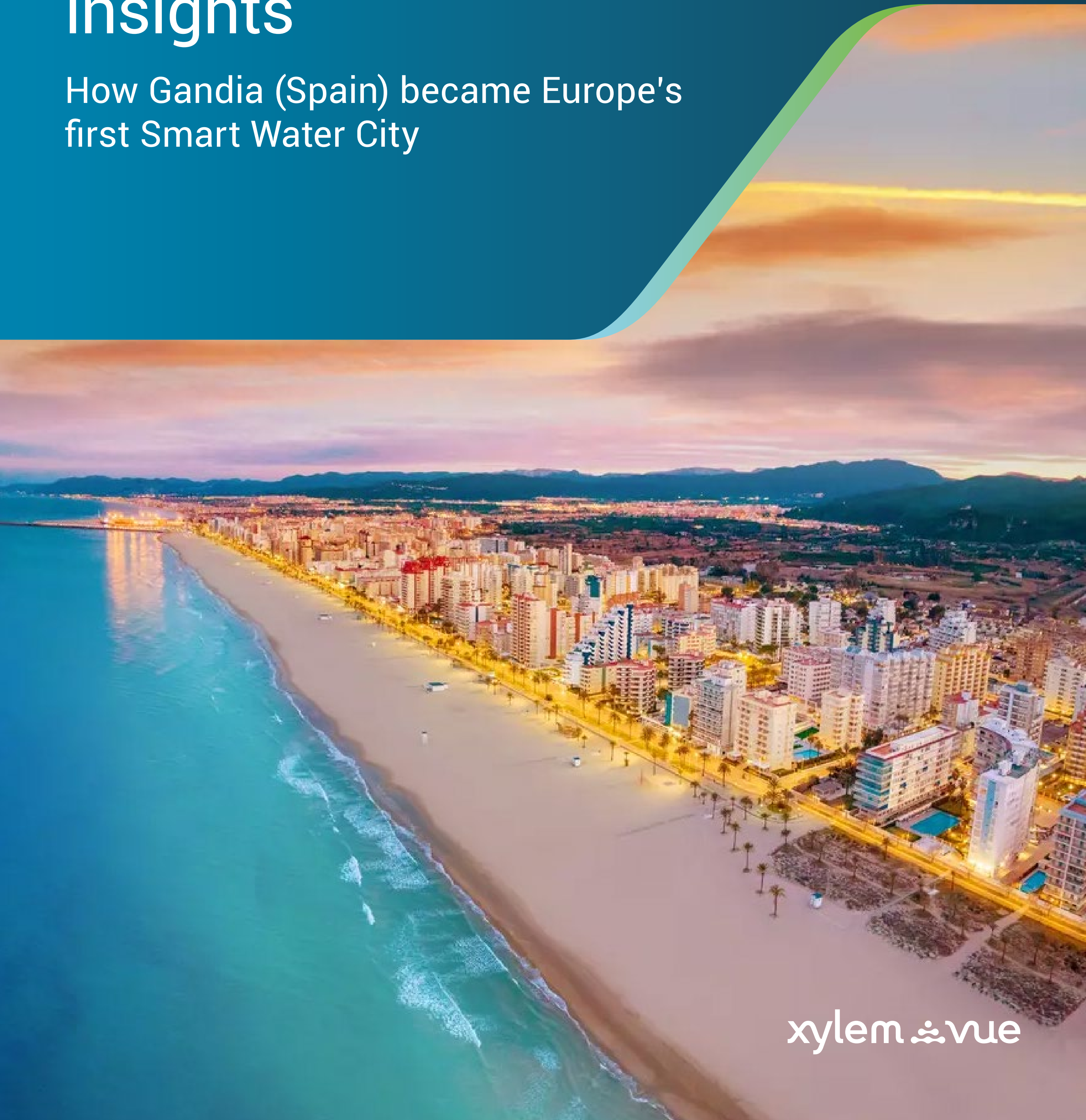
Case study
Gandia, Spain

Leveraging assets to deliver information and insights

How Gandia (Spain) became Europe's first Smart Water City



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Introduction

Over the last two decades, the water industry has undergone a revolution that has shaken its business model to the very core. Utilities, which have traditionally been excluded from innovative solutions as a result of being tied into relatively long concession contracts, are now encountering growing demands from consumers and government to become more accountable for their services.

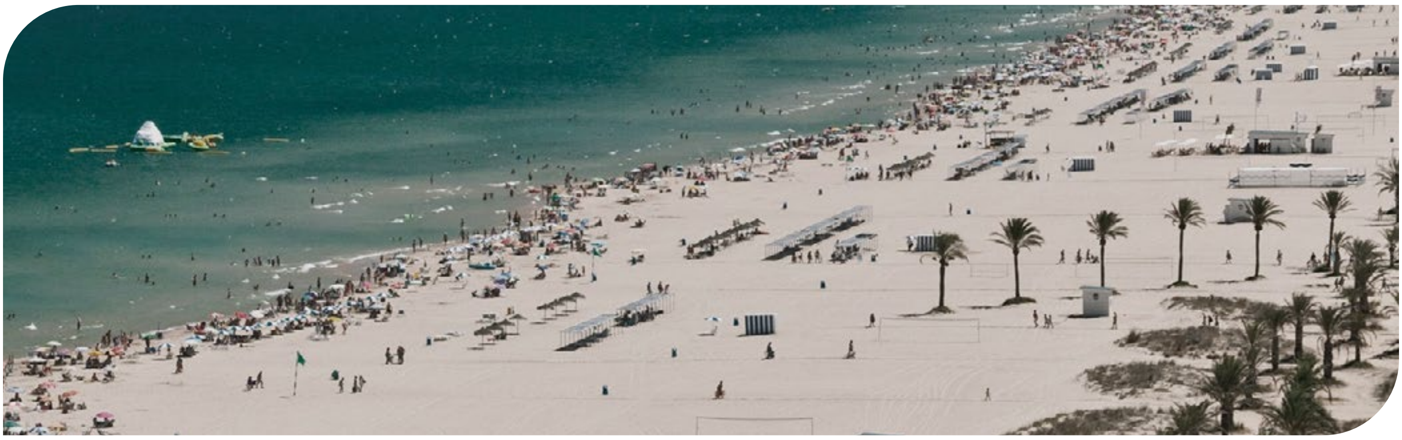
This fundamental change in their business model has been strongly influenced by technological developments that have taken place in the 21st century. The improvements in technology both inside the water industry (such as drive-by and walk-by meters, flow meters, improved sensors, integration platforms and smart metering on fixed networks) and outside it (the digital transformation of society and the customer-centric business model) have moved utilities away from their traditional role as water suppliers. They are now seen as more complex, transparent service providers that understand their customers and provide them with added value.

This radical change has, understandably, shaken the foundations of all utility business areas, starting with parts of their asset base, such as their networks and treatment plants, which have morphed from being simple parts in the larger chain of supplying water to information generators that facilitate continuous improvement. Utilities are building closer relationships with their clients and are striving to make their value proposition unique and keep it up to date. In addition, they are transforming the very culture of the industry and its hierarchies and processes in which traditional decision-makers are relying more on data than on experience, with profiles such as the CDO (Chief Data Officer) starting to scale the ranks, as more powerful algorithms are developed to harness data.

The city of Gandia and its water utility, Global Omnium, embody this qualitative shift in the water industry. The city has experienced a process of total digital transformation in the last 20 years, mirroring what has happened in the industry, and its success story can help to explain how traditional water networks have evolved into their new smart version. This paper seeks to divulge this story by analyzing every stage in the digital transformation of Gandia's water networks, the role that GoAigua's technological solutions have played in them, and how the network's shift towards information assets has enabled the utility to offer a better, more efficient service, while also providing an up-to-date value proposition. During this analysis, particular attention will be paid to the benefits that each new upgrade of the water network has brought to citizens and government.

This radical change in Gandia was driven by GoAigua's technology at a time when digital transformation was still incipient. The lessons learned during this process were leveraged by Idrica, who has since partnered with Xylem to combine Idrica's proven GoAigua technology with Xylem's collaborative and consultative global team of technical and water industry experts.

As part of the partnership, the companies offer an integrated software and analytics platform – Xylem Vue – that enables water and wastewater utilities to connect and manage their digital assets and streamline operations in a simple, secure and holistic view.



From traditional to smart networks

The value of an asset is expected to fluctuate over time. An asset is basically a tool used by a company to generate value in the form of revenue. The more efficient a piece of machinery or software is in creating value, the higher its value as an asset.

The evolution from traditional to smart networks can be directly traced to enhancing the value of physical assets such as treatment plants and distribution networks. Several waves of innovation, including the development of big data platforms and improved sensors, have transformed the role of these assets, seen previously simply as functional pieces of machinery, and have given them a new lease of life.

While pipes, osmosis systems and desalinization plants still have an inherent utilitarian value given that they continue to perform specific functions within the larger water supply chain, the incorporation of sensors, flow meters and pressure meters, to name just a few, has enhanced their value as information-generating devices and facilities.

This information encompasses everything from performance data reflected in monitored KPIs, data-based alarm systems which facilitate predictive maintenance of infrastructures, through to customer knowledge of consumption patterns which enables utilities to deliver a more personalized experience.

Two data scientists, Kenneth Cukier and Victor Mayer-Schöenberger, coined the term “datafication” to explain this data-centric shift in the way certain processes are conducted and improved. The water industry is very much influenced by this evolution towards a “datified” industry, with the inclusion of data-recording mechanisms, such as networks with sensors and smart meters, facilitating the datafication of the water supply chain. This information can later be used by companies to make processes more efficient, improve cybersecurity, provide enhanced services and reduce costs. All of these benefits represent the heightened value of new data-centric assets such as smart water networks.

Technology as an enabler

The datafication of the water supply chain and all the ensuing benefits, as we have mentioned above, have only been possible thanks to the technological progress of the last 20 years.

There are three different levels in the standard architecture of a data-driven utility: the lowest level of this data structure is where data integration takes place, with deployed sensors and smart meters recording a variable and then transmitting that data (via IoT networks or near-field communications) to a receiver or a database; the second level is a big data platform, which is essentially a large, flexible database which receives, re-structures, and integrates the data so that it can be used by the third level in the architecture pyramid. The applications which use the data to deliver value (for example, detecting leaks or predicting customer demand) operate at this level. Figure 2.1 provides an overview of this new environment.

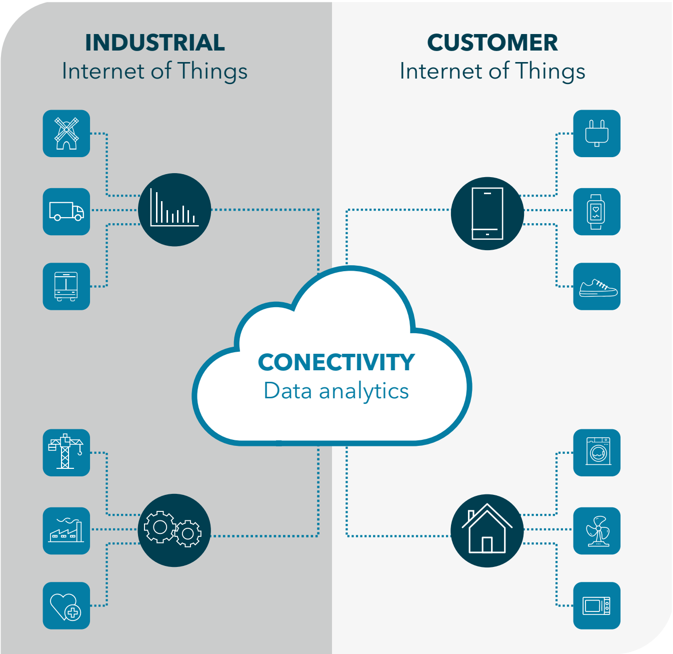


Figure 2.1. IoT architecture and analytics
Source: Cti Group

Level 1
Advances in sensor technology

In essence, the evolution of sensor technology in recent decades has had two direct impacts on the datification of water networks: the first is that improved sensors are better able to record and transmit information in near-real time through different communication networks: this level includes flow meters to measure the flow of water, and smart meters which calculate customer consumption.

The second impact is that these sensors have decreased in price. Though procuring the huge number of sensors and smart meters required to monitor an entire network of meters is by no means a small investment, the unit cost of the improved sensors is lower.

Figure 2.2 shows some of the different types of sensors available for data recording.

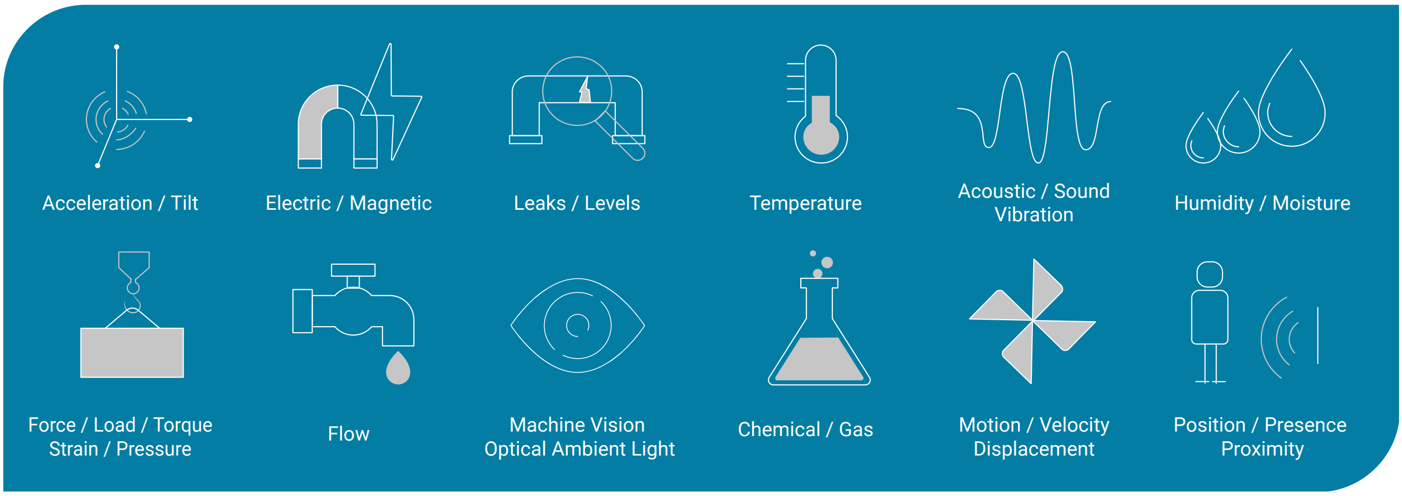


Figure 2.2. Selection of sensors and measurable variables

Level 2
Integration and big data platforms

This second step is crucial to create a coherent, holistic vision of the entire data-driven water supply network. In the field, there are many different sensors marketed by multiple vendors measuring radically different variables. Big data platforms are the nexus for all of these individual pieces of information to be collated, thus providing a combined vision of the operational reality of the company.

The data structuring that takes place at this level gives third level applications access to a consistent, homogeneous dataset, eliminating the different coding, recording and data distribution methods that are exclusive to each vendor. Without big data platforms, no data reporting and data mining could be conducted.

Figure 2.3 shows the architecture of a big data platform.

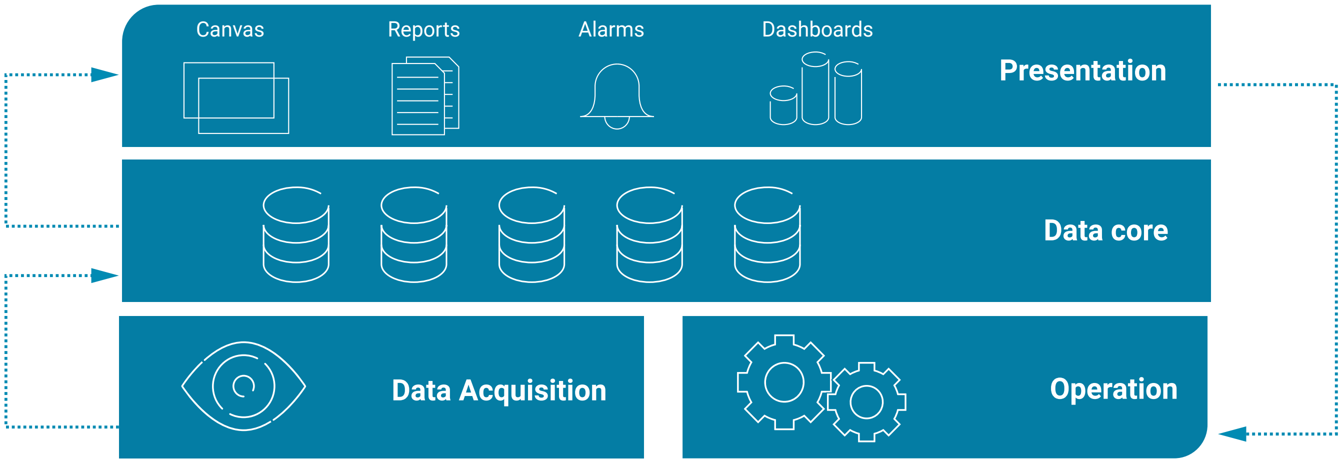


Figure 2.3. Data integration overview

Level 3
Applications

The third architectural level is where the applications using structured operational data run.

This is the point at which an algorithm that has been optimized to detect leaks, for example, accesses the consumption data of an area, checks for non-standard consumption peaks through monthly data series and compares them to the flow measured by the flow meters. This complex tapestry of connections and calculations is achieved thanks to the coherent, homogenous integration of data in the big data platforms.

This brief description of the three basic architectural levels of a data-driven smart water network underlines the power of technological developments, especially in sensors, data integration and machine and algorithm learning. Figure 2.4 shows how applications connect to their databases, either in a data-centric or application-centric scenario.

The following section details the case study of the city of Gandia. Each element of smart water networks will be studied individually based on the architecture explained above, paying particular attention to the technologies involved in making it a reality.

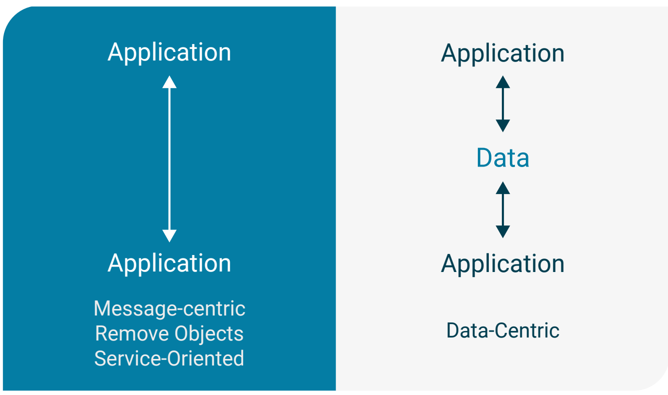


Figure 2.4. Architectural differences between data-centric and app-centric applications

Gandia case study: introduction

Gandia is a city in the Valencian Region of Spain, located on the country's east coast. It is close to the Mediterranean, and is around 65 km (40 miles) south of the region's capital city, Valencia. At its peak (during summer) its population grows to over 200,000 inhabitants, and it becomes a thriving center for commerce and tourism in the region.

In 2008, the utility operating the city's water supply and the Gandia city council decided to phase in a long, gradual process of digital transformation, starting by upgrading most of the water networks and their treatment and purification plants to the latest technological standards of the industry. This process implied sensor deployment throughout plants, the creation of digital twins, the division of the distribution network into DMAs, the deployment of flow and pressure meters to record fluctuating values at the entry and exit points of each area, and finally, during the last couple of years, the replacement of all the conventional meters with cutting-edge smart meters, equipped with integrated NB-IoT communications, thanks to a partnership agreement with the telecom provider, Vodafone.

This upgrade of Gandia's network and asset base did not only center on the addition of hardware in the shape of smart meters and sensors; it also involved the development and implementation of new big data platforms and applications to reduce leakage, forecast demand, segment customers, digitally transform structures, improve energy efficiency and deliver other software-centric value propositions.

In this case study, we will carry out a chronological analysis of the different stages of the network's digital transformation, paying special attention to the implementation of hardware and GoAigua's software solutions, which are now part of the Xylem Vue platform, and highlighting the benefits they have brought to government and citizens.

Figure 3.1. Geographical location of the city

Initial asset sensor deployment

In 2008, when the process of digitally transforming the city's water networks began, two areas were considered crucial to the project's success: the deployment of sensors in its main assets, i.e., its treatment plants, and the division of the city's distribution network into more manageable areas (DMAs) that were easier to monitor.

The deployment of sensors to oversee fundamental KPIs in the treatment plants was deemed to be the first step required to ensure future success. This decision was made on the basis of the need to analyze existing performance prior to the deployment of algorithms and software solutions that could subsequently enhance it.

The deployment of sensors in the network first required dividing the aforementioned networks into DMAs. Hence, the first layer of the smart water network architecture was deployed in some treatment plants and in key assets such as tanks throughout the network.

The basic objective of deploying the sensors was to log operational data that could then be used to provide a holistic reporting view of the process in dashboards and reports, and secondly, to improve the process once the algorithmic applications had been rolled out. Figure 4.1 shows the digital, monitored version of an operating plant, with real-time data, which is accessible to users of the digital platform. On the other hand, Figure 4.2 shows an operational view of a well.

The project to deploy sensors in the large assets in the city of Gandia, as shown in the previous figures, went way beyond mere dashboard reporting. The water utility, Global Omnium, decided to go one step further and generate an entire 3D rendering of the plants and wells, leaving room for data to be taken directly from the deployed sensors and presented on GoAigua's updated, informative dashboards around the digital version of each asset. Figure 4.2, for instance, shows pressure variables in a pump, water volume in a well, and energy KPIs such as voltage and consumption.

Figure 4.1. Digital image of a plant

Figure 4.2. Digital image of a well

Eventually, the digital transformation of assets within the network evolved to such an extent that a digital version of the entire water network in Gandia became a feasible option. This environment aimed to provide a digital representation of the basic assets in the network such as wells and tanks, with their key variables, alongside information about the supply of water to inhabited areas. Figure 4.3 shows the resulting environment, which is included within the digital platform.

This system generated numerous benefits for the city's local government and for its residents. They were as follows:

This system gave the local government full access to an up-to-date version of the operational status of its water network, which now featured an alarm system and monitored variables aimed at informing the relevant authorities and the utility, who had the final version of this dashboard, about the issues detected.

Although this solution had been designed to provide a reporting mechanism and monitoring capabilities to the utility and the government, it also meant a more efficient system for customers, streamlining the water supply process, by, for example, making sure that the tanks always had enough water in them thereby reducing water shortages, as well as ensuring strict controls on water quality.

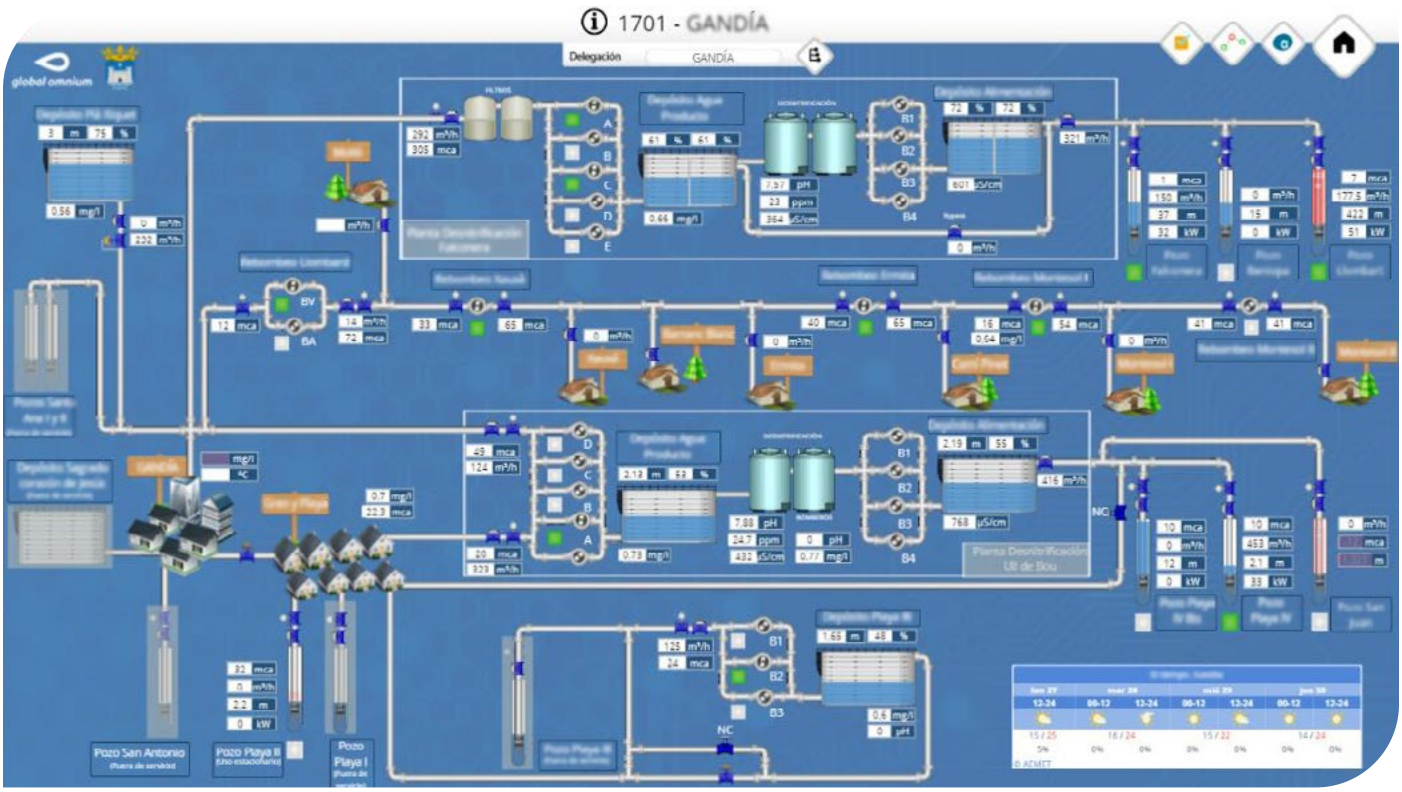


Figure 4.3. Digital environment of Gandia's smart network

Subdividing the distribution network

One of the fundamental concerns of the Gandia city council and Global Omnium was to optimize the efficiency of water distribution, essentially by reducing the amount of non-revenue water. Two axioms guided the approach to respond to this need: the first was that the high levels of non-revenue water were caused fundamentally by large, undetected leaks that went on for months, and secondly, that the best way to detect these leaks was to persistently monitor water balances.

As we have indicated above, any process of digital transformation requires a large amount of hardware. The most expensive pieces of equipment required to record data are flow meters, whose main purpose in a digital water network model is to measure water flow at certain points in the distribution network.

Given their price and considering the limited budget shared between a government agency, such as the Gandia city council, and a private water utility, like Global Omnium, optimizing spending on measuring instruments quickly became a priority for both parties.

However, it was also a priority not to compromise the effectiveness of the project solely on the basis of saving money, so a team of field operators and solution developers, supervised by a CDO, began to break up the network into DMAs.

The division of the Gandia network into 20 smaller areas quickly optimized the deployment phase of the flow meters and secondly of the pressure meters. It was decided that, in order to obtain an updated picture of the flow of water, powerful flow meters would be placed at the beginning and end points of each DMA. This concept helped the utility to reduce the amount of meters required, as there were now only specific points in which the flow of water was monitored, and to deploy the meters relatively quickly.

The different colors in Figure 5.1 show the final division of the network into smaller, manageable DMAs which enabled successful leak detection, a process that will be analyzed in the following section.

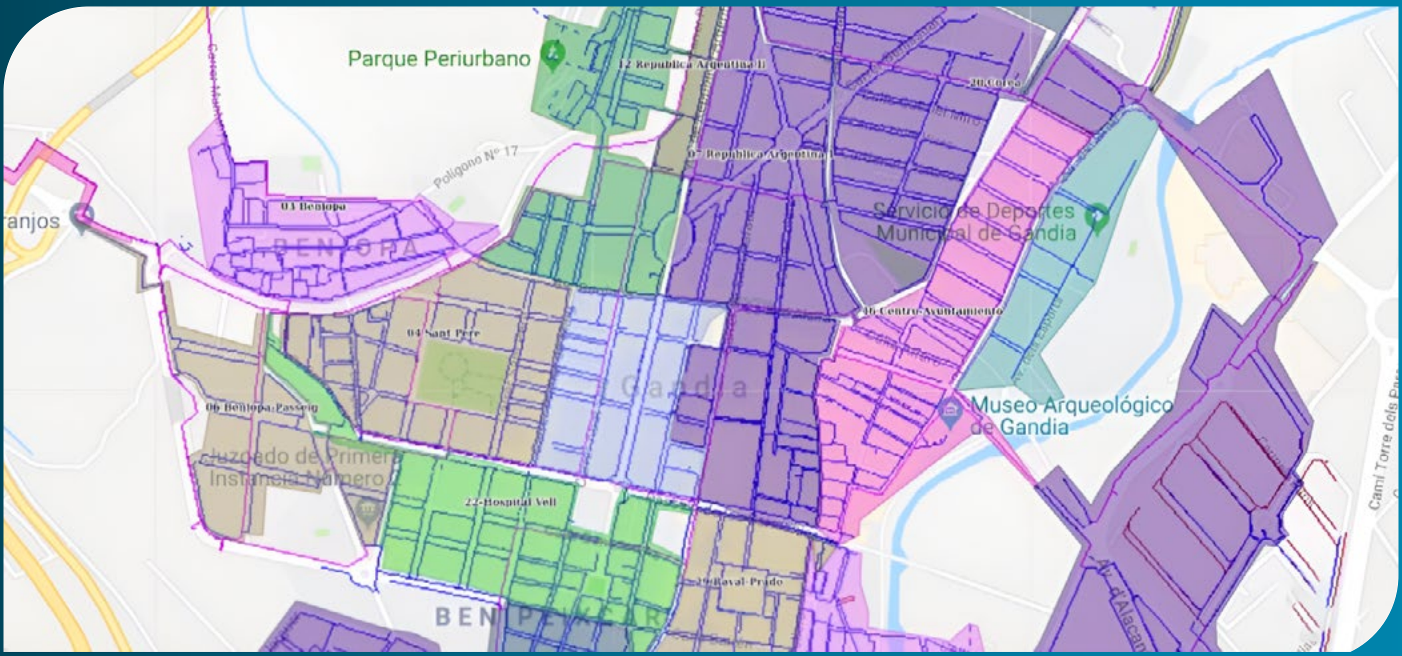


Figure 5.1. DMA Network - Gandia

Smart metering

Once the network had successfully been divided into DMAs and the flow meters had been deployed, it became necessary to update consumption measuring to improve the water balance which, together with pressure monitoring, would indicate leakage in a DMA.

In terms of updating consumption metering, it is important to point out that the disruptive effect that digital transformation has brought to the water industry has triggered several waves of innovation, resulting in the development of new types of meters.

These types of new meters have featured ever-faster distribution of data, first through near-field communication networks, in which a moving receiver (be it a car “drive-by” or an operator on foot “walk-by”) records customer consumption thanks to its proximity to the meters. This has now evolved into a more advanced, independent version known as “smart meters” which send consumption data directly through GPRS or 3G cards to the utility databases, without the need for a receiver.

However, in Gandia, Global Omnium deployed an even more sophisticated type of water consumption meter. In collaboration with the telecom provider, Vodafone, the utility supplied the city with a brand-new device which uses Narrow-Band IoT connectivity to transmit consumption data and other relevant information.

The partnership between Gandia City Council, Global Omnium and Vodafone meant that all of the conventional meters (which needed to be checked by an operator in the field) were replaced with the new NB- IoT type.

This connectivity system offers much lower latency and overall smoother data distribution especially in areas where telecommunication networks are somewhat deficient or limited.

This project of European relevance, given that Gandia is currently the only city that complies with the formal standards of a Smart Water City, enabled hourly readings of customers’ consumption to be integrated in the utility’s platform. This gave the utility an aggregated monitoring system of water consumed and billed to clients in a given DMA.

Global Omnium used its new, upgraded NB-IoT meters to create these aggregated measurements of consumed water recorded in a system which, when compared to the water recorded by the flow meter at the entry point of a DMA indicated the existence of a potentially undetected leak. Figure 6.1 below shows how the water balance is calculated, whilst Figure 6.2 shows it in graphic form, in much the same way as it currently appears in Xylem Vue's (previously GoAigua) dashboards which are available to users.

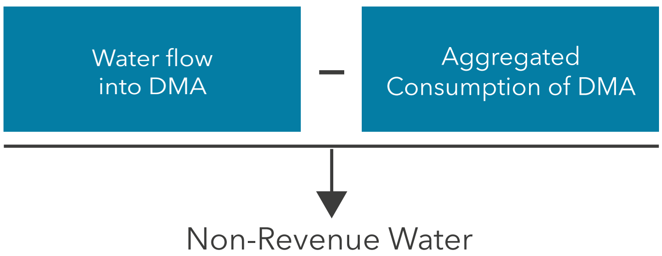


Figure 6.1. Calculation of water balance

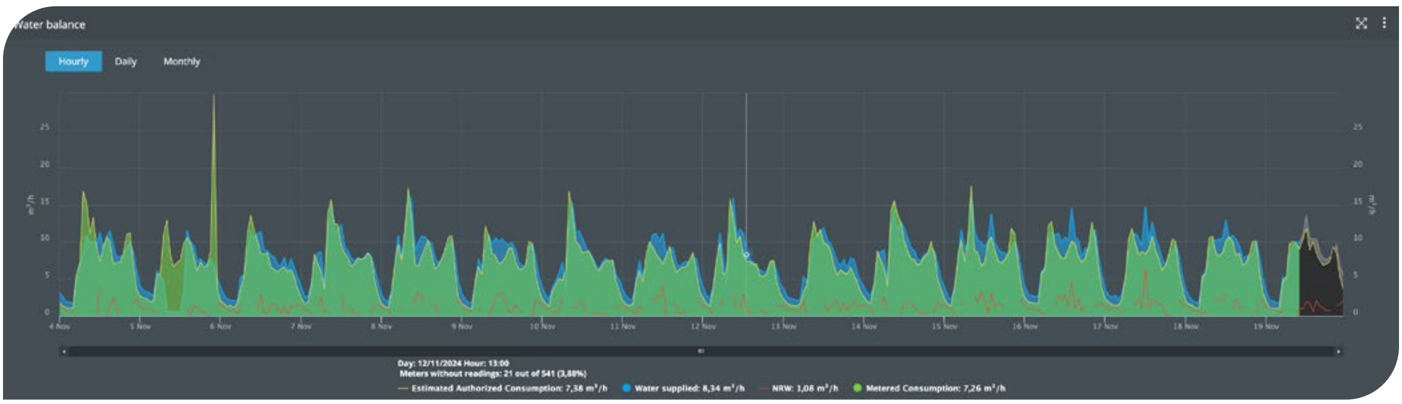


Figure 6.2. Water balance graph

This system brings many benefits not only for the Gandia local government but also for the city's inhabitants. Firstly, the mechanism to detect leaks through water balance calculations within the digital platform makes the distribution system more efficient. It detects the DMAs with the greatest number of problematic lines, which could be caused by the poor condition of the assets. Therefore, this system is a good tool to orient any government investment aimed at replacing these assets.

This system offers other benefits, mainly of an ecological nature, that is, reducing the amount of water consumed is in itself positive. It is also positive for the Gandia city council, since leaks in large networks are generally paid for by government. In addition, the consequences of major leaks, such as flooding, can trigger discontent among citizens.

On the citizens' side, the benefits derived from the system are fewer water shortages or cut-offs as a result of leakage, the improvement of the distribution asset base and the reduction of the above-mentioned consequences of major leakage, such as flooding or contamination of drinking water.

Beyond the benefits that leak detection offers, smart meters and integration tools such as the big data platform used, to which all consumption information is uploaded and integrated, also have a positive impact on the citizens of Gandia, strengthening the utility's value proposition. This enhanced value proposition, which is achieved thanks to the technology implemented, includes:

An **alarm system capable of alerting social services or the police** should unexpected consumption patterns be detected (e.g.: high consumption in households during vacations, low consumption in households with elderly or dependent people).

An **internal leak detection system, based on client consumption data,** has detected over 700 leaks that would otherwise have gone unnoticed and which customers' would have had to pay for.

Figure 6.3 shows this feature by using historical data to represent consumption patterns (shown as as the green line). Once sustained consumption is detected above these given values, an alarm on the customer app lets the client know about a potentially undetected leakage. Overall, this system helps to save over 300,000 m3 (79,250 gallons) of water per year across the entire client base.

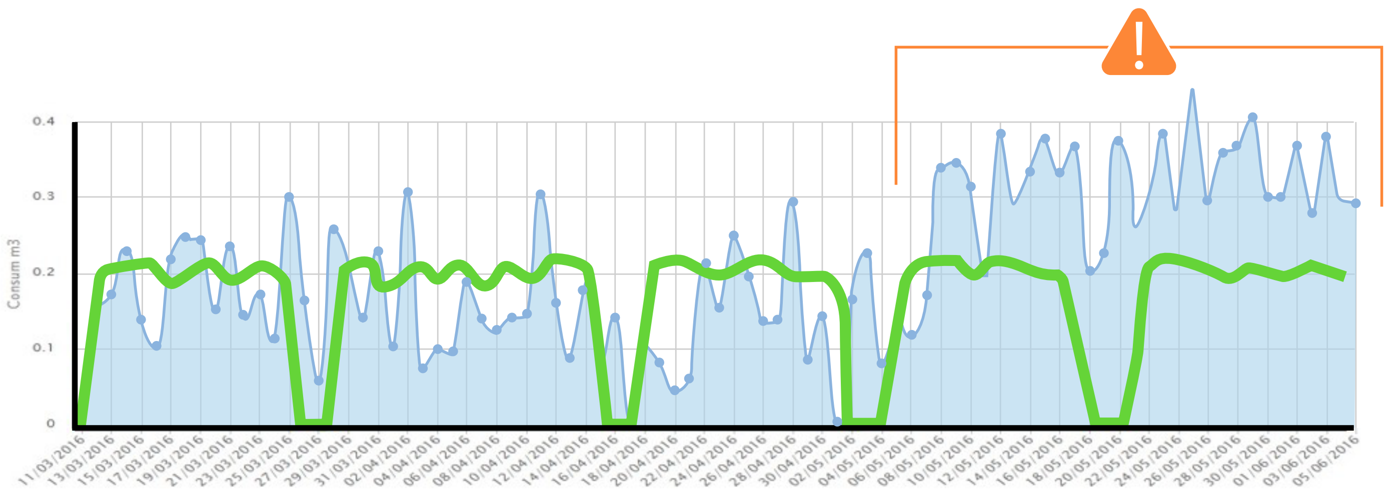


Figure 6.3. Alarm system for internal leakages

Conclusion

Gandia, Smart Water City

The evolution and constant improvement brought to Gandia's water network has radically shifted the nature and value of most of its asset base. There has been a fundamental change in the value of assets such as distribution networks, traditional meters and treatment plants, which originally lay in their mechanical characteristics and has now shifted towards them taking on the role of information generators.

In this digital data-driven world, the evolution towards efficiency is grounded in an information-based blueprint of the operational reality of the utility. In order to obtain this efficient roadmap, large amounts of data must be gathered, and the very assets which need to become more efficient, effective and profitable will have to expand their value into dimensions far beyond any mechanical properties.

The progressive digital transformation of several areas within Gandia's water networks, using GoAigua's technological solutions, which are now part of the Xylem Vue platform, serves as a highly successful example of the regimented process required to achieve this new level of efficiency.

Structures which had previously gone unmonitored, such as distribution networks, wells and meters, have progressively adapted to their emerging role of in-field assets as information generators. Preliminary sensor deployment in the largest, most crucial assets in the city, together with the future integration and creation of their digital twins marked the realization of the true value of data within the city's water networks. Subsequently, as Global Omnium extended their value proposition to the network itself with DMAs, flow meters, smart meters and NB-IoT connectivity, the focus shifted to improving the flow of data and breaking down information silos instead of merely improving asset performance.

These improvements, which are here to stay, are a direct result of Global Omnium, Vodafone and Gandia's focus on data and the implementation of GoAigua's technology. Idrica's GoAigua technology has now been combined with a digital solutions portfolio developed by Xylem to create the Xylem Vue platform, as a result of the partnership reached between the two companies.

Gandia is today the European example of achievement in transitioning conventional water networks to a smart alternative. This example has largely guided both the utility and the city's success in being considered as Europe's first digitally transformed Smart Water City.

Xylem Vue has brought the following improvements to the city of Gandia:

- 46 monitored DMAs
- +250 leaks detected per year in the supply network
- 60 serious leaks detected per month
- 150 average leaks detected per month
- 112 Tn CO_2 saved per year
- 0.5hm^3 water savings per year

Xylem |ˈzīləm|

1) the tissue in plants that brings water and nutrients upward from the roots.
2) a leading global water solutions company.

Xylem is the connective tissue and system in plants which cleanses and transports water from the root to where it is needed most to sustain life.

And this is the essence of Xylem as a company. We are committed to driving sustainable impact by ensuring our connected technologies and solutions support our customers and the communities they serve, to tackle the water challenges that matter most to them.

For more information on how Xylem can help you, visit xylem.com.

xylem vue

Xylem Vue is the result of the partnership between Xylem, a global leader in water technology and Idrica, an international pioneer in water data management, analytics and smart-water solutions. Through this partnership, Xylem and Idrica bring together their technology, innovation, and expertise to solve the world's most critical drinking water, wastewater and other water-related challenges.

Our single, integrated software and analytics platform – built by utilities, for utilities – enables utilities to take digital transformation to the next level, maximize investments, identify and solve problems more quickly, operate more efficiently and deliver water more effectively and affordably to their communities.

xylem