aqua3S

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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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TABLE OF CONTENTS

1. Executive summary 6

2. Introduction 7

3. Water safety and security market overview 8

3.1 Market size and growth 9

3.2 Market trends 9

3.2.1 Demographics 11

3.2.1.1 Behaviors and psychographics 11

3.3 Stakeholders 11

4. Competitive Landscape 14

4.1 Overview of landscape 14

4.1.1 Direct Competition 14

4.1.2 Indirect competition 15

5. aqua3S solution 16

5.1 aqua3S added value 17

5.2 Market drivers and barriers to entry 17

5.2.1 SWOT analysis 17

5.2.2 PESTEL analysis 18

5.2.2.1 Europe 19

6. Segmentations 21

6.1 Customer segmentation 21

7. Potential markets 25

8. Conclusion 26

9. References 27

LIST OF FIGURES

Figure 1. aqua3S stakeholders 12

Figure 2. aqua3S platform modules 16

LIST OF TABLES

Table 1. Competitors of aqua3S 15

Table 2. aqua3S added value points 17

Table 3. SWOT Analysis 18

Table 4. PESTEL analysis 20

Table 5. Segmentation: country profiling 23

Table 6. Organization responsible responsible for organizing water services per country 23

ABBREVIATIONS/ACRONYMS

CAPEX	Capital Expenditure
EU	European Union
SWM	Smart Water Management

1. Executive summary

The 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.

Despite the importance of water safety though, in 2017 there were still 2.2 billion people that did not have access to safe drinking water [2]. At the same time demand for water continues to increase and 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 numbers highlight 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.

Those emergencies may result from water supply interruptions or damage to infrastructural components, but from other situations as well, that cause water contamination and pose a risk to the health of consumers. The range of consequences include, but are not limited to: i) creating an adverse impact on public health within a population; ii) disrupting system operations and interrupting the supply of safe water; iii) causing physical damage to system infrastructure; iv) reducing public confidence in the water supply and v) long-term denial of water and the cost of remediation and replacement [3].

The water security sector is a small sub-domain of the overall smart water management sector, but still a rather important one. Water security tools can help in identifying security vulnerabilities and subsequently establishing security measures. Within this framework, 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. More specifically 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.

2. Introduction

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, in the following sections 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.

All the above will help in putting the stepping stone for the development of the subsequent 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 Error! Reference source not found.. It should also be noted that by s olutions, 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.

3.2 Market trends

The forecast for the water industry indicates that there are several changes expected as a result of:

- 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 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.
- 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.

- 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.
- 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

In other words, the rapid urbanization, severe climate changes, rising customer demands and the emergence of digital technologies are some of the triggers that will drive the trends of the water industry within the next years. But which are those trends?

- **Technology**: 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.
- **Consumers**: 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.
- **Data**: 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**: 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.

In other words, the above are the trends that are going to shape the Smart Water Management segment within the next few years.

3.2.1 Demographics

In the current sub-section we examine how demographics can affect the consumption of water and the quality and health of natural ecosystems. Population growth is usually supposed to be one of the most important factors threatening the sustainability of water systems. Urbanization, migration, and number of households are demographic factors that are less commonly associated with demographic effects on water resources, although they are also important. There are also indirect factors that affect water use tend, which we are going to mention briefly here: income levels, a rise in living standards, modifications to landscapes and land use, contamination of water supplies, and inefficiency of water use caused by a failure to manage demand.

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. The relationship is not simply linear because different populations and individuals will use resources in different ways and in different amounts due to mediating factors and resource limitations. Nonetheless, population size and changes in it are very important factors in the magnitude of water use and of the human impact on the freshwater ecosystems that supply the water. Population growth is perceived by some to be the most important demographic trend affecting water resources. 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.

Urbanization and migration are other important population trends that affect water resources. Urbanization, both by degree and rate of growth, affects the level of water use within a country. It can affect the levels of per-capita use, overtax water resources by concentrating demand in a small area, and overwhelm existing infrastructure. The redistribution of population by migration can shift pressures on water resources, primarily as a major contributor to urbanization. Urbanization affects the level of water use within a country. This is particularly true for the domestic and municipal sector, where urbanization—and the infrastructure that often accompanies it—can make a significant difference in per-capita use. Urbanization of populations can affect water quality when formerly vegetation-covered land is changed to pavement and buildings, increasing the volume of runoff and its pollution levels, degrading or eliminating the ability of the land to absorb rainwater, and possibly putting human wastes into water systems.

3.2.1.1 Behaviors and psychographics

Water authorities are dealing with the challenge of ensuring that there is enough water to meet demand in the face of drought, population growth and predictions of reduced supply due to climate change. In order to develop effective household demand management programs, water managers need to understand the factors that influence household water use.

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 [5]. 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;

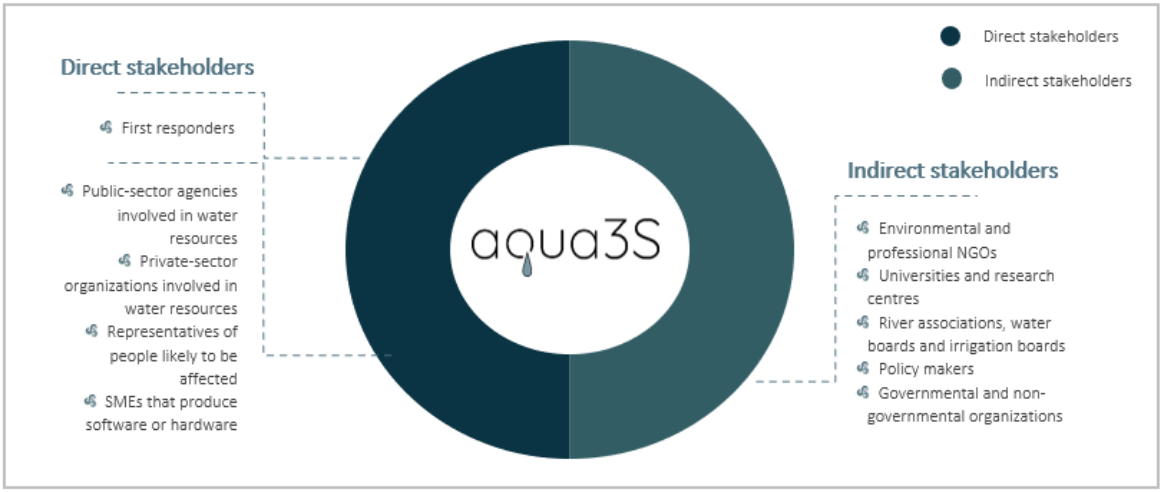


Figure 1. aqua3S stakeholders

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 [6]. 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

In the table below the direct competition of aqua3S is presented. 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.

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

Trimble Water	√ χ	√ χ	χ	√
HydroPoint	√ χ	χ	χ	χ

Table 1. Competitors of aqua3S

As it is depicted in the table above aqua3S offers some modules that cannot be often found in existing solutions. More specifically those modules are the 3D visualization module and the crisis management scenarios. In the following sections the solution of aqua3S is presented in detail, where the added value that it offers in relation with the existing solutions is also examined.

4.1.2 Indirect competition

As indirect competition for aqua3S can be considered the few 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),
- Trimble Water,
- Oracle Corporation (Oracle) Landis+Gyr,
- Sensus,
- Arad Group,
- HydroPoint Data Systems, Inc. (HydroPoint),
- i2O Water Ltd. (i2O),
- XENIUS,
- SenzIoT,
- TaKaDu Ltd. (TaKaDu),
- Badger Meter, Inc. (Badger Meter), and
- AQUAMATIX LIMITED (AquamatiX).

On a strategic front though those companies are utilizing different growth strategies, such as mergers and acquisitions, partnerships and collaborations, and product development, to increase their shares in the market. 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.

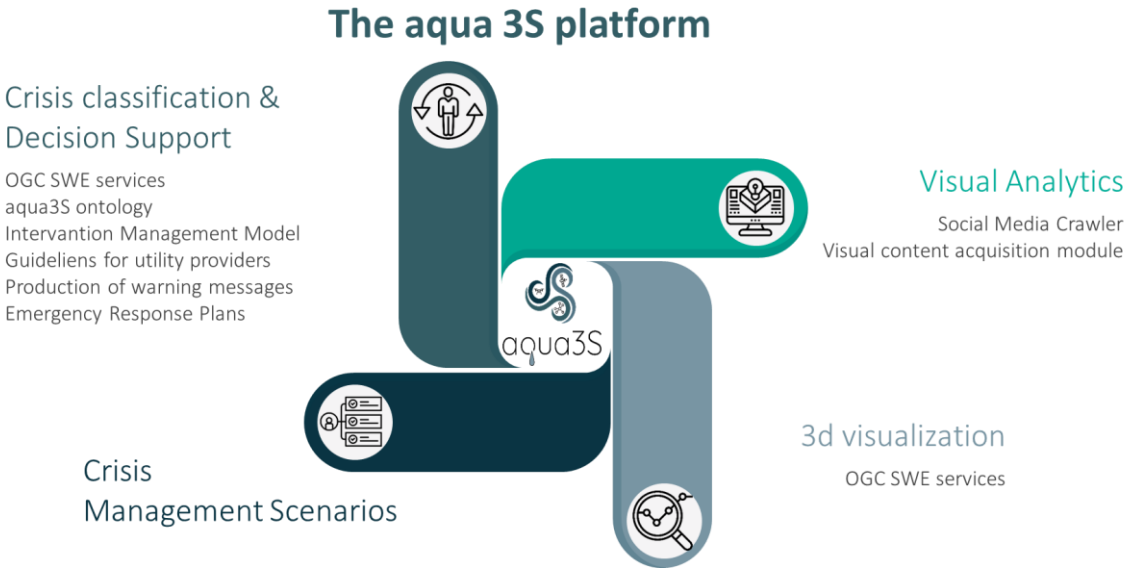


Figure 2. aqua3S platform modules

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 2. 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 [7];
- 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 are presented in the figure 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; ➢ Reluctancy from the stakeholders and/or the customers.

Table 3. SWOT Analysis

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 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.

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

5.2.2.1 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" [8].
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 [9], 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 [10], 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 [11]; ➢ 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 [12];
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 4. 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.

6. Segmentations

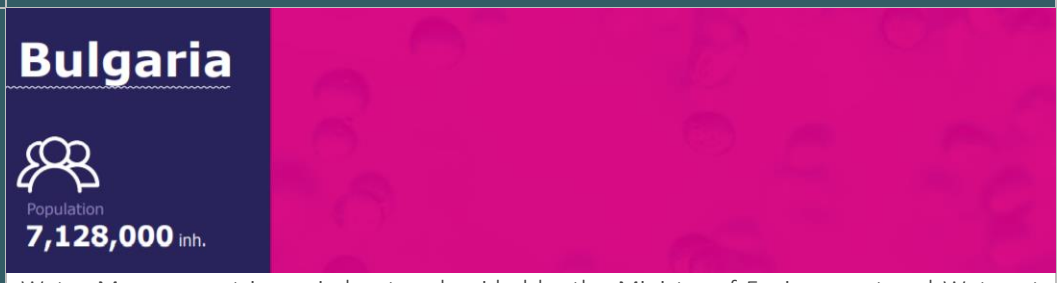
On the section Water safety and security market overview a snapshot of the direct and indirect stakeholders of the aqua3S solution were presented. In the current section we are examining the direct stakeholders that can be considered as potential customers as well, while an overview of where the decision-making 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.

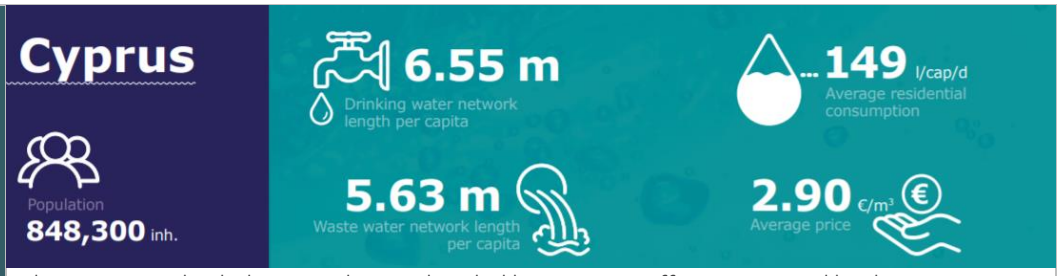
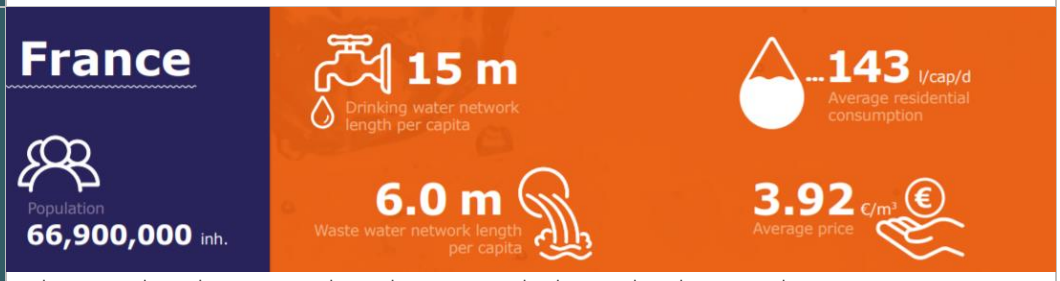
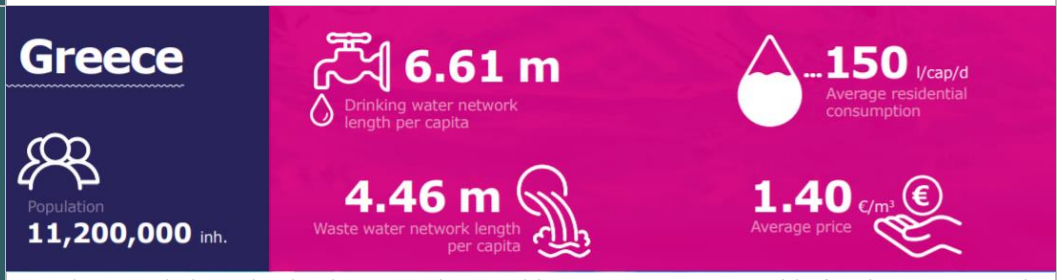
6.1 Customer segmentation

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, followed in the next table 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.

COUNTRY	PROFILING
Bulgaria	 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	 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	 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.

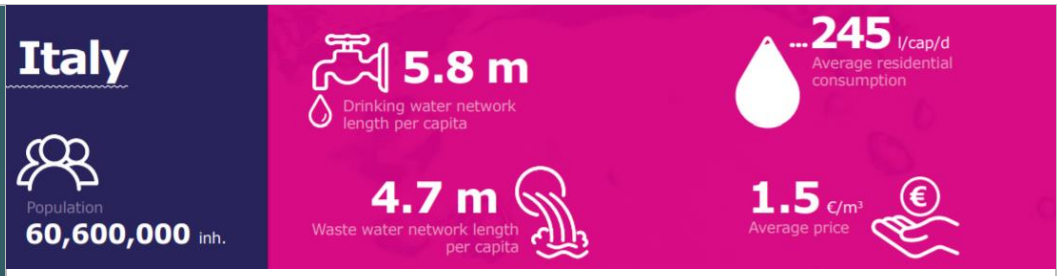
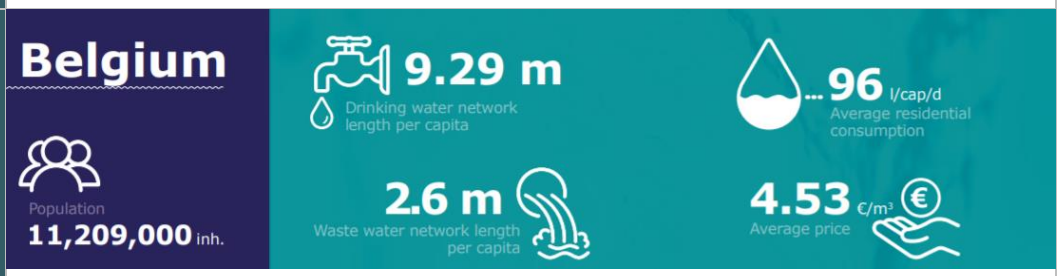
Italy	 The Italian water resources policy has been dominated by infrastructural aspect. The Ministry of Public Works use to be the competent authority, but the Regions acquired competences on many issues. Furthermore, there are also the Basin authorities. As a special regulator, the Committee for the 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 5. 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 6. Organization responsible responsible for organizing water services per country

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 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. As mentioned in previous sections of the current document, Europe has around 3.5 million kilometers 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. 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 will further drive the market growth [13].

Nevertheless, it is not only Europe that is expected to record growth in the SWM systems. The Asia-Pacific region is home to more than 2.1 billion urban residents, with over two-third estimated to be living in cities by 2050. The region comprises countries with substantial non-revenue water (NRW) losses, like India (with almost 60% of revenue losses from the total water distributed) and Singapore, among others. Such figures signify the need for water management and indicate the potential for market growth in the region. The rising number of smart cities in the region is expected to create substantial business opportunities for the smart water management solution providers. Accounting for about half a million dollars, India is planning to build over 100 smart cities by 2022, which is expected to impact the total population of almost 1 billion. Also, Singapore spent over USD 1 billion in smart city initiatives in FY 2019. Such smart city initiatives in the region are expected to provide a huge scope for the adoption of advanced metering infrastructure. Furthermore, significant initiatives, to develop smart water systems, are evident in the Asian countries, like Malaysia, Vietnam, and Thailand, among others, indicating the scope for the growth of the market [4].

8. Conclusion

The current document provides the first 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 market analysis is a "living" document and updates will be made until the end of the project. In the second version of the market analysis in M20 a PESTEL analysis will be done for each one of the countries that are part of the aqua3S solution, accompanied by a SWOT analysis, both of which will help in comprehending the different exploitation approaches that are needed. Apart from the PESTEL and SWOT analysis per partner country, the market trends and the competitive landscape will also be updated in case new information are available.

After the second version of the market analysis, the document will be updated until the end of the project, when the final version will be produced.

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