to the water treatment industry, pooling the best in class technology in water treatment, systems monitoring and control, and purification from a myriad of water sources all the way through the system to the point of application, use, or dispense. Terra Marra offers solutions for:

i) Water Management Surveys,
ii) Energy and Utility Sustainability Audits,
iii) GREEN Building and LEED Points,
iv) Indoor Air Quality and Efficiency Audits,
v) Insurance Liability Evaluations,
vi) Environment of Care Pre-Audit Educational Reviews,
vii) Water System Management,
viii) Improved Building Records Data Collection and
ix) Industrial Hygiene Audit Solutions.

Figure 5. Terra Marre products and services

As a systems integrator Terra Marra falls under the Services segment of the Smart Water Management market.

Valarm is a US based company that developed a powerful platform for Industrial IoT applications collecting GPS- tagged sensor and transform them in:

i) Flood Monitoring Systems;
ii) Water Resource Management;
iii) Water Usage;
iv) Natural Resources;
v) Flow Meters and Water Usage Totalizers and
vi) Water Quality Monitoring for Government Agencies/ Smart Cities/ Communities.

Deploying the power of IoT Valarm is positioned within specific segments of the Smart Water Management market, but expanded in additional markets.

Figure 6. Valarm products and services

Esri is a US that provides ArcGIS a software tool that can be adapted in various sectors including the water management one. The software can be installed and customized for visualizing spatial data, performing distributed analytics and exploring big data. Among the sectors that Esri is serving is that of water and the solution developed is:

i) Arc Hydro: Esri's Arc Hydro consists of a data model, toolset, and workflows developed over the years to support specific GIS implementations in water resources. It operates on both ArcGIS 10.x and ArcGIS Pro platforms. Arc Hydro helps you build a foundational dataset that can be used in water resources analyses and for integration with water resource models. It standardizes water data structures so that data can be used consistently and efficiently to solve water resource problems at any spatial scale.

Esri is positioned within the services market.

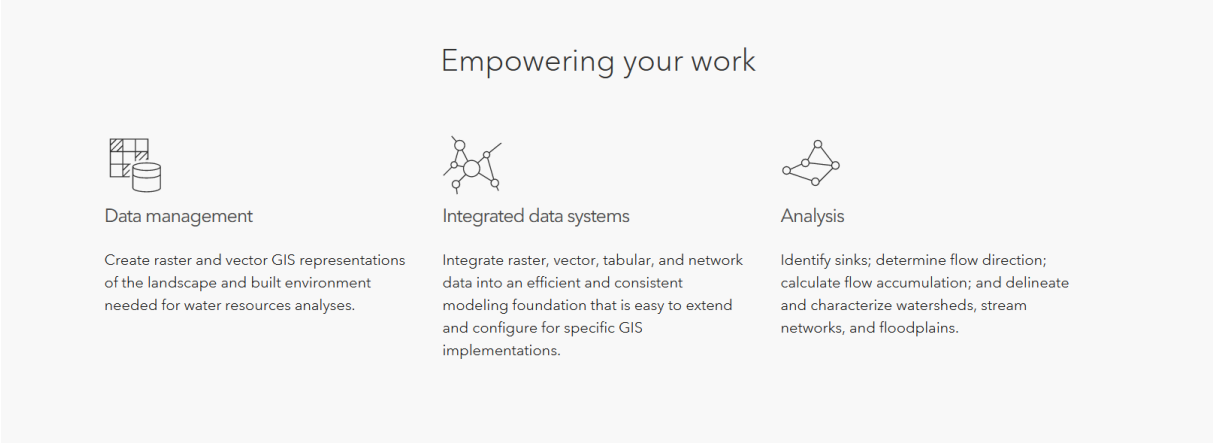


Figure 7. Arc Hydro product pillars

i20 is a UK based company that provides solutions that address the global water challenges. The solutions provided include:

i) Network Analytics: i2O Network Analytics provides a powerful Google Maps interface, which layers information and insights onto a map, bringing together network-relevant data to maximise actionable insight in a single location. The solution is hardware agnostic, and supports data ingress from both i2O and non-i2O devices deployed anywhere in the network;

ii) Advanced Pressure Management: i2O Advanced Pressure Management enables clients to remotely control and automatically optimise pressure across the entire network – at PRVs and pumping stations – to minimise water loss;

iii) Data Logging: i2O Data Logging enables clients to cost-effectively monitor flow and pressure throughout their network; and

iv) Devices: i2O's range of hardware is manufactured in the UK to externally audited ISO certified quality standards.

The solutions are either hardware based or can be provided as SaaS and be integrated in existing systems, while the positioning is in the Solutions segment.

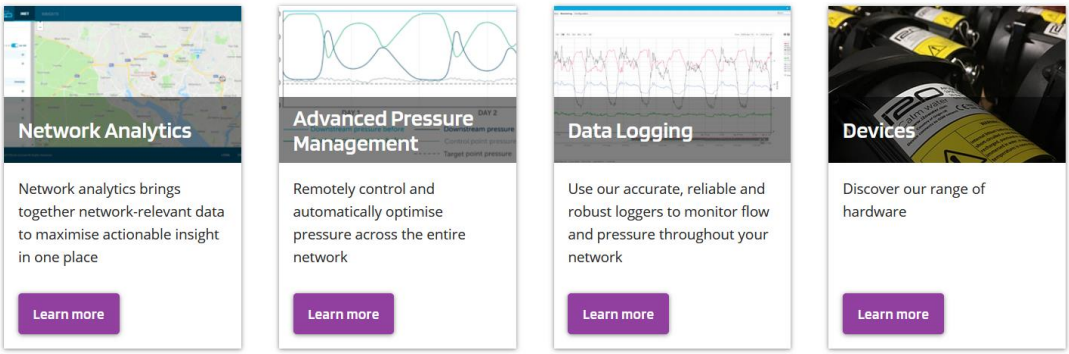


Figure 8. i20 solutions

Sensus is a US based company with offices in Europe, Middle East, Africa and North America that focuses on providing smart water management insights for the optimization of operations. The solutions provided are for the water and electricity sectors and they are the following:

i) Hardware
   a. accuSTREAM water meters
   b. Act Pack Remote Monitoring Instruments
   c. Ally water meter
   d. Command link Wireless Interace
   e. FieldLogic handheld device
   f. FlexNet easy reader
   g. FlexNet EasyLink WorkBook

ii) Software
   a. Accoustic Monitoring application
   b. Admin Application
   c. Alarm Insight application
   d. AutoRead Software
   e. AutoVU software

Sensus mainly It builds upon infrastructure and hardware provided, integrating it with an interface for the data and analytics to monitor, measure and predict business performance.

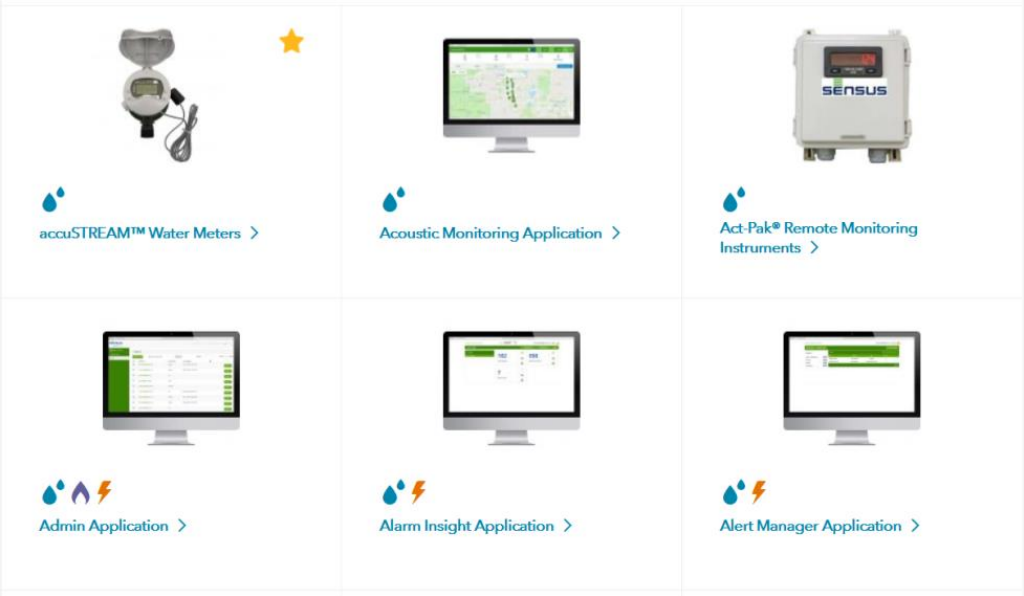


Figure 9. Sensus water hardware and software solutions

Trimble Water is a US based company with offices in Europe, India and Thailand. Trimble provides solutions vertically for the water, wastewater and stomwater sectors through:

- Software: Trimble Unity software platform offers a suite of applications and tools to support smart water management. Those Include advanced workflows to map, manage, measure and improve asset performance, reduce operations costs, and improve public health and safety
- Remote monitoring: A single platform solution for proactive, remote monitoring, alarming, and reporting of water, wastewater and storm water, powered by Telog, a Trimble Company and proven water IoT industry leader in wireless, battery-powered remote monitoring technology;
- GPS and Mobile Devices: The Trimble® TDC600 handheld is a sleek, all-in-one rugged smartphone with a built-in professional GNSS receiver. Designed for ease-of-use in a wide range of GIS applications, the TDC600 helps you collect and retrieve highly accurate spatial information while

staying in touch with the office—all with a single device. It's the smart, productive way to collect data and communicate from the field;

- Professional Services: Business Process Definition/Re-engineering, Program/Project Management, Solution Engineering, Custom Solution Development, Systems Integration and
- Remote Monitoring Solutions-as-a-Service: The Trimble Remote Monitoring Solutions-as-a-Service (RMSaaS) program removes technology complexity by providing a turn-key solution for water and wastewater infrastructure monitoring, delivering data and intelligence to help utility managers address key challenges.

The software platform works as a suite of applications and tools to support smart water management, including advanced workflows to map, manage, measure and improve asset performance, reduce operations costs, and improve public health and safety. Trimble addresses the security market through a specialized application that identifies, supports managing and reporting of incidents and other issues of the water network.

In the figure below aqua3S in the following section the solution is depicted in four pillars: ***Crisis classification and Support Decision, Visual Analytics, 3D Visualization and Crisis Management Scenarios.*** Each of the pillars entails the different tools and components that are used by the aqua3S solution. The comparison with the competitor solutions is done based on that categorization.

	Crisis classification & Decision Support		Visual analytics module	3D visualization	Developed crisis management scenarios
aqua3S	√	√	√	√	√
Innovyze	√	√	√	X	√
DHI	√	X	√	X	X
DELARTES	√	X	√	√	X
Terra Marra	√	√	X	X	X
Valarm	√	X	√	X	X
Esri	√	X	√	X	X
i2O	√	X	X	X	X
Sensus	X	X	X	X	X
Trimble Water	√	X	X	X	√
HydroPoint	√	X	X	X	X

Table 2. Competitors of aqua3S

As shown by the analysis above many of the companies that are active in the Smart Water Management Market are based in the US with offices all over the world including Europe and the Asia Pacific regions. Most of the solutions can address multiple segments of the Smart Water Management market and also include the Security segment. Some of them provide their services as software that can be easily integrated in existing systems (through an API) or platforms that can provide a suite of services to address different needs. aqua3S also explores the provision of the services as standalone solutions that can be easily (through an API) integrated to third party systems or through the aqua3S platform, as a suite of services (Exploitation Plan). Nevertheless, the services will vertically address issues of the Security segment providing amongst others the Development of Crisis Management Scenarios that are not commonly met in other providers. Combining the expertise from the water and ICT domains, with the knowledge of companies that are already well established in the Smart Water Management domain, aqua3S can penetrate the market and build upon the existing expertise.

4.1.2 Indirect competition

As indirect competition for aqua3S can be considered large companies that dominate the water sector with their hardware and software solutions. Some of those major technology vendors include:

- ABB Group (ABB),
- IBM Corporation (IBM),
- Siemens AG (Siemens),
- Elster Group Gmbh (Honeywell Elster),
- Itron, Inc. (Itron),
- Schneider Electric SE (Schneider Electric),
- Suez SA (SUEZ),
- Huawei Technologies Co., Ltd. (Huawei),
- Oracle Corporation (Oracle) Landis+Gyr,
- Arad Group,
- XENIUS,
- SenzIoT,
- TaKaDu Ltd. (TaKaDu),
- Badger Meter, Inc. (Badger Meter), and
- AQUAMATIX LIMITED (AquamatiX).

Some of the companies included in the direct competition (i.e., Trimble, Esri, i20) were larger enterprises with office locations all over the world that addressed directly or indirectly parts of the security segment. On a strategic front though, larger companies are utilizing different growth strategies, such as mergers and acquisitions, partnerships and collaborations, and product development, to increase their shares in the market, discover and adopt new or complementary technologies faster and expand their portfolio. This means that in order to preserve the existing status quo they are willing to cooperate or adapt or incorporate new solutions that may address different or even the same segments of the water sector they are addressing themselves.

5. aqua3S solution

aqua3s is a water pollution detection and crisis management platform that allows its end users to utilize the latest novel technologies in water safety and security to mitigate issues in their facilities. The platform will also facilitate decision making in times of crisis via data driven visualization and analysis capabilities. Envisioned is the creation of a low-end hardware layer with the capabilities to extract multiple types of data such as sensor, video and imaging, as well as, social media data. This information will then be processed and available for consumption by services satisfying the different use cases. Among these will be multiple types of data visualization (3D, water network, hazard map, etc.), prediction capabilities for crisis and hazard management and the possibility to create personalized warnings. System security measures will be available for each layer of the system security in order to handle sensitive data and user authentication, as well as, a parallel monitoring layer to provide support to the system administrators. The figure below depicts the various modules of the aqua3S platform.

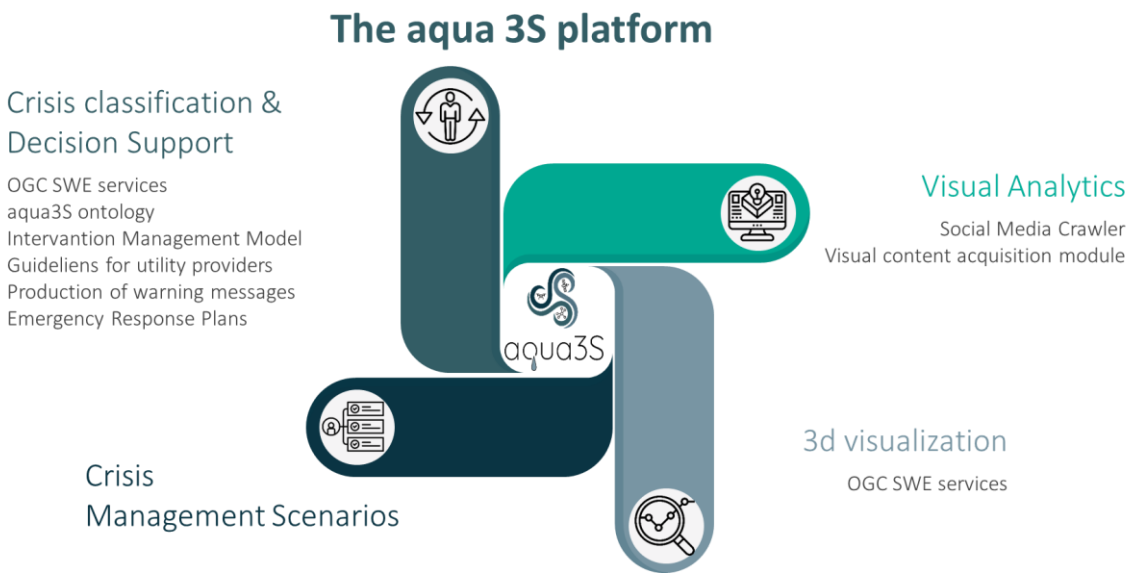


Figure 10. aqua3S platform modules

The aqua3S platform aims to provide new strategies and technologies regarding water safety, as well as integrate already existing solutions wherever in place. The existing legacy systems are isolated on remote sites supporting aging technologies and sensors. Mostly they do not support integration of new solutions that could provide an innovative way of extracting data to be used for enhanced water security and management. An example of this would be satellite data able to map the entire region of the water source, creating a more complete picture for hazard teams or water management authorities. Another alternative source of information would be the population using the water, according to the feedback provided to them via social media. This data can be analysed for keywords, providing valuable warning information about pollution in the water. Furthermore, the more data there is available, i.e. the more sources of data there are, the easier it is to build complex predictive models that will flag dangerous events. Besides the sources themselves there is a need to structure this new data, link it to other data semantically, thus giving it more meaning of what it represents. This makes it much more processable for machines, paving the way for more alternative means of complex analysis such as through machine learning techniques, as well as providing multiple options of visualisation.

5.1 aqua3S added value

The added value of aqua3S solution is described in the table below:

Added Value Points	Description
A.V.P.1	Integration with legacy systems and provision of innovative ways to extract data from them to be used for better water security and management.
A.V.P.2	Creation of a more complete picture for hazard teams or water management authorities, who do not currently have the capability.
A.V.P.3	Incorporation of feedback provided on social media from the population served by the utility provider.
A.V.P.4	Warning information about pollution in the water.
A.V.P.5	More sources of data for building more complex predictive models for flagging dangerous events.
A.V.P.6	Adaptable business model for the needs of any company that wants to exploit the results, especially of the software developed.

Table 3. aqua3S added value points

5.2 Market drivers and barriers to entry

By 2050 it is estimated that 70% of the population will live in urban areas and lack of investment in water management will put the entire water networks in immense pressure. As a result, water utilities are increasingly looking for SWM solutions. This is due to the fact that such solutions use advanced network technologies to offer effective water management capabilities that can be beneficial. The adoption thus of SWM solutions is leading to the growth of the market [4]. Below the drivers that lead to that growth are presented, along with the barriers to enter for new solutions, such as aqua3S.

DRIVERS for the growth of SWM solutions

- Rising need of sustainable water solutions;
- Need for a significant reduction in loss due to non-revenue water;
- Rising need to replace the aging water infrastructure;
- Consumer awareness and perspectives;
- Key national priorities for the sustainable development of water.

BARRIERS to entry for new solution

- Fragmented market with many software providers;
- The design and construction of smart water systems are still not quite standardized for massive applications, due to the lack of consensus on the framework [10];
- Lack of a strong business case;
- Lack of funding even if there is a business case;
- Lack of political and regulatory support.

5.2.1 SWOT analysis

In the current section the strengths, weakness, opportunities and threats for the aqua3S solutions. A SWOT analysis is designed to facilitate a realistic, fact-based, data-driven look at the strengths and weaknesses of an organization, initiatives, or within its industry. Using internal (strengths and weaknesses) and external (opportunities and threats) data, the analysis can guide businesses toward strategies more likely to be successful, and away from those in which they have been, or are likely to

be, less successful. A SWOT analysis for the European market and Asia Pacific market are presented in the tables (**Table 4**, **Table 5**) below:

Strengths	Weaknesses
➢ Combining existing systems with new technologies, marrying the old and the new; ➢ Modularity of components of the overall system; ➢ Interoperability framework for the delivery of the services;	➢ Difficulty in technology implementation over the legacy infrastructure; ➢ Aggregating a lot of sources of different nature (e.g., sensors, images) raises several issues; ➢ Adequacy of the final call qualification in the evaluation;
Opportunities	**Threats**
➢ Indirect competition can turn into an opportunity to enter the market; ➢ Smart Water Management market in growth; ➢ Safety and security markets untapped opportunities; ➢ Government initiatives and regulatory implementations for promoting smart water solutions;	➢ Fragmented market that makes entry difficult; ➢ Slow adoption of new technologies in the sector; ➢ Reluctance from the stakeholders and/or the customers.

Table 4. SWOT Analysis Europe

Strengths describe what an organization/solution excels at and what separates it from the competition. For the European market the strengths of the aqua3S solution lie in three facts: the combination of existing (legacy systems) with new technologies, the subsequent modularity of the different components and solutions and finally the interoperability of the framework for the delivery of the services.

Weaknesses refer to the parameters that stop an organization/solution from performing at its optimum level. The weaknesses identified for the aqua3S solution are the following: the difficulty of integrating the new technologies with the legacy infrastructures, which maybe old and outdated; the aggregation of the different sources and different formats of information into a single system/module/component; and finally the evaluation of those modules/ components which can be unexpected.

Opportunities refer to favorable external factors that could give an organization a competitive advantage. The opportunities identified for the aqua3S solution are the following: the growth strategies employed by indirect competitors (mergers, acquisitions, etc.) that can present an opportunity for aqua3S to enter the market; the fact that the specific market is predicted to grow in the next couple of years; and finally the regulatory framework in Europe, which seems to be favorable to solutions like aqua3S.

Threats refer to factors that have the potential to harm an organization. The threats identified for the aqua3S solution are the following: the fact that the market, especially for smaller competitors, seem to be rather fragmented and difficult to enter; the slow adoption of new technologies by the sector and finally the reluctance that stakeholders show towards adopting those technologies.

Strengths	Weaknesses
➢ Introducing new technologies based on the needs foreseen; ➢ Modularity of components of the overall system; ➢ Interoperability framework for the delivery of the services;	➢ There are no master plans for water resources management in the different river basins; ➢ Decentralisation of decision making; ➢ The allocation of budget is also done on an agency basis; ➢ Lack of skilled resources;
Opportunities	**Threats**
➢ Smart Water Management market in growth for the next years; ➢ Safety and security markets untapped opportunities; ➢ Provision of data, information, modelling that can lead to sounder policies;	➢ Fragmented market that makes entry difficult; ➢ Slow adoption of new technologies in the sector; ➢ Reluctance from the stakeholders and/or the customers.

Table 5. SWOT Analysis APAC Region

Strengths describe what an organization/solution excels at and what separates it from the competition. For the Asian Pacific market the strengths of the aqua3S solution are more or less the same as those in the European market. A slight differentiation is that the market is not yet mature enough compared to the European and the foreseen need for new technologies can be substantial.

Weaknesses refer to the parameters that stop an organization/solution from performing at its optimum level. The weaknesses identified for the aqua3S solution for the Asia Pacific market are the following: there is no decision making center or a common plan for the adoption of new technologies, which creates some uncertainty in multiple levels (including financial), while at the same time there seems to be a gap in the existing skillset that could help in transitioning to the new technologies in an easier way.

Opportunities refer to favorable external factors that could give an organization a competitive advantage. The opportunities identified for the aqua3S solution in the Asia Pacific market are similar to those of the European market with the addition of another parameter that of data and information that can also be used for sounder policies in respect to the water domain.

Threats refer to factors that have the potential to harm an organization. The threats identified for the aqua3S solution in the Asian Pacific market are similar to those of the European market, with the difference in the maturity phase, which means that reluctance may stem from different reasons (i.e. unfamiliarity with new technologies vs threat to expertise or status quo).

5.2.2 PESTEL analysis

In the current section the political, economic, social, technological, environmental and legal macro forces that shape the water domain, including the SWM market and the security segment within it, in the EU and Asia are examined for aqua3S. The analysis of those different parameters will help in understanding how the market could be impacted and analyse how aqua3S business could also be impacted.

It should be noted that from 2018 to 2024 the governments worldwide will invest in 14 billion USD smart water projects, which is expected to augment the SWM market growth and it is forecasted that Europe will be one of the early adopters of the new systems.

Europe has around 3.5 million kilometres of the water distribution network which poses great challenges for the government to manage the distribution network presently. For revamping the infrastructure there is a need for EUR 20 billion investment per year. In Northern Europe, the investments are for maintaining the existing systems and in the Mediterranean region, the investments need to be made to comply with Europe's standards and modern water management systems. On top of that the EU Commission has also laid out a vision for the future of smart water across the region in its Digital Single Market for Water Services Action Plan that is expected to further drive the market growth.

On the other hand, on the Asia Pacific Market the aim is for sustainable infrastructure and innovative technologies are also promoted, but due to different factors. More specifically in respect with the infrastructure in the Asia Pacific there are cases where infrastructure is yet to be developed or were it is developed due to the anticipated urbanization providers are predicted to struggle to respond to supply needs, especially taking into consideration the very high levels of non – revenue water. Hence, sustainability is to be interpreted to mean that projects are client-driven, operational sustainability is promoted through the identification and allocation of reliable sources of funding for operations and maintenance (O&M) and infrastructure is not the end in itself. As for the innovative technologies, it is a recognised ned across the water sector that needs to be financed in prioritisation to help in increasing efficiency of water use, improve resilience and maximise the impact of those innovations [6].

In the sections below we are examining each and every force in respect to the aqua3S solution.

EUROPE	
POLITICAL	➢ There is still much bureaucracy that defines the systems across Europe; ➢ The river basins tried to harmonise the water pricing, regulations and policies across Europe, but the implementation is not linear and is not implemented at the same speed across Europe, creating thus imbalances; ➢ The water sector is moving partially toward privatisation, but again this is not across Europe and not at the same extend across the different countries; ➢ The EC recognised the role that taxation can play as a policy tool for Member States to achieve the objectives set at EU level. The EC's Circular Economy Strategy example encourages member states to "use economic instruments, as taxation, to ensure that product prices better reflect environmental costs" [11].

ECNOMIC	➢ The economy of the EU is a joint one with a common internal market and many mixed economies (free market and advanced social models) with significant disparities in GDP per capita between members, creating thus different possibilities for each (including the possibilities for the water sector); ➢ The business cycle is another economic force that comes into place. As indicated in the introduction the water domain in general is going through a "recovery" cycle, during which investments are expected for the upgrade of infrastructures and smart water management solutions as well; ➢ As indicated in the market analysis the growth rate of the domain is also expected to grow within the upcoming years, reaching a Compound Annual Growth Rate (CAGR) of 12.9%.
SOCIAL	➢ Overall, trends show that there is a population increase in certain urban areas (especially capital cities) and coastal areas [7], significant for water management in those areas; ➢ Europe's working-age population has started shrinking, thus causing a possible constraint to growth. For example 20% of the EU working age population has low literacy and low numeracy skills, while 25% of adults lack the skills to effectively make use of ICTs [13], which is indicative for the workforce in the water domain and the consumers; ➢ Many EU countries exhibit relatively low levels of income inequality compared with other regions of the world (USA, Latin America, Asia). Nonetheless, that does not apply for all the countries or for Europe as a whole. Despite the ongoing relevance of nation states, the current EU transnational space, with its unique institutional configuration, constitutes in itself a framework of social integration, notwithstanding its contradictions and its variable geometry. Those are best depicted in the inequalities of incomes between Eastern and Western European countries, as well as in an asymmetric distribution of educational resources.
TECHNOLOGICAL	➢ Up until now new tools meant high costs and effort, which is something that started changing in the last few years, due to the rise of new technologies; ➢ The integration of high-end technologies, such as IoT, AI, and digital twin, brought a huge upsurge in the adoption of sensors to facilitate real-time communication; ➢ As indicated in the sections above new technologies and solutions do not require high Capital Expenditure (CAPEX) from utility's end, which makes them more attractive to invest into; ➢ At the same time technologies enable societies to improve their resource productivity, meaning that more economic value is derived with less inputs, which is yet another of the technological macro forces that shape positively the domain;

ENVIRONMENTAL	➢ Climate variability is a macro factor that multiplies water risks, since temperatures, frequency and timing and intensity of precipitation, frequency and severity of extreme events and increased uncertainty of weather variability, all multiply water risks [14]; ➢ As mentioned in the political macro forces that shape the water domain, the laws that regulate environment pollution tend to be more severe and use more levers to bring about the change needed, as in the case when taxes or charges on plastic bags were imposed in many countries, and that was in an effort to target single-use plastic bags; ➢ The attitude towards "green" or eco-friendly products and services and the overall trends of consumers themselves are another environmental macro factor. Within that framework it is evident that Europeans support taking a variety of actions for environmental reasons, and they are increasingly changing their behaviour for environmental reasons [15];
LEGAL	➢ Firstly, the EU has in place an antitrust policy that is developed from two central rules set out in the Treaty on the Functioning of the European Union; ➢ Apart from antitrust policy the EU has a number of policies that are directly or indirectly linked with the water domain, such as the Water Framework Directive, the Drinking Water Directive, the environmental Quality Standards Directive, the Urban Waste Water Treatment Directive, the Nitrate Directive, the EU Floods Directive, as well as the Mandate for establishing security standards.

Table 6. PESTEL analysis

Overall from the PESTEL analysis what could be taken as the main outcome is that the political, economic, social, technological, environmental and legal macro factors are more favourable than not only for the growth of the sector, but for its upgrade through the adoption of new technologies that can help in transforming it.

ASIA PACIFIC

POLITICAL	➢ Water management governance has often been fragmented and coordination among water-related agencies has been weak; ➢ Fragmented water resources management has led to over investment and uncoordinated management, especially for water from different sources, e.g. surface water and groundwater and for allocation of water to various sectors; ➢ There were no master plans for water resources management in the different river basins; ➢ As a large number of agencies is involved in the implementation of various projects, information on water resources development is scattered; ➢ Political hesitancy related to regularly raising tariffs.
ECNOMIC	➢ Low tariffs contribute to the lack of revenue available for the modification of this pipework; ➢ Strong metering, billing and collection are needed to overcome intermittent water supply; ➢ Financial revenue estimation should increasingly be made on demand information, rather than simply estimating required revenues based on future financial costs;

SOCIAL	➢ There is a conflict of interest between rural farmers (who want water for irrigation) and urban water users; ➢ The construction of water supply, power dams and flood control systems were mostly related to a few particular interests; ➢ Water scarcity in Asia is not manifested across the board. It is characterized more by un-equal access to water.
TECHNOLOGICAL	➢ Although there may be several technological solutions that exist in many parts of the region that can be easily adapted and applied elsewhere, technological collaborations are not deployed to promote knowledge diffusion and foster greater resource efficiency; ➢ In general, "technology divides" could be addressed to ensure technology becomes an effective means to attain socially and ecologically sustainable development;
ENVIRONMENTAL	➢ Polluted waterways result from a failure to invest in wastewater collection and treatment and implement legislation pertaining to pollution; ➢ Industries that are water intensive should be closely monitored; ➢ Water is a very fragile resource. Its quality or quantity is easily modified by human activity to such an extent that it becomes less suitable for purposes it serves in its natural state; ➢ Many human activities, such as land use changes, influence the hydrologic cycle and can pollute available water;
LEGAL	➢ Traditionally water policy has been linked to specific problems like water shortages, flooding and water pollution; ➢ There are several acts covering water resources. They fall under the jurisdiction of different agencies and are not directly related to the general concept of water resources management; ➢ Competition for water supply contracts must be regulated.

Table 7. PESTEL analysis

6. Segmentations

On the section Water safety and security market overview a snapshot of the direct and indirect stakeholders of the aqua3S solution were presented. In the current section we are examining the direct stakeholders that can be considered as potential customers as well, while an overview of where the decision-making power and the business power lie within those stakeholders. An analysis of the demographics of those segments, as well as the behaviors and psychographics are a few of the other parameters that are also examined to help in creating a more complete profile for each of the segments.

6.1 Customer segmentation

6.1.1 Europe

The potential customers, as identified in the respective section of the current document are the following:

- **public-sector agencies** involved in water resources;
- **private-sector organizations** and companies with water interests;
- **SMEs** that produce software or hardware for the water sector.

In the tables below a profiling of each country that is part of the aqua3S project is provided (**Table 8**), followed in the next table (**Table 9**) by a distinction on who is responsible for organizing the water services, for fixing the price of water services and for deciding about new investments and the way to finance.

The four main categories of water management models that we come across in Europe are the following:

- **Direct public management**: under this system, the responsible public entity is entirely in charge of service provision and their management. In the past, this system was predominant in Europe.
- **Delegated public management**: under this system, a management entity is appointed by the responsible public entity to execute the management tasks. Management entities usually remain the ownership of the public sector, although in the EU, in some cases, there is the possibility of a minor private shareholding.
- **Delegated private management**: under this system the responsible public entity appoints a private company to manage tasks, on the basis of a time-bound contract in the form of lease or concession contract. In the countries where this type of management is common, municipalities subcontract their duties to private companies. The ownership of the infrastructure remains in the hands of public authorities.
- **Direct private management**: under this system all management tasks, responsibilities and ownership of water utilities are placed in the hands of private operators, while public entities limit their activities to control and regulation. This system is in place in very few European countries (England, Wales, and the Czech Republic).

The water management models, along with information on average consumption and tariffs provide us with an overview of the water sector in the pilot countries, which are the entry points for aqua3S solution and the Europe in total subsequently.

COUNTRY	PROFILING
Bulgaria	**Bulgaria** Population **7,128,000** inh. Water Management is carried out and guided by the Ministry of Environment and Water at national level assisted by the High Council of Water with the Council of Ministers. The State Energy and Water Regulatory Commission is a regulator responsible for tariff setting and quality of services of enterprises in the gas, electric, district heating and water supply and sewage sectors. 52 companies (owned by the state or municipalities) run water supply, whilst the water and sewage system are public. Drinking water and wastewater falls under the responsibility of 264 municipalities, including the Municipality of Sofia, 29 District Centres, Towns and Municipalities, as well as other middle sized and small municipalities.
Cyprus	**Cyprus** Population **848,300** inh. **6.55 m** Drinking water network length per capita **149** l/cap/d Average residential consumption **5.63 m** Waste water network length per capita **2.90** €/m³ Average price The country is divided into six districts headed by a District Officer appointed by the Government with two types of local authorities, Municipalities (urban and tourist centres) and Communities (rural areas), governed by separate laws. Municipalities and Communities are responsible for water services. WDD is the responsible body for implementing the wastewater policy through its Wastewater and Re-use Division (WRD).
France	**France** Population **66,900,000** inh. **15 m** Drinking water network length per capita **143** l/cap/d Average residential consumption **6.0 m** Waste water network length per capita **3.92** €/m³ Average price 3 laws conduct the water policy. There are 13 hydrographic districts. There are water agencies in each district to manage the water with the economic development and environment respect. Whereas the responsibility for water supply and sanitation services lies at local level, the State plays an essential regulation role at national, regional and «département» levels. The State ensures social solidarity, guarantees access to water for everyone and sets standards for the protection of environment, public health and consumers. The State also establishes the general rules for managing services: local authorities' responsibility, competition between operators, monitoring of service quality.

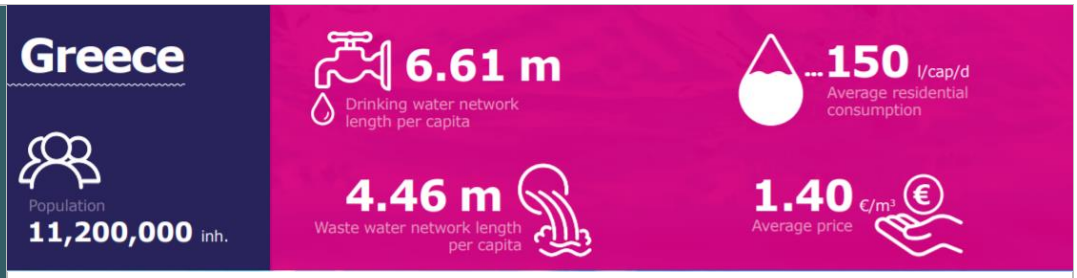
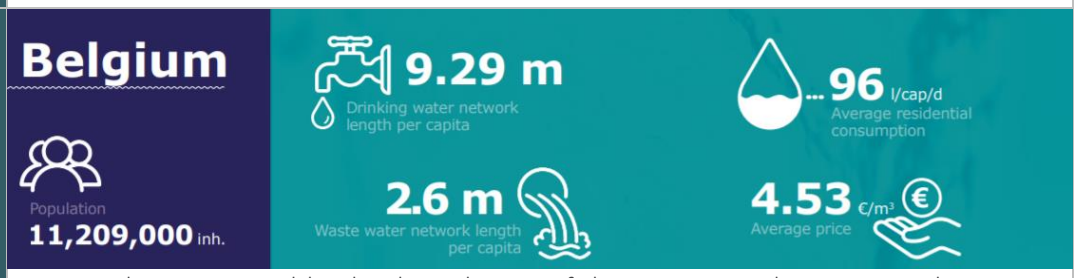
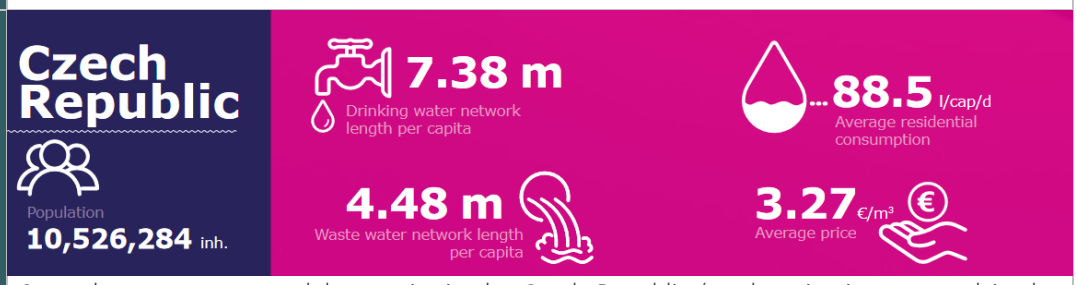
Greece		In Athens and Thessaloniki, there are three public companies responsible for the water supply and sewerage with the state as the only shareholder. They appoint their board of management and are funded by the State. In the rest of the country, especially in the cities with over 10,000 inhabitants, there are municipal enterprises.
Italy		The Italian water resources policy has been dominated by infrastructural aspect. The Ministry of Public Works use to be the competent authority, but the Regions acquired competences on many issues. Furthermore, there are also the Basin authorities. As a special regulator, the Committee for the Supervision of the Water Resources Use (COVIRI) is monitoring the principles of the water sector reform law. This Committee regulates the setting and adjustment of tariffs and the protection of customer interests. There are regional water quality plans that can introduce special measures, in order to protect the water environment from pollution. The level of development of water policies at the regional level is very differentiated.
Belgium		Water policy is managed by the three districts of the country. Drinking water and sanitation services are provided by the 589 municipalities of Belgium (308 in the Flemish region with 6.2 million inhabitants, 262 in the Walloon region with 3.4 million inhabitants and 19 in Brussels with 1.1 million inhabitants). The Belgian water and sanitation sector recognise water as a basic right. Two regions (Walloon and Brussels Regions) have set up Social Funds for Water, which provide financial support to people having difficulties to pay their water bill, and in Flanders, everyone has the right to a minimal supply of 15 m³ (41 litre/capita/day) of free water per person per year. As there is no liberalised water market in Belgium, there is no regulatory body for water to ensure that the water market works as effectively as possible by implementing regulatory instruments. Yet, there are governmental bodies to maintain the water quality (like the Flemish Environmental Agency and Bruxelles Environnement).

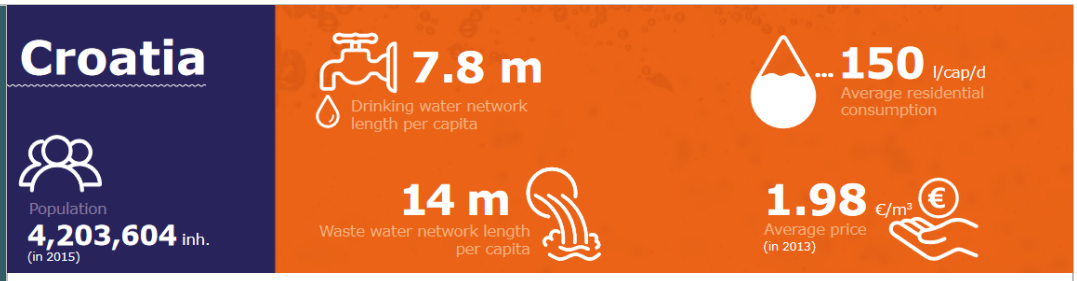
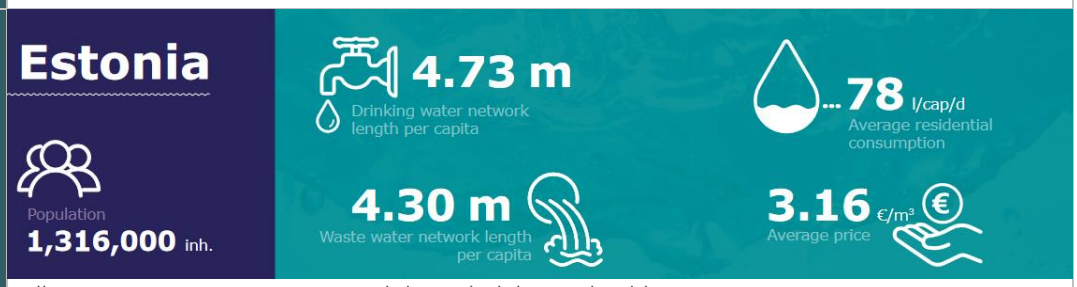
Table 8. Segmentation: country profiling

COUNTRY	Responsible for organising the water services	Responsible for fixing the price of water services	Responsible for deciding about new investments and the way to finance them
Bulgaria	Municipalities, State	State	Water services, State
Cyprus	Municipalities, State	Municipalities, State	Water services, Regional water holdings, State
France	Municipalities	Municipalities	Regional water holdings
Greece	Regional governments, Municipalities	Regional governments, Municipalities	Water services, Regional water holdings, State
Italy	Municipalities	Municipalities	Water services, State
Belgium	Regional governments, Municipalities	Regional governments, Municipalities	Water services, Regional water holdings

Table 9. Organization responsible for organizing water services per country

In the table below, a mapping of water providers across Europe, which are potential customers for aqua3S solution, is also provided:

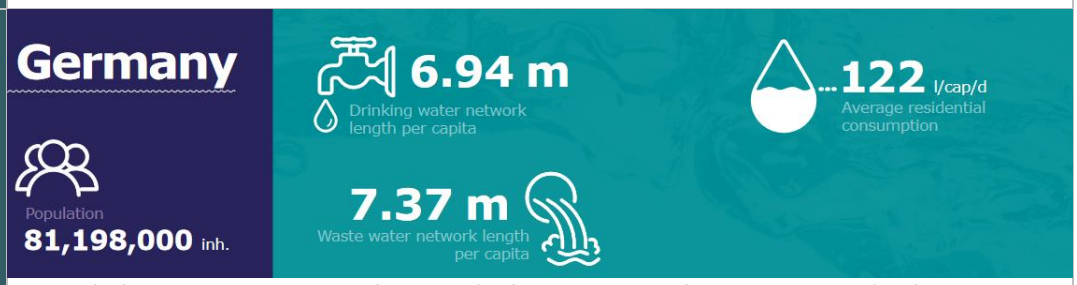
COUNTRY	PROFILING
Austria	 In Austria, water services are organised through direct and delegated public management models. Among the delegated public management system, limited companies and limited liability corporations are the most frequent form of organisational management, where the public authority holds the majority (in most cases 100%) of shares. In total, there are approximately 5.500 drinking water utilities, 49% are urban structures, 20% are smaller municipalities, 11% are water boards and 10% are water co-operations (ÖVGW statistics, 2013). The remaining 10% of the Austrian population is self-supplied by private wells or springs.
Czech Republic	 Several management models co-exist in the Czech Republic (market size is expressed in the mean volume of water supplied to end customers): i) Delegated private management (59% of the market); ii) Delegated public management either through public water companies or through a public multiservice company (usually municipal technical services company) – 25% of the market; iii) Direct private management (private ownership and operation of public water systems) – 9% of the market; iv) Direct public management – 7% of the market. Delegated private management is the most widely used management model, covering59% of the public water supplies.

Croatia	 In Croatia the majority of water and waste water services are provided under the direct public management model, where the responsible public entity is entirely in charge of services provision and management. In the city of Zagreb the waste water treatment plant is managed through delegated private management (concession).
Denmark	 Up to 2010 the main management model was direct public management as municipalities, in general, had water and waste water services integrated in the municipal administration. The Ministry of Energy, Utilities and Climate is the relevant authority with regard to the organisational setup and tariffs. Since 2016 the situation is as follows: Private management: there are around 2.100 consumers-owned water service providers.Delegated public management: there are around 140 publicly owned limited companies responsible for water services and around 110 publicly owned limited companies responsible for waste water services.
Estonia	 All water companies are organised through delegated public management. Water companies are mainly owned by the local government, except few privately owned companies, one of which is listed on the stock exchange, and serves the Estonian capital; around one third of the whole population (Tallinna Vesi).

Finland

Finland has 311 municipalities and most of them have one or more utilities providing water services in their area. Direct public management is still the most common management model: the municipality is in charge of provision, production and management of water services. About 70% of the municipal water utilities are organised as municipal entities or municipal enterprises under the direct administration of the municipality. Lately Finland has moved slightly from direct public management towards delegated public management. Approximately 30% of municipally owned water utilities are organised as companies. They have their own administration, but they are usually owned by the public sector, that is by municipalities. Additionally, Finland has over 1000 (small) co-operatives managed by consumers - especially in sparsely populated areas. These co-operatives can be mentioned as examples of some kind of direct private management in water services.

Germany



In total, there were approximately 6.065 drinking water supply enterprises and utilities in 2010. These are mainly small ancillary municipal utilities and owner-operated municipal utilities. Direct public management: Only a small number of drinking water utilities (less than 50) are organised as ancillary municipal utilities. The share is even lower for water output. As regards waste water, the majority are own-operated municipal utilities. Delegated public management: Delegated public management is carried out mainly through special purpose associations which account for almost 64% of drinking water utilities (about 3.880 companies). These companies account for almost 40% of water output. Special purpose and water associations are also common in waste water service provision. Delegated private management: The share of drinking water companies managed through delegated private management was to 35% in 2012 (about 2.120 companies described as AG or GmbH). These are mainly companies with private participation. The share increases to 60% when looking at water output. Waste water disposal is predominantly carried out by utilities under public law

Hungary

Hungary

Population
10,000,000 inh.

6.74 m Drinking water network length per capita

95 l/cap/d Average residential consumption

5.01 m Waste water network length per capita

2.65 €/m³ Average price

The public water infrastructure used for the provision of drinking water, waste water disposal and waste treatment services can be owned exclusively by local municipalities or the state. It is also the responsibility of the local governments and, in certain cases specifically defined in the legislation, of the state itself to provide customers with these services. The asset owner (the municipality or the state) signs a contract of service provision with the service provider (utility company). The contract can be one of three different types: asset management contract, concession or rent-operation scheme. Each type of contract involves different legal provisions and obligations. The 'concession' contract provides the widest range of rights and the largest responsibility to the operator. The smallest responsibility and narrowest scope are given to the service provider by the 'rent-operation' type of contract.

Ireland

Ireland

Population
4,792,000 inh.

10.6 m Drinking water network length per capita

130 l/cap/d Average residential consumption

19.1 m Waste water network length per capita

The management model is a delegated public management, where Irish Water – the publicly owned national utility – is responsible for providing drinking water and waste water services, while local governments are responsible for storm water as well as certain duties under the Water Framework Directive relating to river basin management, pollution of water courses etc. Exceptions to the above include small rural (drinking) water supplies which remain with the local authorities and privately owned and operated group water schemes (in rural areas.

Luxembourg

Luxembourg

Population
590,000 inh.

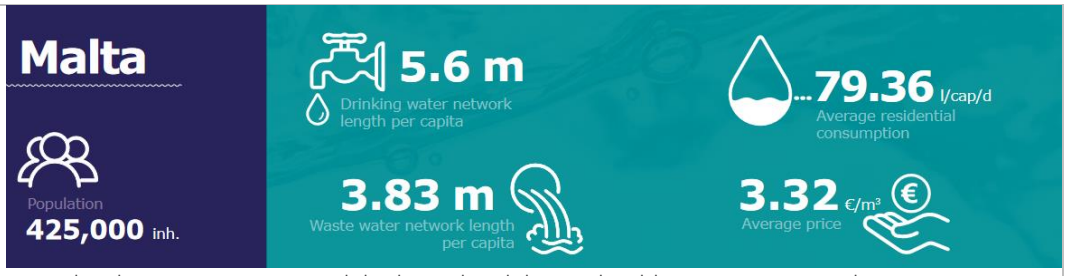
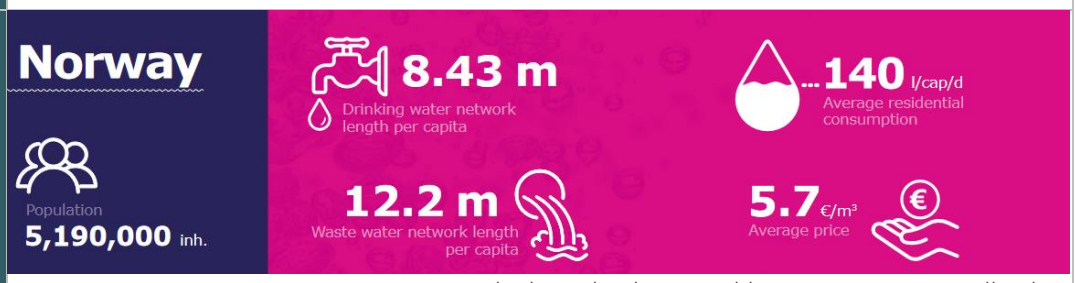
7.0 m Drinking water network length per capita

137 l/cap/d Average residential consumption

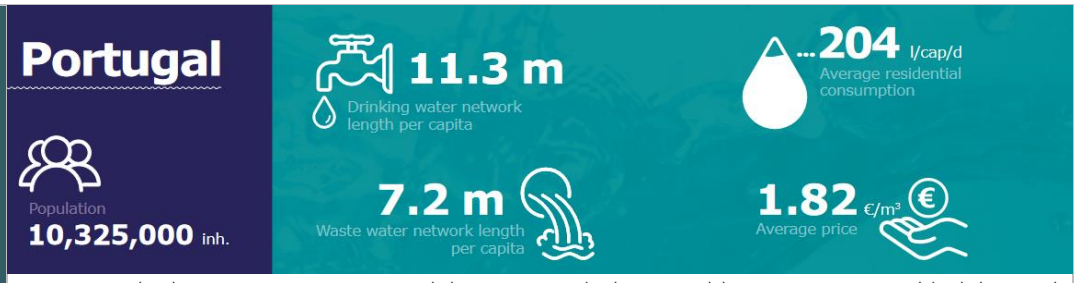
8.0 m Waste water network length per capita

5.5-6 €/m³ Average price

Water tariffs are proposed by the municipalities (voted by the municipal council) and have to be approved by the competent national ministry, the Ministry of Sustainable Development and Infrastructure. Prices are set based on the break-even principle.

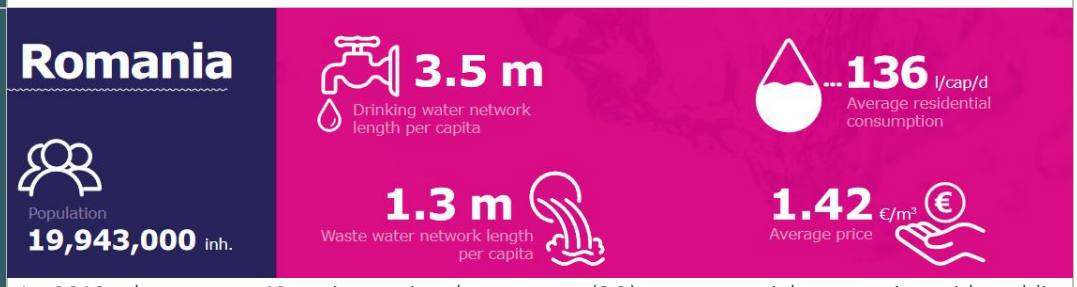
Malta	 In Malta the management model adopted is delegated public management. The Water Services Corporation is a public utility owned by the state.
Norway	 In Norway water services are managed through direct public management. Still, the municipalities are not obliged directly by law to serve inhabitants with water and water facilities, but have an obligation to secure the health of their inhabitants and to avoid pollution from waste water. It is enshrined in law that utilities should be owned by the municipalities.
Poland	 The management models in Poland are: direct public management by municipalities (budgetary unit), delegated public management (the biggest part of the market - municipal companies such as limited liability companies, joint stock companies, etc) and delegated private management (private operator). There are also small entities owned by consumers or private companies. A large section of drinking water consumers have their own wells and are not subject to any regulation.

Portugal



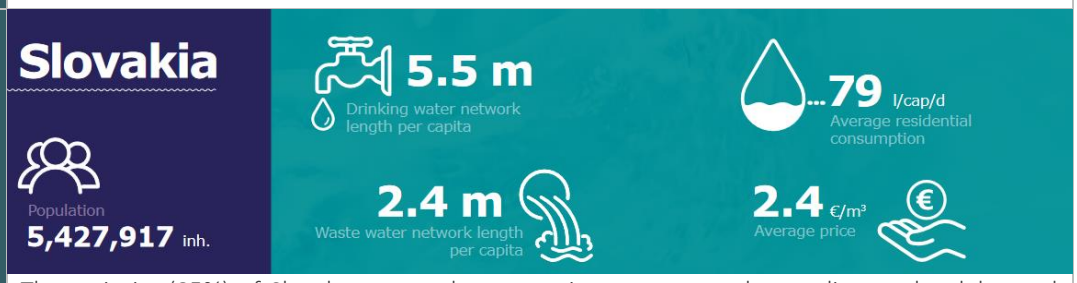
In Portugal, three management models coexist: a) direct public management, b) delegated public management and c) delegated private management. 'Direct private management' is not considered in Portuguese legislation. Direct municipal management without a specific administrative organisation for water services (a1) covers 33% of Portuguese households for drinking water and around 39% of the households for waste water. Together, the other sub-models of public management and the delegated public management model (a2, a3 and b1) cover 52% of drinking water consumers and 46% of domestic waste water collection. The delegated private management model covers around 15% of drinking water consumers and of household waste water collection.

Romania



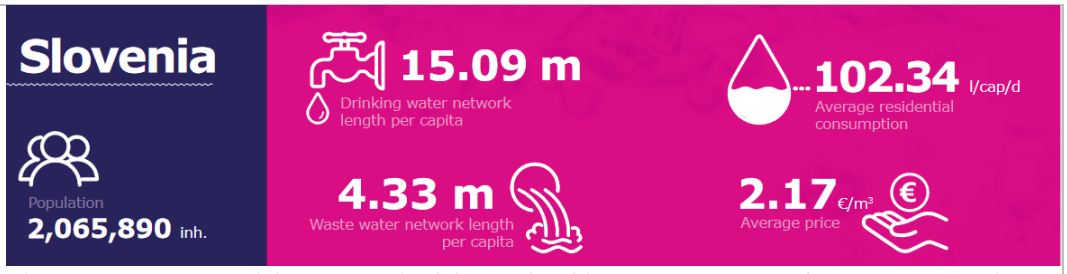
In 2013, there were 43 active regional operators (RO) - commercial companies with public capital owned exclusively by local public administration authorities managed according to the delegated public management model. Two large local water utilities were created in 2000, in Bucharest and Ploiesti, as a result of an international public tender - commercial companies with mixed capital (public and private). More than 1000 small local water systems are managed by specialised services from municipalities. Regional operators and the two private managed companies cover 85% of the water supply and sewage services market. The process of absorbing the small operators continues with a rate of 1.5%/year.

Slovakia



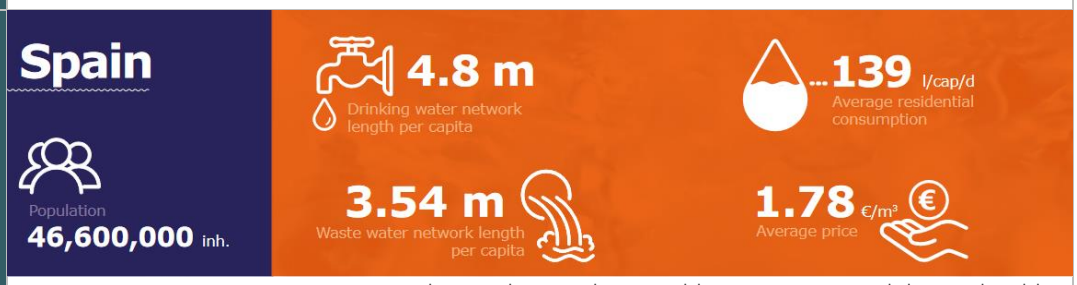
The majority (85%) of Slovak waterworks companies are managed according to the delegated public management model. The owners of the networks systems are public bodies (municipalities: towns or villages) which are responsible for providing water services. The services are carried out by public waterworks companies. About 15% of the network is managed according to the delegated private management model. It is owned by public bodies, while private companies provide water services. The cooperation between the public authorities and the private companies is defined by specific contracts.

Slovenia



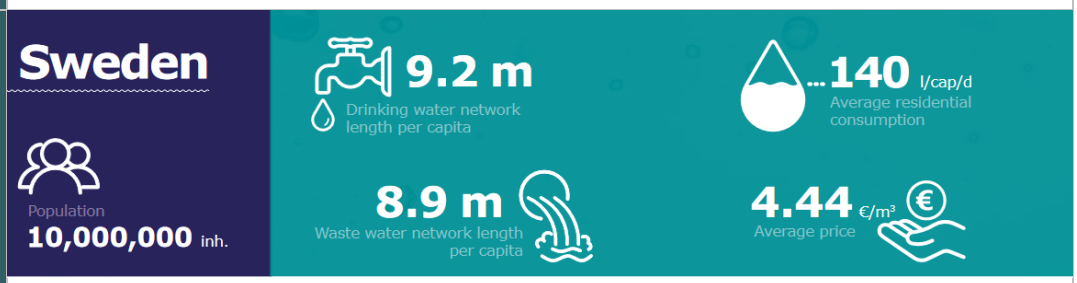
The management models are mostly delegated public management and in some cases direct public management (direct management by municipalities) and delegated private management (time bound contract in the form of a concession). Drinking water supply and the collection and treatment of urban waste water are obligatory municipal public services, so the responsible public entities are municipalities.

Spain



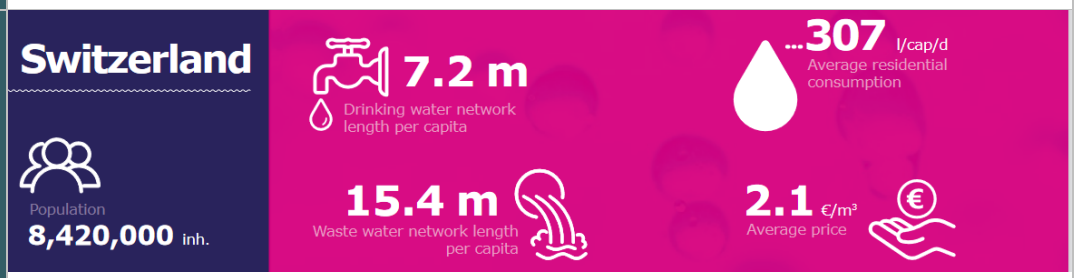
In Spain, water services are organised according to direct public management delegated public management and delegated private management. 10% of the population is served by local entities (direct public management), 34% of the services are performed by public companies and 22% by public-private companies (considering both delegated public management) and 34% of water services are provided by private companies (delegated private management). The data for water supply is representative for the situation in the whole country.

Sweden



In Sweden water services are managed either by the municipality itself according to the direct public management model, or by a 100% municipality-owned company, according to the delegated public management model.

Switzerland



For drinking water supply all four management models are possible, however the direct public management and delegated public management models are prevalent. Direct private management often takes the legal form of cooperatives. In remote areas households also own and manage their own supplies.

The Netherlands	**The Netherlands** Population **16,993,000** inh.	**7.01 m** Drinking water network length per capita	**126** l/cap/d Average residential consumption
		6.2 m Waste water network length per capita	**3.91** €/m³ Average price
	The services of the production and delivery of drinking water are organised according to the delegated public management model (where water companies are 100% owned by local and/or regional governments).		
United Kingdom	**United Kingdom** Population **65,100,000** inh.	**6.45 m** Drinking water network length per capita	**139** l/cap/d Average residential consumption
		6.02 m Waste water network length per capita	**3.54** €/m³ Average price
	Water services are organised under the direct private management model in England and Wales, with the latter operated on a not-for-profit basis. In Northern Ireland and Scotland, services are organised according to the delegated public management model.		

Table 10. Water providers across Europe

A conclusion that can be drawn from the tables above is that the public sector is one of the key segments that can potentially adopt the aqua3S solution either in a state, regional or municipality level. Nevertheless, the potential of the private sector (like in the case of Germany) should not be underestimated, since responsibilities including water service operation, consumer relation management, electromechanical renewal, existing infrastructure renewal, main infrastructure extension and R&D may be transferred to private operators in the years to come. This will swift the dynamics of the sector and of the buying and possibly the decision-making power.

7. Potential markets

Intelligent and efficient water management is anticipated to be a key issue in recent times, with a number of forces impacting the delivery of freshwater supplies to the growing population. Water stress, a situation rising due to increasing demands, pollution, and uneven resources is expected to fuel smart water management industry growth.

Indicators point towards Europe being one of the early adopters of SWM systems, while the Asia Pacific region also seems to be a potential market with untapped opportunities. Both markets were analysed throughout the document, with a more detailed analysis focused on the European market, which is also the market in which the aqua3S solution is currently being developed and can be easier penetrated, based on the existing network of the partners.

8. Conclusion

The document provides an updated version of the market analysis for aqua3S solution. Included are an overview of the Smart Water Management market including the sub-segment of water safety and security, the market trends, including the demographics and of the various stakeholders. The competitive landscape is also entailed, addressing both direct and indirect competition. The market drivers and barriers are also examined, along with the added value of the aqua3S solution and the strengths, weaknesses, opportunities, threats and a political, economic, social, technological, environmental and legal analysis on an EU level. A segmentation, along with the potential markets for the solution of aqua3S.

The current market size, but more importantly the forecasted growth of the market seems rather promising, at a Compound Annual Growth Rate (CAGR) of 12.9%. At the same time market trends support the foreseen growth and there are various triggers contributing to that end, such as environmental (i.e. climate change, water reuse), population, technological and consumer.

The competitors' analysis provides the framework for identifying the aqa3S added value, but also to understand how the competition is positioned and what dominant players are doing in the market and where there may be some shortfalls or "room" for solutions like aqua3S. Although direct competition with smaller providers shows that the market is partially fragmented at the moment, the indirect competition with bigger and well established companies is the one that is setting the pace of the market at the moment. It is also that bigger competitors are looking into synergies that is opening new opportunities and exploitation pathways.

Along with the above a SWOT and PESTEL analysis were also conducted. The SWOT analysis is a compilation of aqua3S's strengths, weaknesses, opportunities and threats concerning the internal business environment, while the PESTEL analysis examines the micro economic external factors that can affect the solution. Those are also indicating that the current environment seems favorable for solutions like aqua3S, since political decisions, technological advancements, environmental factors, as well as social are all favoring the idea of more automated and effective ways of managing water resources.

Finally, a market segmentation is provided as well as a mapping of the customers in the European market. More specifically, the mapping concerns public and/or private organizations in the different European countries that are the decision makers for water related decisions and it includes information for their respective population, average consumption and price.

The market analysis is a "living" document and updates will be made until the end of the project if required.

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