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Let's Solve Water

PROJECT SUMMARY

From Conventional to Smart Water

LESSONS LEARNED FROM BUILDING ONE OF THE LARGEST SMART METER NETWORKS IN EUROPE

IN PARTNERSHIP WITH

IDRICA

Contents

Introduction

Over the last few years, several waves of innovation have driven a remarkable improvement in efficiency in the water industry. The development and implementation of new technologies has been the fundamental enabler behind a qualitative shift in how processes are conducted within this industry.

One of the key technological advances in the past 50 years has been the progressive innovation in conventional water meters, which record a customer's water consumption and thus enable the billing process. The upgrades of these assets, which have finally become industry standards, have been driven by improvements in efficiency.

In line with the principles that are shaping the industry today, and given the large meter networks that an average-sized utility typically manages, the first innovations introduced in water meters enabled a faster and more reliable way to read water consumption. These initial efficiency requirements, which were largely driven by the advent of widespread availability of proximity wireless communications around 2008, led to the deployment of walk-by and drive-by meters that enabled a mobile data receiver (an operator on foot or in a car) to receive consumption data directly from these devices, simply by being close to them.

This system considerably reduced inefficiencies in terms of time and money, providing optimized reading routes and eliminating the need for each operator to check each meter individually. This was especially useful as some of these meters were located in hard-to-reach places or inside a customer's home.

The advanced consumption metering system, called "Smart Metering / AMI" goes one step further, incorporating the modern capabilities of the Internet of Things (IoT) devices and Big Data platforms. These systems do away with the need for a mobile proximity receiver, required in walk-by and drive-by systems. Instead, they simply send readings through networks with LPWAN technologies to the utility's databases, which are later integrated into its Big Data platform, where historical consumption data is collected and mined.

This document presents the lessons learned from the management of one of the largest smart meter networks in Europe. It begins by describing the background of Global Omnium (the water utility on which this white paper will focus), and then moves onto the key lessons learned at each stage of the process to digitally transform its meter network: the choice of hardware vendors, the deployment phases, how to leverage the data obtained, and best use and optimization of the network. Global Omnium's digital transformation process was enabled by the GoAigua technology, built by water experts based on real experience in the field.

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 powered by GoAigua – that enables water and wastewater utilities to connect and manage their digital assets and streamline operations in a simple, secure and holistic view.

Background

The Global Omnium case study is intended to illustrate the lessons learned from the management of a smart meter network.

Global Omnium is one of the largest water utilities in Spain. Its main customers are a number of cities on the country's east coast, the largest of which is Valencia. It provides water-related services to more than 300 cities on four continents, including water treatment and supply to homes and industries.

A couple of decades ago, Global Omnium managed around one million meters. This was before the innovations that would later transform the water industry had been developed, and before the invention of the enabling technologies that would serve as the drivers for improvement: proximity wireless communications and the IoT capabilities of modern devices.

At that time, all meters were conventional, requiring a direct check by operators in the field, who took note of their readings once a quarter and forwarded them to the accounting and customer department, thus triggering the billing process.

This system generated many inefficiencies and associated costs, which will be discussed in the next section. However, it is important to point out that the progressive evolution of Global Omnium's meters, from the conventional to the smart network it now operates, makes this success story and its lessons learned even more valuable for utilities with similar needs.

Lesson 1
Realizing the need for digital transformation

As we have said before, the meter situation Global Omnium found itself in, which is the same one many companies face today, implied inefficiencies and direct and indirect costs for the utility company, which hindered its business performance.

Of the many direct costs associated with a network of conventional meters, there were three that were a priority for Global Omnium: the high costs of meter readers, the difficulty in accessing some meters, and the growing cases of fraud.

A conventional meter network as large as that of Global Omnium, located both in cities and in industrial and suburban areas, required a large team of meter readers and the right tools to accurately take readings. This constraint made Global Omnium's costs extremely high, given that it had to train, supervise, coordinate and maintain a large team of employees.

However, this was not enough to guarantee an efficient reading system, as there were many instances of meters being located inside customers' domiciles, requiring an appointment to ensure they were at home. This situation made it extremely difficult for field workers to organize their tasks, as they were tied to long waiting periods. This significantly prolonged the reading process which, in turn, dragged out the entire billing and payment cycle.

In addition to the high monetary and operational costs, the conventional meter network also meant that Global Omnium had limited control over its network of meters, which over the years had been subject to major increases in fraud and tampering. Some meters that had been tampered with were not detected by operators in the field. When tampering was detected, it was only because it coincided with the quarterly meter reading, resulting in a significant loss of revenue.

In addition to these costs, there were many shortcomings to quarterly readings since, given the size of the network, it was common to only check half of the meters and then apply the averaged-out consumption to the remaining customers. This process led to many inefficiencies, and complaints increased during the quarterly meter reading campaigns.

These costs, added to many other smaller expenses, drove Global Omnium's move towards innovation. Its current concession for the operation of water networks and treatment plants in the city of Valencia gives Global Omnium exclusive rights until 2050, creating incentives to invest in developing the network and assets.

These two factors made it easier to upgrade its network of conventional drive-by and walk-by systems to its current almost 700,000 smart meters of which more than 550,000 are on the fixed network.

Lesson 2
Choosing the technology

Every process of digital transformation aims essentially to create efficient data flows. From the sensor hardware layer, the network through which the procedure data or KPIs are shared, to the platform in which they are integrated. This is why current architectural models place so much importance on the process of choosing which instrumentation (sensors) are the best choice to build the foundations of this data flow.

This decision, which is relevant in any digital transformation process, is particularly important in a smart meter deployment initiative, since the equipment base is vast (each household requires an upgraded operational meter unit).

In 2008, Global Omnium was fully aware of the consequences of deploying the wrong technology. Choosing a meter supplier that had restricted protocols to a closed source, proprietary integration solution, or choosing meters with a low battery life or which were easy to tamper with, would create problems that would quickly escalate as the deployment phases unfolded. The goal was a cheaper, faster and more efficient reading process, so deploying meters that generated more inefficiencies threatened to bring the project to a complete standstill.

The following section outlines the deployment phases in more detail. However, it is important to note here that this phased approach to meter deployment enabled the utility to conduct several tests with different technologies and suppliers.

After detailed scrutiny of the results, Global Omnium decided not to limit meter deployment to a single brand, but instead chose to retain several different technologies. Figure 2.1 shows that several vendors still operate within the network.

The key requirements that the company looked for in these vendors' meters after carrying out the tests were as follows.

Firstly, they had to have long battery life enabling the meters to operate unattended for long periods of time as well as drastically reducing network energy expenditure.

This requirement was heavily influenced by the comparison between energy suppliers and the scalability of costs as more phases were deployed.

Secondly, they had to use an open-source, non-proprietary data exchange protocol. The need for efficient, open integration and the restructuring of information to enable real use of consumption data will be discussed further in Lesson 4 of this paper. Hence, many vendors whose proprietary solutions did not support this restructuring and further mining of data flows were discarded as these would have generated information silos.

Thirdly, there were security concerns in relation to the exchange of data. Since hourly consumption data, as well as its inferred patterns, could shed light on the private habits or routines of Global Omnium customers, the company quickly realized the need for secure data transmission. End-to-end encryption was a prerequisite for participating in the early tests.

Although Lesson 5 will go into this in more detail, it is pertinent to note that once a large number of smart meters from the selected brands were deployed, a comparative performance dashboard was created (shown in Figure 5.1) and added to the Big Data operating platform where consumer data is integrated. This enables managers and operators in the field to track the performance of each manufacturer by continuously testing their equipment.

The following meter vendors were deployed by Global Omnium and still operate within the system.

CONTAZARA   CONTHIDRA S.L.   DIEHL METERING

ELSTER   ITRON   KAMSTRUP   SENSUS

Figure 2.1: Hardware vendors deployed

Lesson 3

Deploying the technology

As this paper has indicated in previous sections, Global Omnium's meter network evolved from an all-conventional one to its current smart meter network in a well-structured manner. Throughout the 20+ years of progressive evolution to its current state, there were two key aspects that drove the ongoing deployment and replacement of the meters: a technological consideration and a geographical consideration.

In terms of the technological consideration, it is important to point out that Global Omnium was driven by a single goal throughout its digital transformation process: to use the latest hardware and software innovations in this field to minimize inefficiencies and reduce the direct and indirect costs it encountered when reading meters.

This technological vision divided the deployment of upgraded meters into three distinct implementation stages, each characterized by a generation of new meters.

The first generation consisted of the deployment of walk-by meters that made use of the aforementioned proximity wireless communications. Global Omnium was able to reduce its operating costs in the field and speed up the meter data reading process by giving each operator a receiver. This system was, however, quickly superseded by the drive-by system.

It is important to mention that 20% of Global Omnium's current smart meters are still walk-by. They are the best choice in areas where driving is difficult and there is poor network connectivity, which limits the usability of the smart meter.

In the second generation, drive-by meters further accelerated the reading process, once again reducing operating costs in the field. The problems, however, with drive-by meters are their limited access in certain areas and the need for highly optimized driving routes to avoid incurring in new costs for misspent gasoline and time, both of which were problems that Global Omnium encountered during this second phase.

The third and final generation was the deployment of smart meters which do not require a mobile receiver, as they are equipped with IoT capabilities and can either share data directly with the utility's databases through the existing network or via the IoT chips they are equipped with. Figures 3.1 and 3.2 outline the current status of the Global Omnium meter portfolio. Two main trends can be observed here: the first is a steady upward trend in the size of the network and the second is how

January 2020

1.195.464 Meters

698.213 Smart Meters
497.251 Conventional Meters

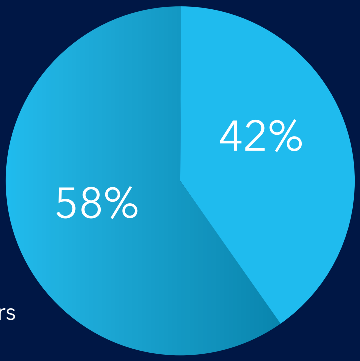

Figure 3.1: Number of meters (2020)

January 2020

698.213 Meters

581.080 Fixed Network
137.133 Not Fixed Network

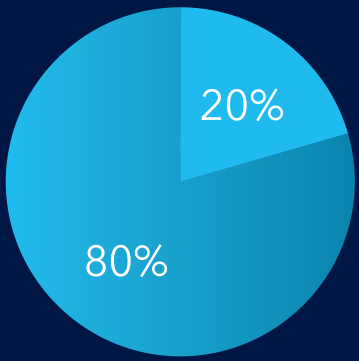

Figure 3.2: Meters on the fixed network (2020)

This system greatly reduced the inefficiency costs outlined in Lesson 1, and after the initial technology test runs defined in the previous section, deployment got underway based on geographical factors.

The geographical consideration in the deployment of the smart meters was needed to establish which areas of the meter network should be prioritized. This systematic process was essential given the high cost to the utility of finding and replacing all the meters in each area simultaneously.

As we have mentioned before, Global Omnium is the utility in a large number of cities on the east coast of Spain. Each of these cities has three basic areas: the city center, where the largest number of customers live; an industrial area, where large clients have their factories; and the suburbs, with a smaller number of inhabitants.

The company, therefore, decided to organize the geographical deployment of its meters according to the number of clients in a particular area and the volume of consumption. Hence, the first stages of smart meter deployment took place in city centers, such as parts of the city of Valencia, followed by large consumers in industrial areas and ending up with the smallest segment of customers in satellite towns and the suburbs.

Figure 3.3 shows the current geographic deployment of smart meters as seen on the Global Omnium dashboard, 90% of the green and blue areas, which are those closest to the center of Valencia, have a smart meter, while the red areas have less than 50%.

This organized digital transformation response enabled the company to successfully plan and manage its hardware, training and deployment costs. In addition, the idea of progressively upgrading meters gave Global Omnium the opportunity to develop extensive experience and in-depth knowledge of the communication networks involved, their deployment and the problems that could arise.

Today, Global Omnium is leading the innovation trend towards smart meters in the European water industry and is considered to be an influential partner in the sector for digital transformation and consultancy. None of this know-how and other innovation initiatives, such as the NB-IoT success story in the city of Gandia, would have been possible without a dedicated, organized deployment strategy.

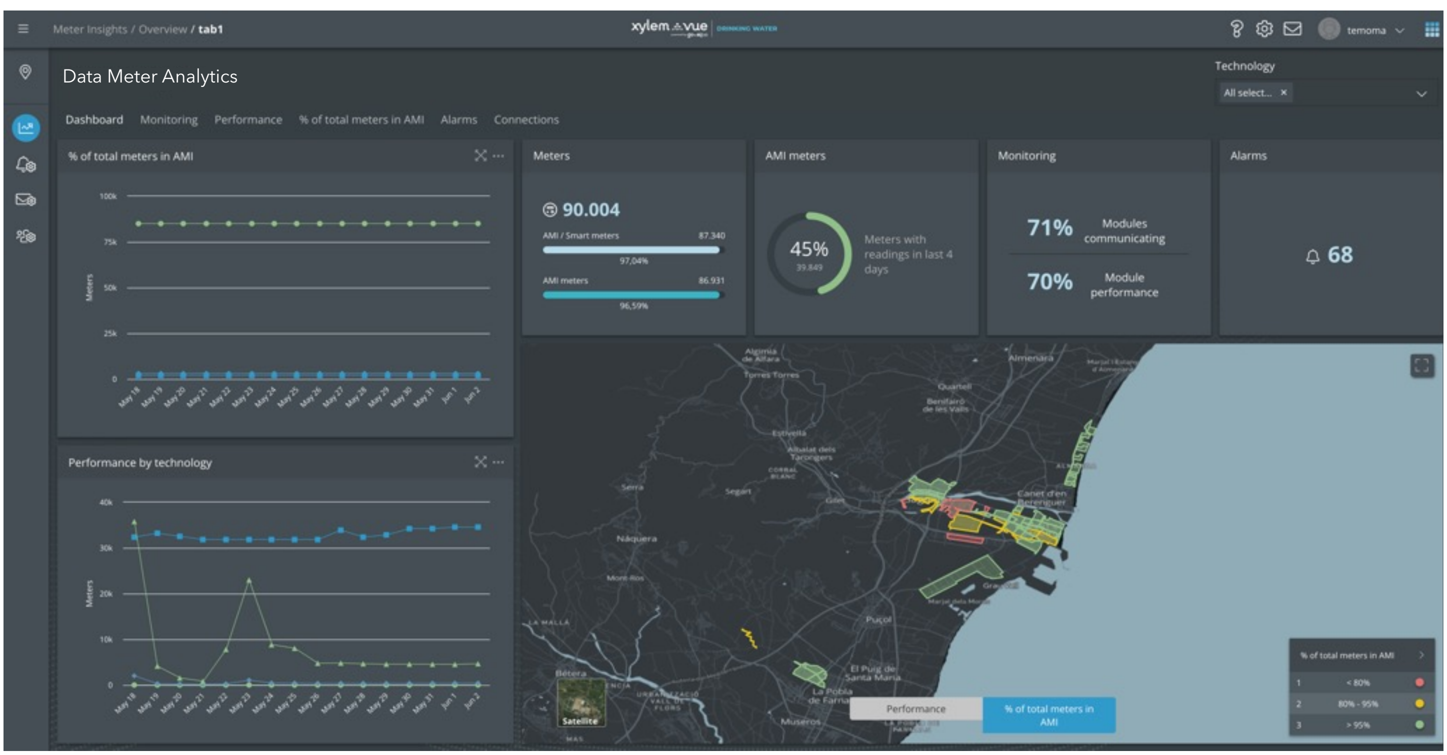

Figure 3.3: Geographical deployment of smart meters at DMA level

Lesson 4

Integrating the data

The digital transformation process has been defined as a structured data flow, based on a sensor layer capable of recording data. However, the end of this data flow, i.e., the platform on which consumer data is logged, restructured, stored and converted into business intelligence, is where the true value of digital transformation really lies.

According to Jaime Barba Sevillano, the CEO of Idrica and Chief Disruptive and Digital Officer at Global Omnium, "Data means nothing if it cannot be turned into information. And it is this fundamental distinction between raw consumer data, which is collected by smart meters and stored in Global Omnium's databases, and information, i.e., what the company actually uses that data for, that is at the core of its digital transformation drive".

This paper has focused on innovations in tools that optimize how meters communicate. Conversely, technological developments in the field of consumer data processing have transformed the operating software that aims to obtain value from this data.

We have indicated how Global Omnium has streamlined its billing cycle and reduced operational costs in the field. However, one of the key benefits of its smart meter network is its one-stop customer usage data center.

When the utility company realized the knowledge that could be extracted from the consumption data collected, it began to engineer a centralized operating platform to store, access and mine the data, thus turning it into actionable information. Figure 4.1 shows an architecture concept that supports the utility's digital transformation strategy in monitoring customer consumption.

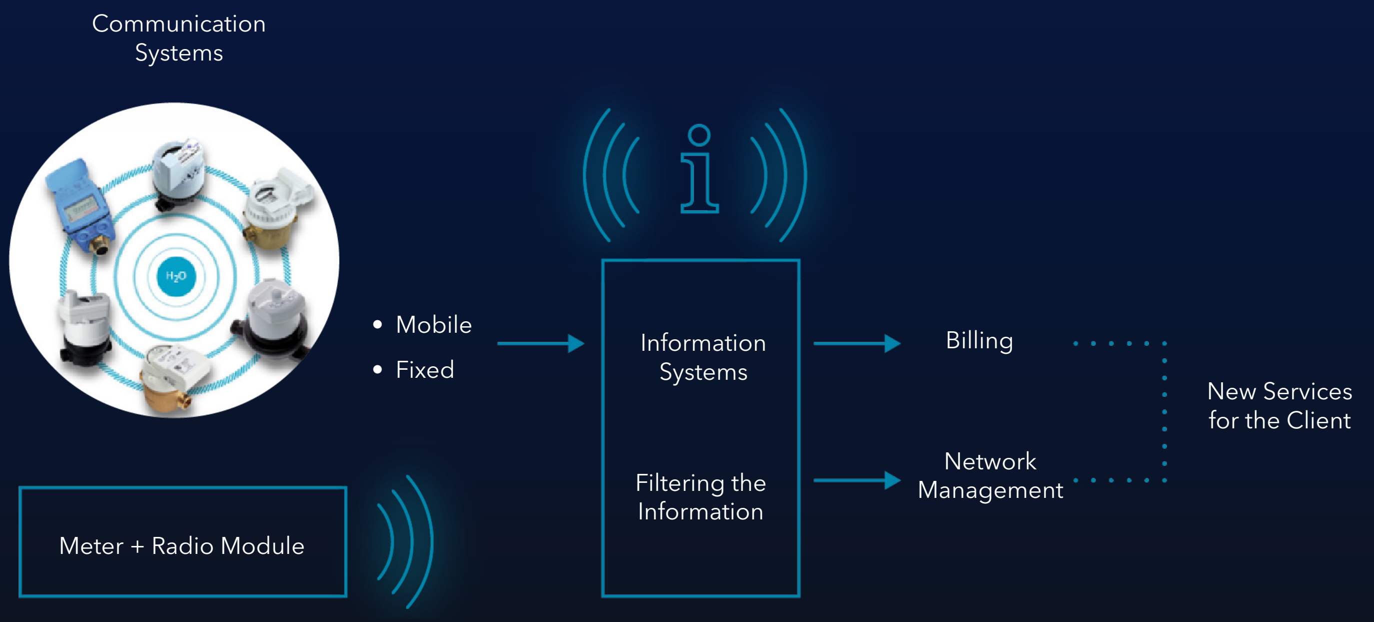

Figure 4.1: Architecture of consumption data flow

The Big Data platform that Global Omnium built enabled it to integrate historical and real-time consumption data for each customer (at meter or household level) in a single point. Given the different technologies, communication protocols and smart meter vendors in the network, the platform had to have a vendor and protocol-agnostic integration procedure. Basically, this means that differently structured data flows, from a wide range of vendor-specific meters, can be re-structured into a single architecture. This subsequently enables queries (from agents, billing systems, and machine learning algorithms) to access all client consumption data as a single, homogenous dataset.

Figure 4.2 outlines some of the most common data-exchange protocols currently used in Global Omnium's consumer data integration architecture. If the platform had not had this initial requirement, data from different brands of meters could not be easily accessed with a single query, nor could historical data from two customers with meters belonging to different vendors be cross-checked. This system would not meet the needs of transparency and interoperability that Global Omnium sought to achieve, creating instead opaque information silos.

While the first requirement of a Big Data platform focuses on the need to facilitate smooth integration from different sources, the second requirement refers to how that data is accessed by any applications that want to use it.

There are currently two basic architectural trends in the way Big Data platforms share information with applications: application-centric architecture, in which each application, solution or algorithm includes an up-to-date copy of the dataset in question and performs its calculations on it; and data-centric architecture, which opposes the mirroring of datasets by each application and instead chooses to grant each algorithm access to a shared central repository, where all updated and historical data is stored.

Global Omnium, driven by its continuous improvement strategy aimed at digitally transforming its processes whenever possible, and the need to enable seamless data exchange between applications, opted for a data-centric architecture. Now its customer consumption data lake is at the heart of its Big Data platform and can be queried by various algorithmic solutions.

Figure 4.2: IoT-based data exchange protocols

Thus, Global Omnium was able to design solutions that use the same consumption data. These included:

- A cutting-edge machine-learning algorithm for demand forecasting at meter level, based on the customer's historical data. Figure 4.3 shows the meter-level demand forecast as seen in Global Omnium's Big Data platform. The blue graph traces historical hourly consumption and the white area on the right shows the forecast.

- 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 4.4 shows this feature by using historical data to represent consumption patterns (shown as the green line). Once sustained consumption is detected above these given values, an alarm 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 4.3: Meter-level demand forecast

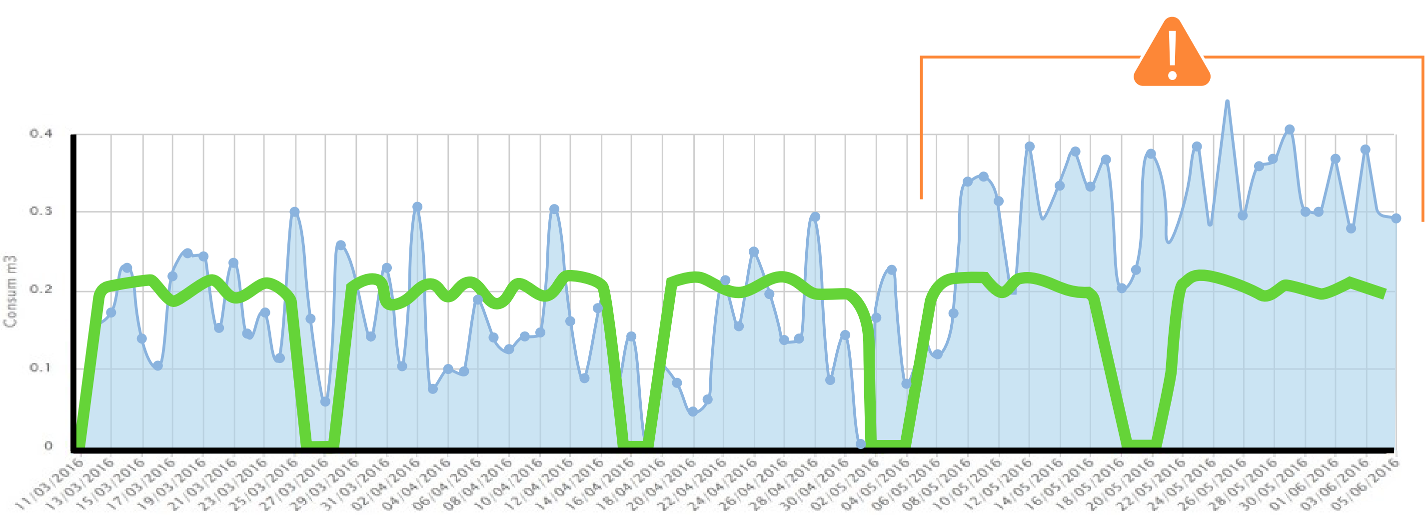

Figure 4.4: Alarm system for internal leakages

This robust architecture has enabled Global Omnium to reap unexpected benefits from its smart meters, while enabling it to develop on-demand products and offer ready-to-use services that are provided to its customers free of charge. This enhanced value proposition has helped the utility expand the number of towns and cities it serves by winning a series of public tenders, as well as winning over its customers, whose complaints have steadily decreased by up to 60% since smart meter deployment.

The data integration platform implemented in Global Omnium evolved into the GoAigua technology. Today, as a result of Idrica's partnership with Xylem, the GoAigua technology has been combined with a portfolio of Xylem's digital solutions to offer Xylem Vue powered by GoAigua, an integrated software and analytics platform that unifies and standardizes all utility data, regardless of source, to accelerate the digital transformation of water utilities.

Lesson 5

Managing a smart meter network

In previous sections, we have listed the different lessons that Global Omnium learned during its decade-long process of digital transformation. This section describes how each of the previous sections is linked to managing the utility's smart meters, starting with the technology chosen and the impact it has on operations.

One of the essential lessons learned when managing a multi-vendor smart meter network is that it requires supervision. As outlined in Lesson 2, Global Omnium decided to deploy multi-vendor hardware, in line with a strategy designed to reduce the risk of escalating the limitations of a single vendor across its entire meter fleet. While this was helpful in mitigating the shortcomings of each individual brand, it also meant that the utility had to conduct tests and trials for each brand.

To this day, when more than half of Global Omnium's network is made up of smart meters, manufacturers are still subject to continuous testing and monitoring.

The central console of the platform, where the consumption data is collected, includes a dashboard that compares the performance of each brand of meter. Several quality KPIs are shown at a single and aggregated level for each vendor. They include the quality of connectivity, the number of disrupted data exchange processes, connection security, latency and many others.

Figure 5.1 shows this feature, rating each of the vendors and showing historical graphs of each of their ratings.

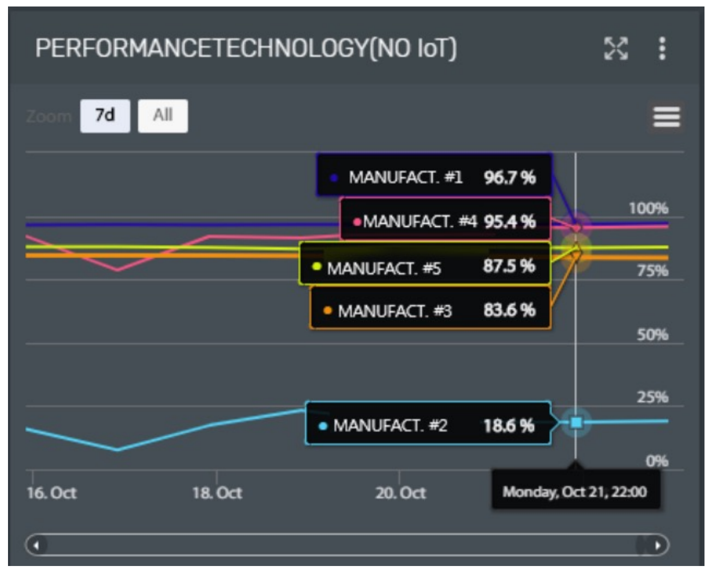

Figure 5.1: IoT meter performance at manufacturer level

This dashboard gives engineers and operators who manage the meter network a clear overview of individual brand performance. The comparative framework of the capacities of each brand is achieved by individual metadata shared with hourly consumption, which indicates the brand of the meter and identifies it individually in the network.

This cross-vendor comparative framework is only possible thanks to the data-centric architecture and open integration procedures of the digital platform.

Thanks to this process, the utility can pinpoint the inefficiencies of a particular meter brand, and establish which technologies are performing better depending on the location of the meter or the delay in data reception times (latency) related to the equipment's signal coverage.

This type of data enables Global Omnium to narrow its provider base to the most efficient brands while still testing the limits of current technology.

Regarding Lesson 3, which studied how the geographical and technical deployment of the meters was addressed, it is important to point out that, although this is crucial in early stages of any deployment, as was the case for Global Omnium, the lesson learned in terms of the need to plan new meter deployment remains just as important in later stages.

As mentioned, more than half of Global Omnium's network is comprised of smart meters. However, although these devices are coming down in price, the company still needs to follow strict cost-control criteria when increasing the numbers of smart meters it deploys.

Failing to devise a coherent, organized plan for the deployment of smart meters, which are still an expensive piece of equipment when considering the huge numbers required by a large water utility, could mean innovation budgets are quickly depleted. To avoid this, Global Omnium maintains its controlled deployment strategy, based on the geographical factor (reaching residential areas further away from the city) and the technological factor, testing new and innovative smart meters.

Figure 5.2 shows the water supply lines in a particular district on a map of the city in 3D. The scale corresponds to the sum of the individual customer meter readings.

This ongoing deployment strategy has enabled Global Omnium to introduce improvements in different locations such as Gandia, a city recognized as a pioneering European Smart Water City thanks to its digital transformation of water management, and Valencia, where over 40,000 meters are being read with different technologies (WMBus with WMbus-NBIoT concentrator, LoRaWan and NB-IoT).

In terms of Lesson 4 and the need to leverage consumption figures on an integrated, data-centric architecture, it is important to highlight the versatility of the system that has enabled Global Omnium to maintain a constant flow of innovations and an upgraded value proposition for its customers.

As explained above, the true benefits to be derived from digital transformation largely stem from the applications that use the data to generate value for the company in the form of business intelligence insights and for clients, in the form of customized products and services.

The data-centric architecture of the data integration platform has proven to be a successful terrain upon which innovative algorithmic and machine-learning solutions can be tested and eventually turned into marketable products and services for the clients to harness.

The core of the innovation ecosystem that the utility is developing is its open innovation hub, with its startups constantly providing solutions that operate with the integrated, homogenously structured figures of its data lake. This system, which is only possible thanks to its pre-emptive design as a data-centric architectural model, means innovative solutions can quickly be tested and converted into fully fledged products and services to be delivered to the market.

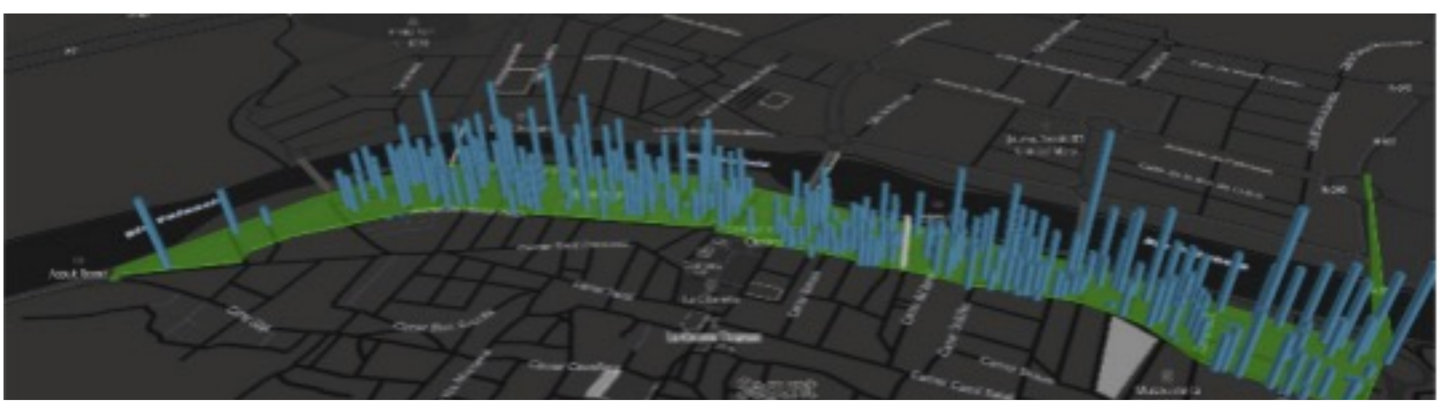

Figure 5.2: Smart Meter readings per water supply line in a DMA

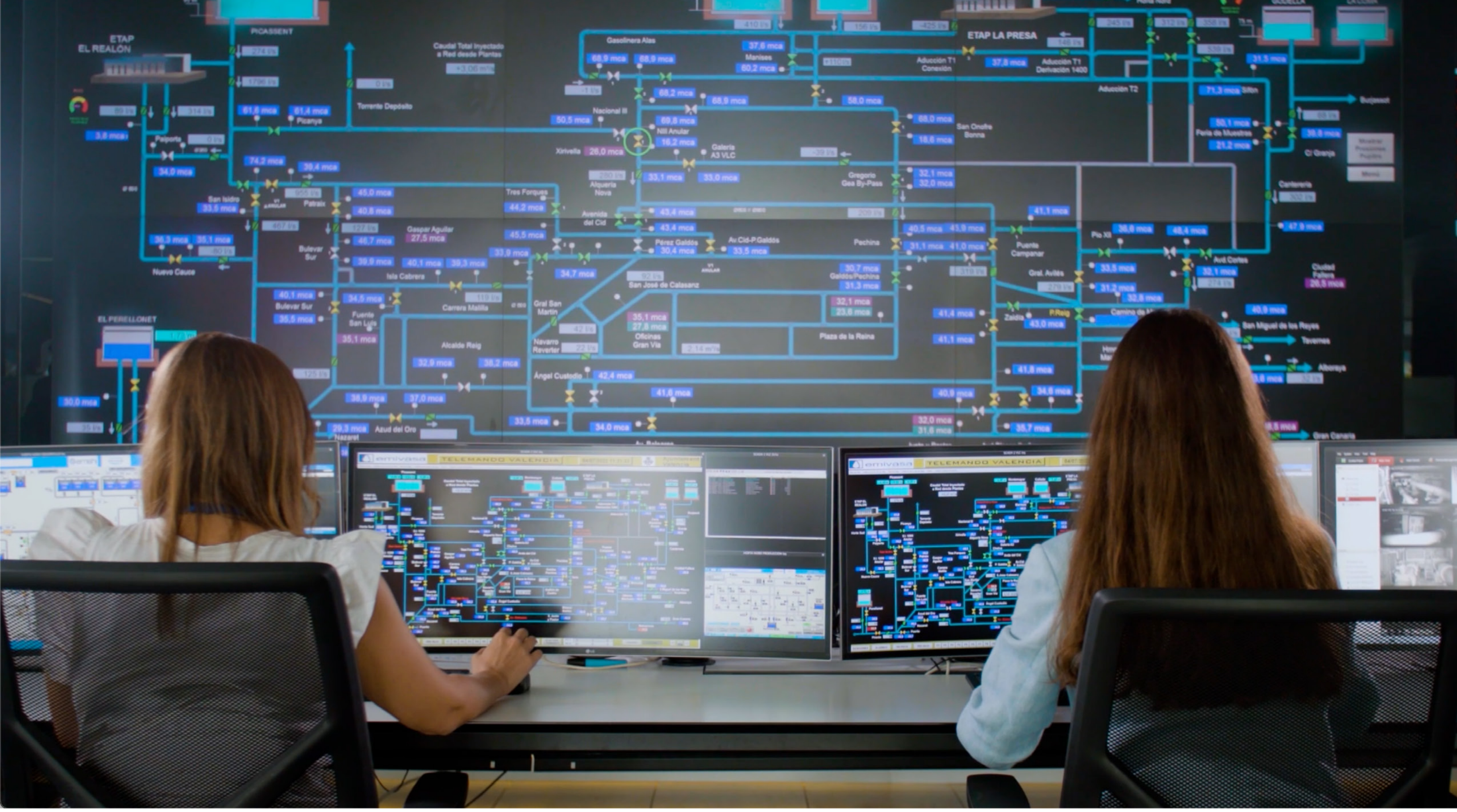

Figure 5.3 shows the monitoring of the aggregated daily consumption that is offered to customers through the Virtual Office app. This client-oriented service helps promote transparency in the billing and charging mechanisms while also serving as an excellent example of the benefits of smart meters.

We have already mentioned some of these benefits, such as the alarm system for second homes and internal leakage detection processes. However, there are others in the pipeline, such as dynamic billing based on consumption patterns or a green reward system for customers who limit the amount of water they consume, which could soon be a reality.

However impressive these solutions are on their own, perhaps the most important lesson to be learned about smart meter data integration is that it is the system that enables Global Omnium to quickly and efficiently test these innovative processes.

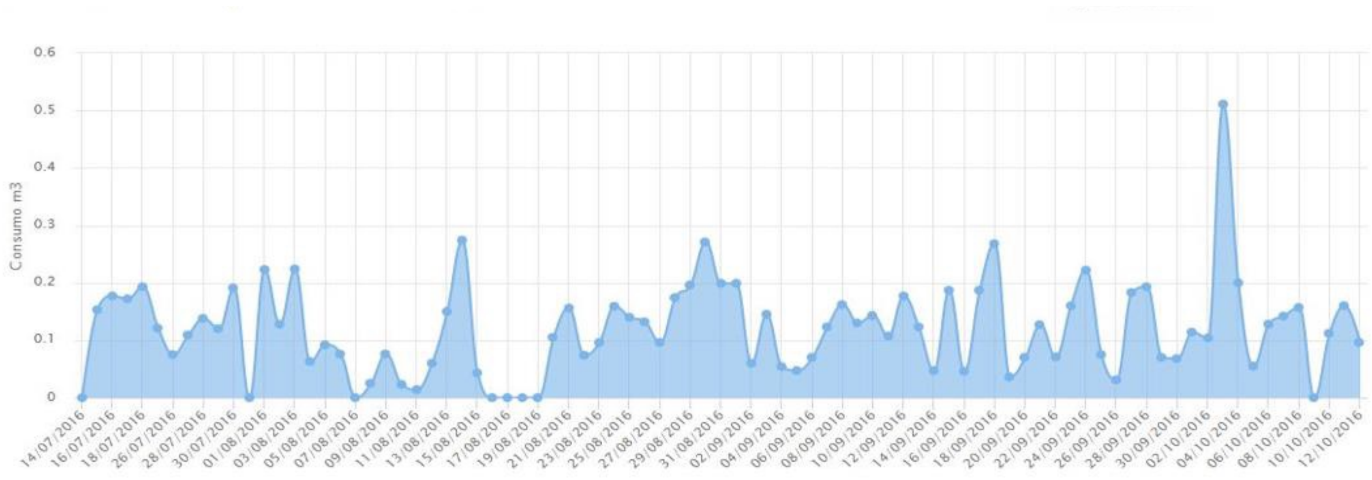

Figure 5.3: Aggregated daily consumption in customer app

Conclusion

Looking into the future

Global Omnium's commitment to digitally transforming its conventional meters over the last two decades has given the utility a holistic perspective on the implications of the process of upgrading its meter network and managing it, through several generations of innovative meters.

Despite this, Global Omnium remains committed to constant implementation of the innovative technologies that continuously upgrade and transform the technical and managerial lessons learned up until now.

As we have explained above, the main driver of continuous innovation is the ecosystem that the Spanish utility has built around its meter network. This ecosystem includes its commitment to standardized testing of new technologies; its structured deployment procedures, which enable cost-efficient expansion of its smart meter network; and its data-centric architecture and innovation hub, which enable innovative ideas to be quickly tested by giving them access to a large dataset they can work with.

The data integration platform implemented in Global Omnium evolved into Idrica's GoAigua technology and, as a result of the partnership reached between the two companies, has now been combined with a digital solutions portfolio from Xylem to create the Xylem Vue powered by GoAigua platform.

This entire transformation process has put Global Omnium in a privileged position to address emerging technology disruptions, which center on two radical innovations: the emerging 5G networks and NB-IoT technology. Both these technologies which are still in their infancy and have little traction in mainstream markets, have quickly found their niche within the innovation ecosystem of water utilities.

This process has enabled Global Omnium to forge strong partnerships with different network providers in the European market and it has mapped out several locations for conducting test projects. The use of NB-IoT technology, which will become the gateway for data communication in areas where traditional networks are not available, can already be hailed as a success story for the utility in different cities, such as Valencia and Gandia, with almost all of its conventional meters being replaced with smart meters which use NB-IoT networks to transmit the data they log.

However, despite past successes and lessons learned along the way, perhaps the most important lesson that both operators and innovative companies should keep in mind is that, irrespective of any knowledge, the only way to stay ahead in an industry is to build an ecosystem that encourages, tests and implements innovation.

Xylem |'zīləm|

1) The tissue in plants that brings water upward from the roots;
2) a leading global water technology company.

We're a global team unified in a common purpose: creating advanced technology solutions to the world's water challenges. Developing new technologies that will improve the way water is used, conserved, and re-used in the future is central to our work. Our products and services move, treat, analyze, monitor and return water to the environment, in public utility, industrial, residential and commercial building services settings. Xylem also provides a leading portfolio of smart metering, network technologies and advanced analytics solutions for water, electric and gas utilities. In more than 150 countries, we have strong, long-standing relationships with customers who know us for our powerful combination of leading product brands and applications expertise with a strong focus on developing comprehensive, sustainable solutions.

For more information on how Xylem can help you, go to www.xylem.com

xylem vue powered by go aigua

Xylem Vue powered by GoAigua 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 join their technology, innovation, and expertise to solving the world's critical drinking water, wastewater and other water-related challenges.

For more information on Xylem Vue powered by GoAigua, go to xylem.com/XylemVue

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