Water & Wastewater IIoT & Remote O&M

Overview

Water

Wastewater

Chile IIoW Example

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Overview

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$31 billion Municipal Water and Wastewater IIoT Market by 2026

Municipal water, wastewater treatment and distribution facilities are embracing automation and remote operation and monitoring. The Industrial Internet of Things (IIoT) empowered by the Industrial Internet of Wisdom (IIoW) will have a $15 billion impact on the market by 2026 and will divert another $16 billion through different market routes. Sales of all flow control and treatment for these plants will exceed $100 billion in 2026. Of this total $31 billion will be attributable to the impact of IIoT and Remote O&M.

Segment	Wastewater	Drinking Water	Total Municipal
Traditional Route to Market	35	34	69
New Route to Market	8	8	16
New Smart Revenues	8	7	15
Total	51	49	100
IIoT Impacted Market	16	15	31

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Companies Jockeying for Position

- This potential is illustrated by the role that Suez is playing in Chile. The company operates 40% of the water and wastewater plants in the country. Suez has a remote-control center in France and is monitoring key parameters at water and wastewater facilities throughout the world. It also owns Degremont who has furnished much of the equipment at these plants. If the guidance from the remote-control center is not sufficient then the equipment supplier who also has the cloud connection can provide advice.

- Suez has just announced the acquisition of GE Water. This adds additional equipment expertise but also a substantial treatment chemical capability with the Betz operations. So, the operator and the remote center can also benefit from the expertise of the treatment chemicals experts and can change the quantities and types of chemicals remotely.

- Xylem has moved forward aggressively with the purchase of smart meter firm Sensus. It also acquired Viscenti which provides data analytics to predict pipe breakage problems as well as providing analytics of the smart meter data.

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Some Segments are Already Significant

- The smart water metering market emerged in the 2000s as water utilities responded to global trends of using detailed and near real time data and analytics to deliver more predictive and proactive services. The backbone of this effort is advanced metering infrastructure (AMI) technology. AMI can provide a remote and constant two-way data link between utilities, meters and consumers. Communications are delivered through various technologies including power line communications (PLC), telephony, broadband, fibre optic cable, wireless radio frequency and cellular transmissions.

- The revenue in smart meters already exceeds $2 billion/yr. worldwide. This market segment will grow at near double digit rates over the forecast period.

- One of the biggest opportunities for IOT and Remote O&M is the control of dissolved oxygen used in aeration in the biological treatment step. The is a tendency for operators to use excess oxygen. This can increase wastewater plant energy costs by 25% or more. Proper sensing and remote control can provide substantial savings.

- There is a big opportunity for water treatment chemical companies who are in reality selling a service. The Nalco 360 Expert Center operates 24/7 to ensure someone from Nalco is always watching each system. The expert center will routinely make recommendations for operational improvements and will also take immediate action on alarms. All the expert center professionals hold degrees in Chemistry or Chemical Engineering and have real world experience in water treatment. Eighty years of water treatment expertise drives comprehensive, on-going training program, resulting in a team of highly trained specialists.

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Water Treatment

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Water - $ billions

World Region	2016	2018	2020	2022	2024	2026	2028	2030
Total	13.5	18	22.5	28.5	36	49.5	66	84
Africa	0.61	0.82	1.02	1.30	1.64	2.25	3.00	3.82
CIS	0.57	0.76	0.95	1.21	1.52	2.09	2.79	3.55
East Asia	4.97	6.63	8.29	10.50	13.26	18.23	24.31	30.94
Eastern Europe	0.29	0.39	0.49	0.62	0.78	1.07	1.43	1.82
Middle East	0.60	0.80	1.00	1.27	1.60	2.20	2.93	3.73
NAFTA	2.06	2.74	3.43	4.35	5.49	7.55	10.06	12.81
South & Central America	0.93	1.24	1.55	1.96	2.48	3.41	4.54	5.78
West Asia	1.90	2.54	3.17	4.02	5.08	6.98	9.31	11.85
Western Europe	1.56	2.08	2.60	3.29	4.15	5.71	7.62	9.69

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Municipal Water Equipment Purchase by Percent of the World

Country	2012	2013	2014	2015	2016	2017	2018	2019
United States	4.09	4.55	5.22	5.94	6.12	6.31	6.51	6.71
Canada	0.33	0.35	0.39	0.42	0.43	0.44	0.45	0.46
Mexico	1.72	1.84	1.98	2.14	2.23	2.32	2.41	2.51
Argentina	0.53	0.56	0.61	0.66	0.68	0.70	0.72	0.74
Brazil	4.36	4.68	5.08	5.52	5.86	6.22	6.60	7.00
Chile	0.44	0.47	0.51	0.55	0.58	0.61	0.64	0.68
Colombia	0.53	0.56	0.61	0.66	0.68	0.70	0.73	0.76
Ecuador	0.15	0.16	0.17	0.19	0.19	0.20	0.21	0.21
Guatemala	0.07	0.08	0.08	0.09	0.09	0.09	0.10	0.10
Peru	0.62	0.66	0.72	0.78	0.82	0.87	0.91	0.96

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Water Opportunities

- With over 50,000 water utilities in the U.S. itself, the opportunity for internet of things (IoT)-based technology is growing in. the water industry. There are some 300-plus large-scale utilities that each have more than 30,000 connections. While the initial surge of advanced meter reading (AMR) and advanced metering infrastructure (AMI) into distribution systems was to quantify and collect usage metrics with the aim of conservation and billing customers, adding layers of sophisticated analytics has improved the value of the gathered data. Most utilities lose a big chunk of their revenue to nonrevenue water (NRW) losses. These are measured as direct losses, such as leaks or pipe bursts, and apparent losses where water usage statistics are lost due to data irregularities, meter errors, meter registration problems, theft, or simply unbilled water. Coupling leak detection and pressure sensors with IoT software analytics in a smart metering infrastructure is now paving the way for better water management, helping utilities recover millions of dollars in lost revenue.
  While smart meters and sensors that can communicate over wireless networks are a form of IoT, it isn't limited to drinking water or freshwater collection and distribution.
- Israeli company TaKaDu (client registration required) provides integrated cloud-based solutions that automate detection of network events like leaks, bursts, pressure spikes, and supply interruptions. Its value proposition lies in the ability to manage everything from individual events to work crew response times. The technology addresses different use cases; for instance, utilities in the Netherlands focus on the need to monitor expensive infrastructure, whereas in other regions, like Israel and Chile, the need for monitoring is driven by the cost of water, which is high because a big portion of it is desalinated. TaKaDu has grown strategically through strong business partnerships in Australia, Israel, the Netherlands, Spain, Portugal, U.K., Chile, and Brazil. Lux recently spoke with Valor Water Analytics (client registration required), whose software vertically integrates individual meter data, historical billing data, and a utility's financial metrics to find apparent losses in NRW. It promises to identify a minimum of 1.5% of lost revenue for medium- to large-scale utility within the first year of operation. Clients should also see profiles of "high-potential" companies, such as CitiLogics, Portugal-based Baseform, and Inflowmatix (client registration required for all), that integrate hydraulic modeling, GIS, billing, and water quality data to provide simulations and forecasts on how the distribution system reacts to changes in different parameters.

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Netbiter Cloud Based Water Treatment Control

- Netbiter is helping both manufacturers of water treatment systems and service organizations streamline their operations and improve overall customer service. By accessing the system from the cloud. It provides immediate control of single or multiple installations 24/7. This enables operators to:
- TRACK OPERATIONS ONLINE :See how much levels and flows in your tanks and basins at any given time. Reduce onsite visits by only making necessary service.
- MONITOR ENERGY CONSUMPTION: See exactly how much power you are using.
- PERFORM ENERGY AUDITS: Get statistics and reports on historical consumption.
- MONITOR WATER QUALITY: Monitor the pH levels of your water. Configure and send Email/SMS alarms to yourself or service personnel if certain safety/quality triggers are reached.
- OPERATE EQUIPMENT REMOTELY: Turn on or off pumps or other equipment such as heating or ventilation, lighting etc.

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Linde G-TECTA Monitors Gas Hazards in Water

- Gas detection is essential in both waste water and water treatment processes. The number and volume of toxic and combustible gases present at all levels, makes permanent monitoring of risks vital. In water facilities, gas hazards are caused not only by the waste itself, but by the chemicals and gases used in processing the waste, hence monitoring at all levels is critical. From measuring levels of oxygen displaced by carbon dioxide in confined spaces, levels of ozone used during filtration and chlorine and ammonia during disinfecting stage, through to monitoring levels of hydrogen sulphide in digester processes and levels of methane in storage after production, gas hazards make detection solutions indispensable for all areas of water treatment processes.
- Linde G-TECTA range has been developed for reliable monitoring of common gas hazards in waste water and water treatment:

Combustible Gases and Vapours (LEL)

- G-TECTA SG_2
  G-TECTA SG
  G-TECTA 4G
  G-TECTA 4GP

O_2 – Oxygen Deficiency

- G-TECTA SG_2
  G-TECTA SG
  G-TECTA 4G
  G-TECTA 4GP

CO - Carbon Monoxide

- G-TECTA SG_2
  G-TECTA SG
  G-TECTA 4G
  G-TECTA 4GP

Hydrogen Sulphide

- G-TECTA SG_2
  G-TECTA SG
  G-TECTA 4G
  G-TECTA 4GP

SO_2 – Sulphur Dioxide

- G-TECTA SG_2
  G-TECTA SG
  G-TECTA 4G
  G-TECTA 4GP

NH_3 – Ammonia

- G-TECTA SG
  G-TECTA 4G
  G-TECTA 4GP

Cl_2 – Chlorine

- G-TECTA SG
  G-TECTA 4GP

O_3 – Ozone

- G-TECTA SG
  G-TECTA 4G
  G-TECTA 4GP

Linde supplies Gases with Remote Controls and Monitoring

Large volumes of gas are supplied by bulk deliveries, either as a cryogenic liquid or a high pressure gas into storage on customer sites. Bulk deliveries of oxygen, nitrogen, argon, hydrogen* and carbon dioxide are supplied as liquid because it requires much less storage capacity than gas.

The liquid is delivered by a dedicated fleet of cryogenic tankers into vacuum insulated bulk storage vessels that Linde usually owns and maintains on customer premises. The stored liquid is controlled at the required pressure by means of an automated regulation system.

If the customer process requires gas, the liquid is vaporized and delivered as a gas along the supply pipe. If the process requires liquid, it is delivered directly from the storage vessel through a cryogenic vacuum insulated pipeline.

The size and type of storage vessel and vaporization is selected to suit customers' individual requirements.

*Bulk hydrogen would normally be supplied in high pressure gas tube trailers. Deliveries are made either by direct pressure transfer to permanent storage cylinders or with an on-site trailer used as storage.

Storage vessels and high pressure gas tube trailers can be fitted with telemetry systems to provide real time remote monitoring of stock levels ensuring product is always available.

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IoTSens Ultrasound Sensors in Plant in Valencia

- Implementing IoT for water and wastewater in a small town is exactly what four-year-old Spanish IoT start-up IoTSens has done in Castellón, near Valencia. IoTSens had the advantage of being a start-up within the Gimeno Group, which had run a traditional water business for more than 100 years. But Ignacio Llopis, head of business development, says that, even then, convincing the conservative, traditional business to try IoT solutions was hard work. “They have the mentality of ‘I am comfortable with what I have’, and it is seen as risky to change,” he says. New laws to tackle flooding was the fillip. Just five years into a 10-year contract, the new demands for better information and management of flood risks meant data became king. IoTSens still had to fit its ultrasound sensors for free to convince its sister firm the system would work. Now the firm can monitor the flow, fill capacity and temperature for each pipeline, pump and other part of the system. Data on rainfall and predicted incoming waste water all feed in and can trigger warnings that require action to avoid floods from overflows.
- IoTSens has since gone on to sell its technology outside Gimeno and outside Spain. It has a contract with the Saudi royal family and minister for water to monitor and report on water usage in 25 of the most important urban areas in Saudi. The government has traditionally paid 90 per cent of citizens’ water bills, but reduced revenue from lower world oil prices are forcing a rethink. It has already cut the subsidy to 80 per cent and wants to get citizens to cut water usage. IoTSens’ sensors report on household usage down to which device or activity uses the most water – is it the shower or the washing machine? – with an aim both to educate people to use less and to develop more water-efficient products.

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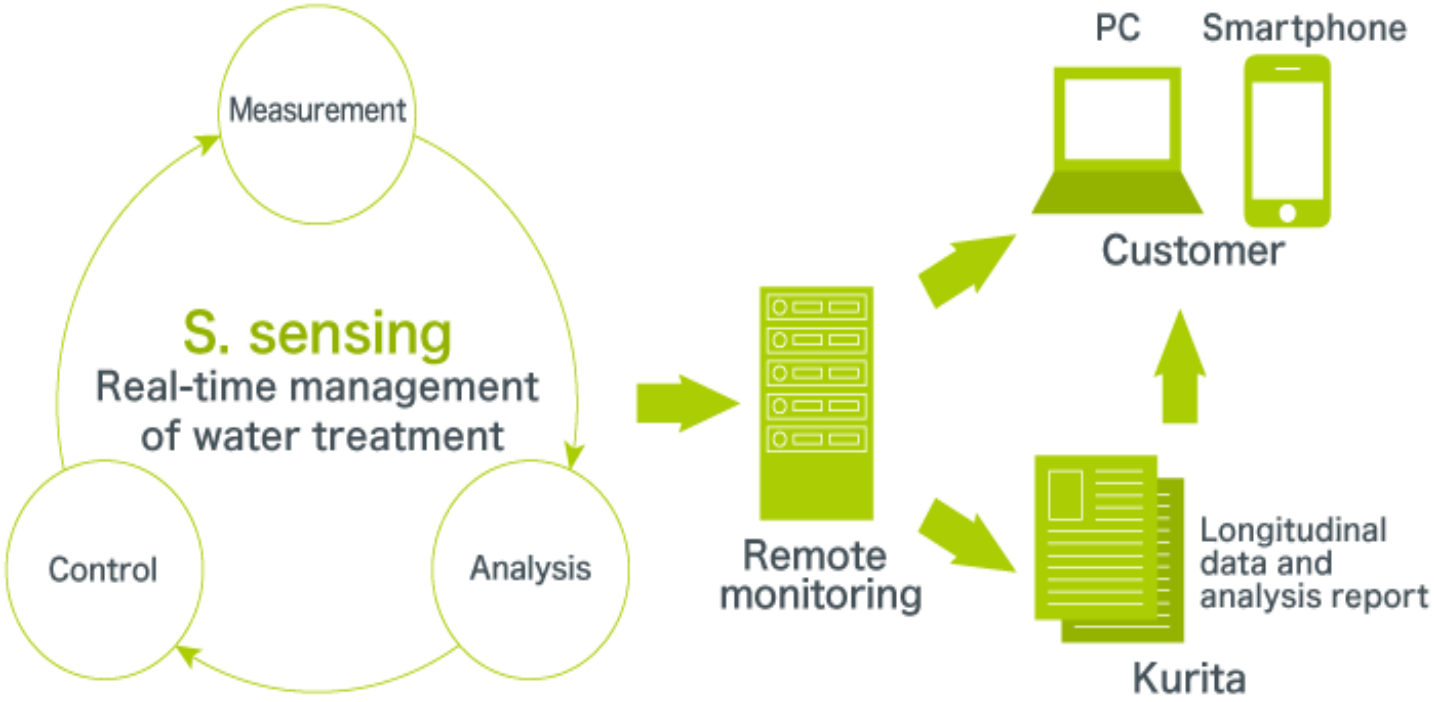
Kurita Remotely Monitors Water Treatment Systems

Kurita provides services for the remote monitoring of customers' water treatment conditions. The purpose of these services is to monitor the water treatment conditions and effects of treatment on a real-time basis with customers at their sites, and to share information about water treatment issues that need to be addressed together so that Kurita can quickly implement more beneficial solutions to all the issues customers face.
A new water treatment management service called "S.sensing," combines Kurita's original core technologies for measurement, analysis, control, and monitoring by installing the sensing equipment in the plant facilities of customers. With this system, it controls and optimizes chemicals injected in response to changes in water quality on a real-time basis at the target facilities where water treatment chemicals are used, based on the automatic analysis of the effective density of chemicals and the water treatment effect, along with conventional services to monitor data such as water quality, the amounts of the chemicals injected, and the remaining amounts of chemicals.



Smart Water Metering

- The smart water metering market emerged in the 2000s as water utilities responded to global trends of using detailed and near real time data and analytics to deliver more predictive and proactive services. The backbone of this effort is advanced metering infrastructure (AMI) technology. AMI can provide a remote and constant two-way data link between utilities, meters and consumers. Communications are delivered through various technologies including power line communications (PLC), telephony, broadband, fibre optic cable, wireless radio frequency and cellular transmissions.
- Through a communications infrastructure of concentrators, repeaters and gateways, data is passed between meter and utility and funneled into analytical software that can immediately set off pre-determined alerts. This is as well as produce accurate billings and consumption patterns at neighborhood and area levels, inform other utility software such as GIS (Geographic Information Systems) and SCADA (Supervisory Control and Data Acquisition) and departments including customer services, pumping stations and reservoirs. Apart from monitoring the current status of water consumption, data can contribute towards hydraulic modelling to help predict outcomes and changes in water distribution.

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Sensaphone Monitors Conditions at Remote Pump Stations

- Sentinel PRO is an enhanced version of the Sentinel cloud-based system, which monitors up to 12 conditions at remote pump stations and tank farms including power, pump status, tank level and flow rate.
- Sentinel PRO supports the Modbus communications protocol and includes a second relay output – capabilities required to integrate multiple devices and monitor complex networks. The Sentinel PRO system monitors, delivers alarms, and data logs input/output points from third-party Modbus sensors, transducers and programmable logic controllers (PLCs). The system supports Modbus RTU/485 and Modbus TCP.
- All Sentinel remote monitoring systems send alerts via phone, email or text. Data values can be viewed in real time via sensaphone.net or the Sensaphone iPhone/Android app. The standard Sentinel system is Ethernet based, but it is also available with a cellular option for remote locations that do not have Internet access.
- "Sentinel PRO is ideal for water and wastewater professionals who need a convenient way to remotely monitor remote locations and equipment," said Dave DeFusco, vice president of engineering at Sensaphone. "By integrating devices, the system can immediately deliver critical system-wide information."

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AMI vs AMR

- Water utilities often debate whether to fully convert to AMI or run an AMR (automatic meter reading) water grid instead. The truest of smart water grid definitions requires AMI technology and its enabling two-way communications. Many water utilities, however, do not see a clear advantage to AMI and feel the "smart-lite", uni-directional communications from meter to utility offered by AMR is fit for purpose.
- Receiving one-way information for accurate billing, leakage and NRW detection and GIS and SCADA is viewed as solving the bulk of water utility needs. Many water utilities feel the financial cost to roll out and operate an AMI grid will not justify the benefits of two-way communications. It is felt that remote upgrades rather than replacements will be infrequent, centralized alarms will be sufficient and utilities will rarely restrict water flows into homes, even if this is legally permitted.
- The price difference between AMI technology and traditional, drive-by AMR (automated meter reading) solutions has decreased significantly in the past five years. However, it’s still wide enough to sway purchasing decisions for many utilities Because the payback is long-term, some still see the benefits of smart technology as optional, rather than critical.”

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Monroe Washington using Smart Water System

- the City of Monroe Public Works Department in Washington is using smart water technology from Sensus, a Xylem brand, to update its infrastructure, reduce leaks and change the conversation with its customers.
- Recognizing an opportunity to improve its ability to detect water leaks, the department recently began an upgrade of its existing system to one that would simplify the tedious process of detecting and resolving them. Using Sensus technology, technicians now have access to real-time data that enables them to detect the source in mere seconds.
- “We’ve already begun using the Sensus leak detection capabilities, and the results have been amazing,” said Jakeh Roberts, operations and maintenance manager, City of Monroe. “Reducing the time it takes for our technicians to identify leaks enables us to apply their time to other important projects. We can see where the water is going in a way that wasn’t available before, with the potential for significant cost savings.”
- The City of Monroe’s smart water system is comprised of Sensus OMNI® and iPERL® water meters as well as the FlexNet® communication system and Sensus Analytics, all managed by Sensus Software as a Service (SaaS).

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Xylem provides Predictive Simulations of Pipe Breakages to complement Smart Meter Business

- Xylem has purchased Singapore-based water analytics firm Visenti Solutions, in tandem with its $1.7 billion acquisition of smart meter giant Sensus .
- Xylem has been working with Visenti since 2012, providing sensors for the latter's analytics programs for PUB in Singapore. Visenti, which was spun out of a Massachusetts Institute of Technology (MIT) research project in 2011, specializes in the analysis and visualization of data from pressure sensors in water distribution networks. Its software provides predictive simulations of possible pipe breakages to help utilities plan asset maintenance and repair.
- In addition to pressure sensors and flow meters, Visenti's software also analyses data from smart meters, making it highly complementary to the Sensus business. Sensus is one of the world's leading advanced metering specialists, and has developed its own closed data transmission network for meters and sensors.

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Eaton has expanded Remote Monitoring and Control Solutions for Water and Wastewater Plants

- Eaton introduced the latest addition to its fast and secure remote monitoring and control solutions. The ELPRO 645M-1 is a 4G, long-term evolution (LTE) especially suited to a wide variety of monitoring and control needs in the industrial, construction and utility sectors. The rugged and adaptable technology helps make it faster and simpler to connect, monitor and control a variety of mission critical field devices and assets, including sensors, meters, pumps and controls used in water, wastewater, utility, irrigation and oil and gas applications.
- The multi-service broadband cellular modem and router package is equipped with wide-area Ethernet, serial, and internal input/output (I/O) connectivity options. It is designed to enable customers owning several types of devices – including programmable logic controllers (PLCs), remote terminal units (RTUs), sensors, pump panels, human machine interfaces (HMIs) and other advanced devices – fast, seamless and reliable connectivity to a cellular network for remotely and wirelessly monitoring and controlling systems or for diagnosing and troubleshooting network issues.

  “With interest in Internet of Things (IoT) and Industry 4.0 on the rise, we are seeing the cost and energy savings benefits of ubiquitous computing and remote monitoring and control impact all industries,” said Moe Dais, product line manager at Eaton. “Our newest technology is designed to meet those needs, offering customers the versatility, speed and reliability needed to quickly and easily connect, remotely monitor and control their industrial devices from anywhere in the world.”

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Advantech Battery Powered Nodes and Gatewaty Units in Illinois Water System

- Mike Fahrion is VP for IoT technologies with US firm Advantech. Says the firm has retrofitted its battery-powered nodes and gateway units to a water system for Illinois city South Beloit. Each node has a potential 300m outdoor range and the firm likes to have each node in sight of at least two others about 200m away. That way each chooses the most effective route to send its data, piggy-backing from one node to the next to the gateway, so even if the path to one neighboring node is blocked the signal will get through. Communication is via 802.15.4E Wi-Fi with nodes all set to communicate at the same time, giving battery life measured in years. Currently a gateway can interact with 32 nodes but that is about to rise to 100. Each node can have between two and four sensors.
- Fahrion says it’s hard in the US to break into the market as most operations managers in the major firms want to contract with a total solutions providers and they are already tied in with the big name automation firms. “Our best hope is when someone from IT is involved because they buy from different vendors and have different procurement requirements to the operations guys,” he says. One potential is firms bidding for city utility contracts that get a share of any savings. Fahrion says: “If they can lower energy bills they can share the savings with the municipality. They want to know how, why and where they are using energy so they can reduce usage. They need IoT.”

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Wastewater

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Wastewater - $ billions

World Region	2016	2018	2020	2022	2024	2026	2028	2030
Total	13.5	18	22.5	28.5	36	49.5	66	84
Africa	0.56	0.75	0.93	1.18	1.49	2.06	2.74	3.49
CIS	0.47	0.63	0.79	1.00	1.26	1.74	2.32	2.95
East Asia	4.44	5.93	7.41	9.38	11.85	16.30	21.73	27.65
Eastern Europe	0.48	0.63	0.79	1.00	1.27	1.74	2.33	2.96
Middle East	0.37	0.49	0.62	0.78	0.99	1.36	1.81	2.30
NAFTA	3.48	4.64	5.81	7.35	9.29	12.77	17.03	21.68
South & Central America	0.33	0.44	0.54	0.69	0.87	1.20	1.60	2.03
West Asia	0.34	0.46	0.57	0.72	0.91	1.26	1.68	2.13
Western Europe	3.02	4.03	5.04	6.38	8.06	11.08	14.78	18.81

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Municipal Wastewater Treatment by Region in MGD

Continent	2011	2012	2013	2014	2015	2016	2017	2018
Total	687,876	701,696	714,312	728,223	738,854	750,219	762,570	780,721
Africa	37,252	39,531	39,963	41,054	40,938	41,419	41,905	42,398
America	179,971	182,633	185,368	188,163	190,477	193,075	195,709	198,382
Asia	244,131	250,934	258,089	265,594	273,152	279,740	287,215	294,904
Europe	226,520	228,597	230,890	233,410	234,286	235,984	237,738	245,035

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Wastewater Opportunities

- The wastewater business is in the process of a complete overhaul in their process control capabilities. The chemical complexity of water systems as well as the geographic scale of wastewater systems have proven to be a significant barrier to improve process control. While some amount of operator presence is always going to be required at large wastewater facilities, a 24/7 physical presence is a safety, health, and quality risk. Additionally, staff typically accounts for nearly 30% of operational costs of the plant. Another key issue is remote monitoring of stormwater capacities in locations with frequent storm events, where combined sewer overflows (CSOs) threaten treatment plants with inflexible capacities. To improve process control, new sensors and IoT platforms found globally in manufacturing facilities are finding their way into wastewater plants, largely driven by discharge regulations and avoiding hundreds of thousands of dollars in fines.
- Combined sewer systems and real-time stormwater management require low power, long-range wireless communications: With the penetration of LPWAN technologies including LoRa and Sigfox in the water industry, remote monitoring for precipitation, groundwater, surface runoff, water quality, and wastewater volumes is both low-cost and in real-time, with little operator interference. For instance, Israeli startup Ayyeka, which recently joined forces with Sigfox, has completed the installation of 200 remote monitoring modular kits for the Sewer District of Greater Cincinnati in Ohio. These sensor-agnostic kits form the telemetry backbone of the municipality's SCADA system by using real-time control for inflating dams, tanks, and pumps networks. This project prevented the municipality from building additional stormwater infrastructure that would've likely cost the city billions of dollars.

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IBM and Aqualia optimize Spanish Wastewater Plant

IBM joined forces with Aqualia Spain, the world's third largest private water management company, and developed a technology for operations optimization using sensors and analytics. Up until now, the plant planned their settings and adjustments of resources on a seasonal basis. This was done based on experience and intuition. The goal was to use mathematics and analytics to improve the process, reducing the energy and resources used, while improving the compliance with standards for water treatment.

- Starting in November 2014, the system was in use every day of the week, around the clock for one calendar year, with recommendations updated every 2 hours. The system use showed a dramatic 13.5 percent general reduction in the plant's electricity consumption. The plant also uses its resources more effectively, with a 14 percent reduction in the amount of chemicals needed to remove phosphorus from the water, and a 17 percent reduction in sludge production. Other benefits include significant improvement in total nitrogen removal, especially in low temperature conditions. In addition to these measurements, the plant observed a significant improvement in the control of effluent parameters and satisfaction with regulations.
- For WWTPs such as Aqualia's, there are challenges due to the dynamic nature of the operations. For example, different volumes of water come in at different times of day or night. Moreover, in cold weather, the bacteria used to break down the wastewater behave differently. Electricity rates can also vary at different times of day or night. But using IoT to optimize various systems has the potential for optimization under all conditions

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Wireless Network for Pumps, Chemical Injection and other WWTP Applications

- Water and wastewater treatment facilities around the globe turn to FreeWave to help automate and improve the security of their facilities through high performance M2M wireless communications. FreeWave designed a suite of Class 1 and Div 2 spread spectrum unlicensed and licensed radios specifically for water/wastewater applications, including high speed wireless Ethernet, serial and IO radios. These radios can be easily networked to ensure that facility monitoring and performance data are accurate and delivered in a timely fashion. Through extensive industry experience, FreeWave can help design and implement a world-class point to point wireless network for each unique facility applications. FreeWave wireless communication solutions are used for water & waste water treatment plant monitoring, pump house control, chemical monitoring & control, SCADA systems, remote video surveillance & security, water flow control and cathodic protection applications.

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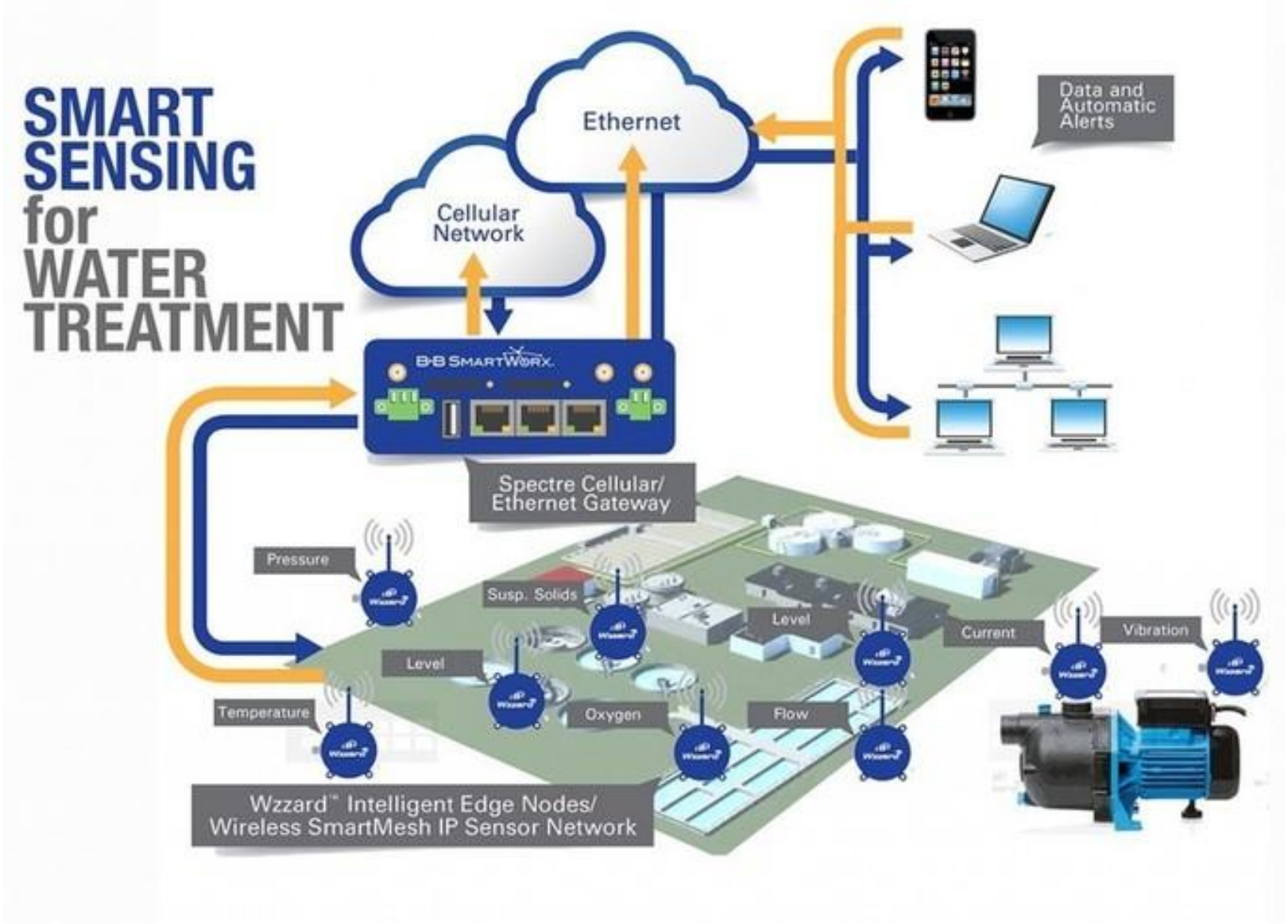
Advantech B&B Smartwork



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Wireless and SCADA upgrades at Connecticut WWTP

(reported in a Control Engineering blog by Daniel Capano, president of Diversified Technical Services Inc. of Stamford, Conn)

An industrial wireless network and supervisory control and data acquisition (SCADA) system is being upgraded at the Stamford Water Pollution Control Authority (SWPCA) of Stamford, Conn., part of a five-year, $47-million capital improvement plan formed and approved by the SWPCA board. SWPCA operates a 24-million gal/day (MGD) wastewater treatment plant serving 20,000 ratepayers with a drainage area of 12,000 acres through a total of 275 miles of collection system pipelines.

The facility is being made more energy and process efficient, leading to lower operating costs. Upgrades to the treatment process allow operation conforming to new state discharge requirements. An existing SCADA system will be replaced: The distributed control units and associated communications equipment will be replaced or upgraded. Wireless network coverage of the entire facility will be a goal during this upgrade to allow integration of wireless field devices into the process control network without expensive wiring.

The goal was to design a limited (within the fence line) IEEE 802.11 Wireless LAN (WLAN) providing coverage and communication for wireless instrumentation, general network resource access, communication, and security. Several wireless and instrumentation vendors were considered for inclusion in the project. The selection criteria were based on equipment reliability and capabilities, availability, ease of management, and conformance to open standards.

The typical water treatment plant is well suited for optimum radio propagation. Tanks for the various treatment processes are usually at ground level, or if elevated, at the same elevation; this provides large, unobstructed open spaces for line-of-sight transmission. In addition, several elevated structures provide advantageous locations for transceivers, further enhancing the favorable propagation environment. On the other hand, many structures in these facilities are constructed of reinforced concrete and can introduce attenuation and radio frequency (RF) shadows. Fortunately, these structures can be designed around, and their effect minimized by using the proper WLAN architecture.

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Stamford WPCA

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Stamford Upgrade, continued

(reported in a Control Engineering blog by Daniel Capano, president of Diversified Technical Services Inc. of Stamford, Conn)

It was of paramount importance that the system be open, that is, not proprietary. This follows the model of wired networks (IEEE 802.3 Ethernet), the widely used standard for wired networks. No proprietary cable, software, or interface is required for an addition or expansion of the system; it is essentially "plug and play." The growth and perfection of the IEEE 802.11 WLAN standards makes plant-wide wireless a natural choice for future expansion.

At the instrument level, however, there are no set standards, and the various low-level communication protocols being used are vying for supremacy. The quasi-proprietary nature of these protocols typically requires specific cabling and cabling standards, separate interfaces and drivers, specialized testing equipment, and trained designers and technicians. These all add cost to a project before, during, and after implementation.

Cloud-based management The WLAN system is a mesh network that does not require a central controller to monitor and control the activity of connected wireless access points (APs). A controller can lead to throughput and performance issues on some networks. The elimination of a controller also removed the possibility of a single point of failure and loss of the network. A cloud-based utility provides network management from anywhere. The APs form a cooperative mesh network, allowing multiple and redundant transmission paths. Losing an AP will not take down the network. Links are dynamically re-routed to ensure communication is uninterrupted. Such an architecture is very well suited to integration with a distributed control system. The WLAN conforms to IEEE 802.11 Wi-Fi, an open standard.

At implementation, there were no instruments with IEEE 802.11 communications. To interface field instruments, a cabinet for analog signal wiring and conversion to IEEE 802.11 wireless signals was required; the time and cost essentially removed any benefit of wireless.

Another wireless system uses smart gateways and modules for instrument-level wireless communications. HART (Highway Addressable Remote Transducer) is a well-known wired instrument-level communication scheme. HART allows the remote management of field devices; small transceivers are used in conjunction with HART-capable instruments, resulting in WiHART. This system operates under the IEEE 802.15 standard (Personal Area Networks), forming a separate mesh network among instruments.

The system was chosen to allow easy integration of existing instruments into the new wireless system, requiring minimal wiring and involvement of the plant electrician. Transceivers are installed in series with the existing current loop and scavenge power from that loop. The instrument-level mesh architecture actively repeats signals from any device without line of sight to the gateway. This capability fits neatly with the overall system concept.

It should be noted that most, if not all, instrumentation is proprietary to varying extents, even with use of standards. Within each instrument or device are physical or electrical characteristics unique to the device's function. The project goal was to use open protocols as far as practical to allow for easily expanding the plant network using standard equipment and interfaces. As WLANs become even more widespread, IEEE 802.11 interfaces will become standard features; new instrumentation or mobile devices will easily associate to the network and require minimal, if any, configuration.

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Stamford Upgrade, cont.

The following vendors were chosen for upgrade of the plant SCADA system and network.

- Arcadis of White Plains, N.Y., was chosen as the design consultant.
- Aerohive Networks of Sunnyvale, Calif., was chosen as the WLAN system vendor. Aerohive does not require a central controller to monitor and control the activity of connected wireless access points (APs); a controller can lead to throughput and performance issues on some networks. Aerohive allows management of the network from a cloud-based utility, "MyHive," which can be accessed from anywhere. The APs form a "Hive," a cooperative mesh network, allowing multiple and redundant transmission paths. While the cooperative control protocols are unique to Aerohive, the system conforms to IEEE 802.11 WiFi, an open standard.
- Emerson/Rosemount proposed its WiHART system using HART capable instrumentation, Smart Gateways and THUMs (The HART Upgrade Module) for instrument-level wireless communications. HART stands for Highway Addressable Remote Transducer.
- The Emerson system works with IEEE 802.15 WiHART devices and did not support voice and video at the time of the analysis; ideally, SWPCA wanted a system that could be used for communication with any IEEE 802.11 device. After much discussion and review, and considering the already substantial installed base of Emerson/Rosemount devices in the plant, the system was chosen for the project to allow easy integration of existing instruments into the new wireless system, requiring minimal wiring and involvement of the plant electrician. THUMs were installed in series with the existing current loop and scavenging power from that loop. THUMs create the separate instrument-level mesh architecture and actively repeat signals from any device without line of sight to the gateway.
- Five transmitters (THUMs) were installed at the primary odor control system (OCS).
- The link required two outdoor APs, in this case, Aerohive AP 170s, rated IP68, were used. Each AP has a "Hive Key" that allows the APs to automatically configure into a mesh network ("Hive"). At least one member of the "Hive" must be a wired portal into the network. Without a hard connection, it would be difficult to enable and maintain secure access to wired network resources. Within several minutes, by using Aerohive's online "MyHive"management interface, the management dashboard was populated with the two wireless network access points.
- THUMs communicate with a "Smart Gateway," a Rosemount product. The gateway converts the data to IEEE 802.3 Ethernet, then over a wired network connection to an IEEE 802.11n industrial WiFi hotspot for communication with the scrubber AP.

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DTSI implements IT Solutions

DTSI successfully manages the development of an IT application from inception to sustainment. From requirements gathering to system maintenance and support, DTSI has the talent to perform all phases of the project lifecycle.
Using the customer requirements as the ultimate goal, DTSI project management develops a project plan that produces a timeline, milestones, and a budget with defined, proven processes. Project lifecycle tools, management techniques, and verifiable, reproducible metrics ensure project activities occur when expected and are delivered as designed.

DTSI's project modelers and designers use Business Modeling Notation (BPMN) consulting in standardized documentation of requirements. In using the Unified Modeling Language (UML), DTSI ensures complete and easily understood system architectures.
Throughout a project, DTSI IT project managers communicate with all project stakeholders. Project changes are quickly identified, analyzed, and documented. During the project, DTSI documents all changes and the related evidence. Project management views the progress and makes required changes at scheduled project status meeting.

DTSI has competency implementing IT solutions in a variety of complex environments. DTSI continues to work in environments as diverse as DoD testing and development platforms, such as DISA, to mobile phone platforms. Regardless of the environment, our system engineers understand the complexities and are able to identify issues and risks, provide risk mitigation, and apply risk burn-down plans and other fixes when necessary.
To insure a timely delivery of a solution, DTSI involves the Test Team early in the process. The Test Team is experienced at creating functional as well as non-functional test models including load, stress, and regression testing.

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Xylem Cloud Based SCADA System for Wastewater Pumps

- Flygt's new cloud-Based SCADA system offers an ideal, cost-effective monitoring and control solution for high-demand wastewater pump station network applications. Its sophisticated SCADA capabilities require no up-front costs and deliver proven performance and reliability for a low monthly fee. The easy to install and operate system includes all necessary hardware, software and a communication platform for dependable pump station control, monitoring and alarming.

  Supplied with Flygt's level probe, accuracy is assured. The system is extremely simple to install, operates virtually maintenance-free and is backed by a ten year warranty. Operation is unaffected by sludge and foam buildup.

  Flygt MultiSmart is the next generation of technology for water and wastewater pump stations – combining the best of PLCs, RTUs and pump controllers into a comprehensive, intuitive package. The pump station manager integrates numerous control panel components, reducing control panel cost. It also includes pre-programmed logic specifically designed to reduce operating costs. MultiSmart is easy to configure, and includes a 'setup wizard' for commissioning of a new station. Built-in local SCADA eliminates the added cost of HMI hardware and software. Remote control programming reduces maintenance costs by preventing clogging and labor intensive call-outs.

  The new SCADA cloud-based solution works with Xylem's Flygt MultiSmart and PumpView3 monitoring and control systems.

  PumpView3 web-based pump control software by Flygt delivers around the clock service with alarm notification (voice, SMS or email) and standard reporting (daily monthly, or on-demand) – all with full encryption to safeguard against security concerns. It enables operators to connect to a new or existing pump station and execute many functions of traditional telemetry without any of the risks, for a much lower cost. PumpView3 hardware is installed in the panel with the MultiSmart pump station manager. It connects through a simple Ethernet connection and sends status and alarm information to a managed web server through a cellular data network. Well levels can be checked, fault status viewed, and alarms reset while historical data is recorded and readily available on demand.

  Flygt's SCADA system combines the best features into one, turnkey package. Without any up-front SCADA license cost, no server installation and maintenance, and no need to continually update software, train personnel, the system is one of the most user-friendly effective packages on the market.

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Xylem Smart Wastewater Pumping System

- Xylem has developed a smart wastewater pumping system that senses the operating conditions of its environment, adapts its performance in real time and provides feedback to pumping station operators. The new Flygt Concertor is the world's first wastewater pumping system with integrated intelligence.
- Flygt Concertor's flexible performance represents a significant change in how pumping systems will be selected and managed in order to accommodate different flow rates. In contrast to the fixed performance curves of conventional pumps, Flygt Concertor offers a wide performance field from which to choose the right operating point. This makes selection extremely simple, facilitates performance fine-tuning and, as a consequence, significantly reduces inventory.

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Xylem can offer IIoT and supply most of the Components

- Xylem has acquired Sensus, a leader in smart meters, network technologies and data analytics solutions. With Xylem equipment and the Sensus network, Xylem will help customers gather data about their energy consumption across the network, and help them avoid unnecessary maintenance or breakdowns in pumping stations.
- Since Xylem already has what they term as transport, treat, and test the company can now offer an integrated IIoT system with the water quality sensor, pump condition monitoring and control over the water treatment equipment and the metering of treatment chemicals. The metering rate can be varied depending on the water quality data which is being continually analyzed.

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Continuous D.O. Monitoring can reduce Energy Costs by up to 50 Percent

- If the dissolved oxygen content is too low, the environment is not stable for these organisms and they will die, the sludge will not be properly treated and plants will be forced to conduct an expensive and time-consuming biomass replacement process. Because of this risk, many plants compensate by adding excessive amounts of dissolved oxygen to their process. However, when the dissolved oxygen levels become too high, energy is wasted and expensive aeration equipment undergoes unnecessary usage.
- The crucial question many plants face is how to maintain the proper dissolved oxygen levels to keep the bugs alive without killing the operations budget. And the answer is purely a question of monitoring choices.
- Power costs associated with the operation of the aeration process generally run from 30 to 60 percent of the total electrical power used by a typical wastewater treatment facility. Today, however, plant managers can equip their aeration basins with on-line analysis systems that provide continuous dissolved oxygen measurement. Couple this analysis with automatic aeration systems, and according to the EPA, plant energy costs may be reduced by as much as 50 percent.

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Emerson – Sensor Performance is Key

Open- or Bare-electrode Sensors

- In the open- or bare-electrode design, the electrodes are two independently spring-loaded concentric rings, insulated from each other. These electrodes are subject to the same fouling agents that afflict membrane-type sensors, but a rotating diamond grindstone continuously polishes the electrode surfaces. This self-cleaning capability eliminates the time-consuming tasks of cleaning and replacing membranes and replenishing the electrolyte solution required in traditional membrane sensors.
- The open electrodes are protected from exposure to air bubbles and suspended solids in the process solution by a sample chamber, in which fresh sample is pumped to the electrodes through an oscillating chamber. This chamber also ensures that sufficient sampling occurs in wastewater with low-flow or zero-flow rates.
- The primary benefits that open- or bare-electrode sensors provide are long life, lower long-term total cost of ownership and reduced maintenance requirements.
- Because of the self-cleaning design, the probe housing can last 15 to 20 years, as opposed to membrane sensors that typically last three to five years. Practically the only maintenance requirement for open-electrode sensors is to replace the rotating diamond grindstone every eight to 18 months, and replace the electrodes every three to five years. While the open-electrode sensors have a higher initial investment cost than membrane sensors, the reduced maintenance costs and long life can translate to a lower total cost of ownership over the life of the sensor. In addition, bare-electrode dissolved oxygen probes are typically built mechanically rugged and can withstand certain environments better than membrane sensors, especially greasy or oily applications.

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Pentair Pump Monitoring and Control

- **Link$_2$O** is a cloud based wireless ecosystem that enables 2 way communication between operator and the product. The **Link$_2$O Gateway** device plugs into your home's router. Your product "talks" to the gateway device, which then communicates with your mobile device and/or computer.
- The Flotec FPD30 battery backup pump is easy to install, works alongside any existing sump pump, and includes the Virtual Water Assistant, a cloud-based service that continually monitors sump pump activity. As a connected device, the pump can send an alert when there is a malfunction or other issue that is of concern to the owner. When a problem is detected—the backup pump is activated during an emergency, power is lost, or the battery charge is low — the Link$_2$O immediately sends text or email alerts to notify the homeowner, limiting potential flood damage.
- Pentair uses the Pentair Arrayent Connect platform.

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WIN 911 Alarm System at Iowa City eliminates Night Operator

- The municipal treatment plant for Iowa City, Iowa has 15 mgd (million gallons per day) of treatment capacity between two plants. The system serves a population of 67,000, a wastewater treatment plant (WWTP) population equivalent of 120,000 since the system services all of Iowa City and small town of University Heights as well as the University of Iowa with a student population of almost 30,000.
- The City had been staffing their WWTP system 24/7, but could see that with the SCADA upgrades the night operator was unproductive and bored. The overnight position was difficult to keep staffed and if a dramatic event occurred at either facility, the night shift operator would likely be unable to handle it himself.
- Iowa City runs an IFix 5.5 SCADA system with three nodes operating in three different locations via a local area network. WIN-911 is set to run 1900 alarms ranging from monitoring tank levels and flow failures to building temperatures and rises in plant conditions. To ensure full coverage, the municipality runs a back-up copy of WIN-911 on a separate PC in another location.
- The WWTP facility's two plants are five miles apart, with one operator on duty on the weekend. With WIN-911 on alert, that operator can be more productive, monitoring plant conditions in one location while at another.
- WIN-911 was called into action when a waterline broke in the basement of one of the WWTP buildings, triggering an alert. "WIN-911 sent us cell phone notifications and we had early warning to respond," said the plant manager.
- WIN-911's intelligent decision matrix also allows the City to categorize alerts, recognizing urgent responses from less immediate concerns. The urgent alerts are sent as text messages to the maintenance staff on-call cell phone, where WIN-911 makes it easy for that employee to call for additional assistance, if needed. The less urgent alerts are sent to the maintenance supervisor's computer station, where items are evaluated and prioritized for action.
- "WIN-911 sends different levels of response based on the issue," "We also receive early warnings, which allow us to start investigating before issues become big problems."
- Mcilvaine conducted an Interwebview™ with Ronald Aschkar of Win 911 on 4-3-2017. The recording and the power point presentation are made available on this website and also displayed on YouTube

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Interwebview™ with Ronald Aschkar of Win 911

Interwebview conducted on 4-3-17

Recording:
http://home.mcilvainecompany.com/index.php/component/content/article?id=1266

PowerPoints:
http://home.mcilvainecompany.com/images/WIN-911.pdf

Ronald Aschkar
Channel Account Manager at WIN-911

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Bob McIlvaine
Host

Pump and Clarifier IIoT - James Gillespie of Grey Matter Systems

- Treating water and wastewater requires chemical processes that can now be monitored more accurately using digital data collection. These digital transformations are taking the guesswork out of chemical processing and allow utilities to optimize the amount of chlorine dollars spent to maintain safe levels — saving time, money and empowering operators to make fewer mistakes.
- A new SaaS application will calculate wastewater clarifier tank performance — providing quick analysis on a critical step in the wastewater process. The tool, called ClariFind, alerts utilities as they're getting close to a failure before they experience it. ClariFind will predict when sludge will overflow and be released. This kind of problem causes EPA issues and fines that can run in the millions of dollars. It will also be able to predict a thickening failure, which is when the effluent doesn't settle correctly and creates a costly sludge blanket in the tank. ClariFind is just one part of a water operations suite of productivity enhancers — solutions as a service.
- Predictive analytics are also solving monitoring problems that were not previously possible for utilities. For example, there are a large number of pumps that are commonly found within water facilities, and digitized data is making it possible for companies to accurately predict when these pumps might fail — ahead of time. This cloud-based application easily connects to pumps and helps companies avoid costly and inconvenient failures, allowing engineers to schedule controlled maintenance rather than reactive maintenance.

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Motorola IIoT Solutions for Wastewater Plants

- Motorola Industrial IoT solutions gives the wastewater plant the power it needs to be more productive and the insight to help reduce safety risks. This allows the plant to better safeguard personnel and communities, extends the life of assets, and creates greater efficiencies across operations.
- Comprised of four different components, the Industrial IoT portfolio provides an end-to-end solution, customizable for a variety of applications. SCADA remote terminal units (RTUs) help operate more efficiently with powerful process automation and expansive communication capabilities seamlessly integrated across your organization.
- M2M modems expand the organizational view and control by enabling further operational technology connectivity and data communication. A Network of Networks integrates devices across a variety of communications systems for enhanced reliability, coverage and the ability to better leverage the networks already in place.
- Partner Solutions delivers the complete integration and development of intelligent control and monitoring solutions from the sensors at the edge, to the application interfaces in the control room.

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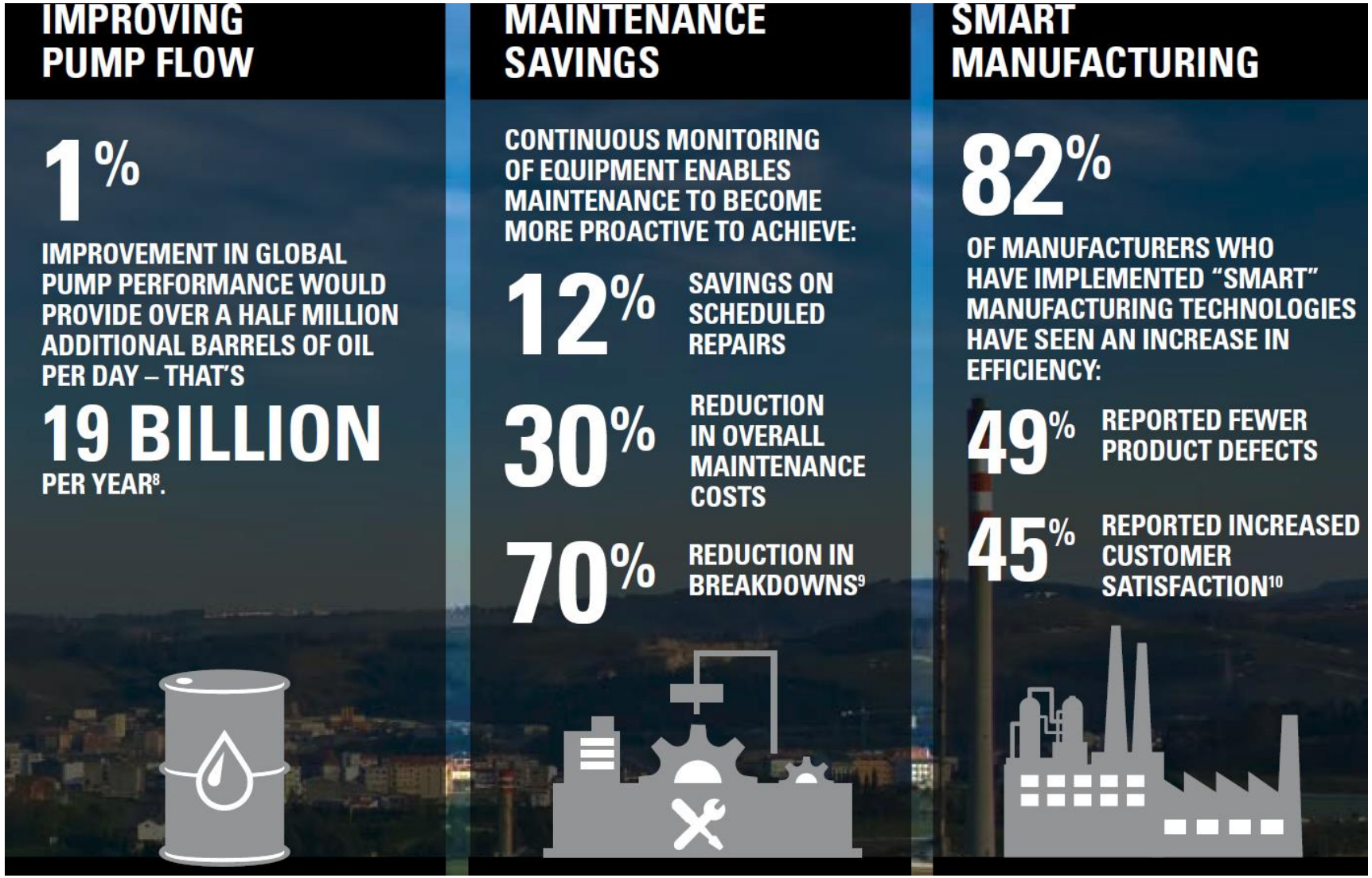
Motorola Assessment of IIoT Advantages



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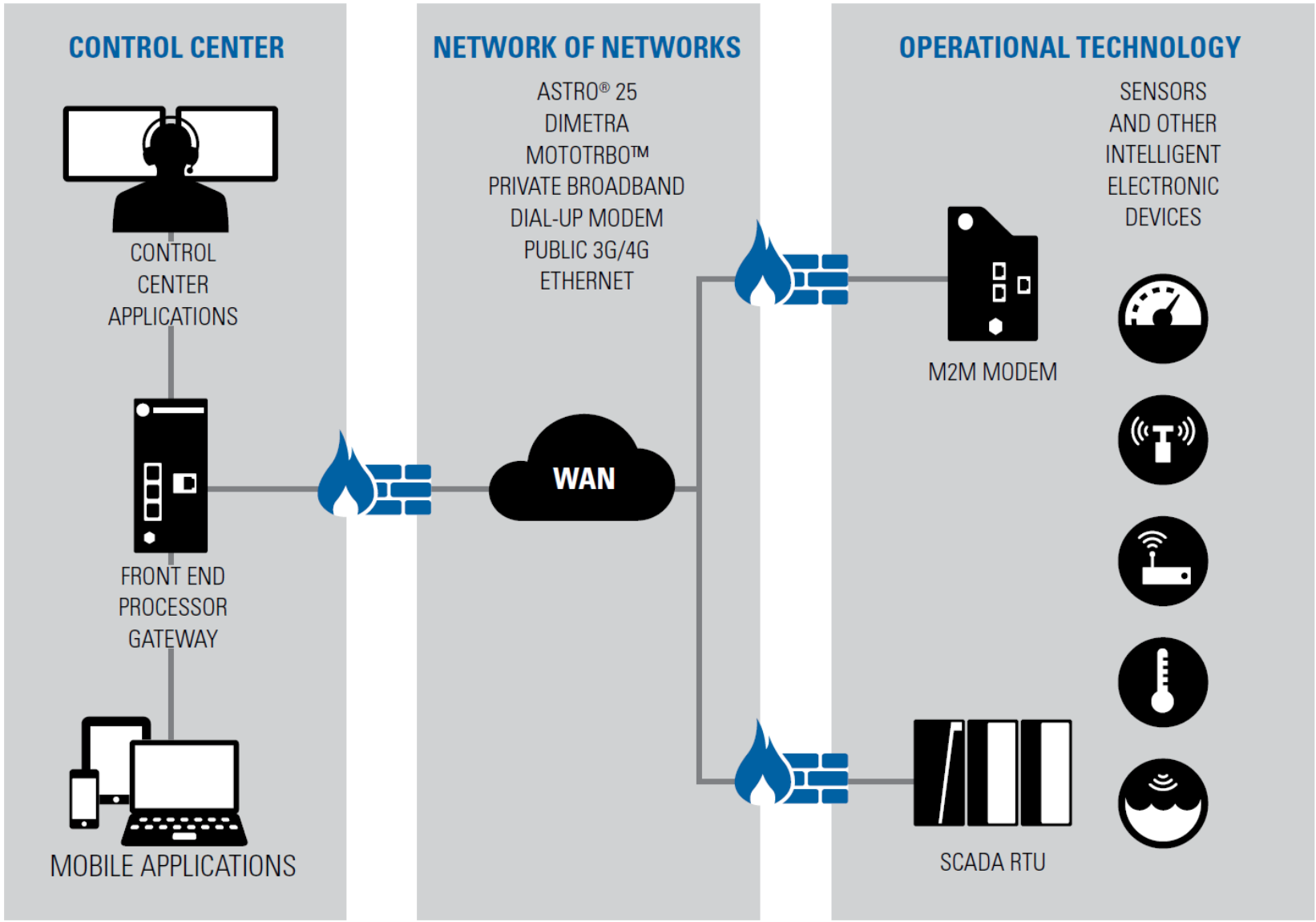
IIoT System Architecture Overview - Motorola



Motorola SCADA RTUs

- SCADA RTUs are made to help you keep teams out of harm's way, reduce downtime and optimize operational efficiencies – maximizing safety, productivity, and profitability.
- RTUs feature versatile interconnectivity over a combination of wired and wireless networks – including two-way radio networks – for the most encompassing and reliable process automation and monitoring of assets and field equipment. They also support a variety of other broadband and narrowband technologies including third party analog/digital two-way radio, dial-up modem, point-to-point microwave, 3G/4G public or private, and Ethernet. And, they are standards compliant and compatible with a variety of common protocols including MODBUS and DNP3.
- All RTUs also feature the MDLC protocol which uses advanced compression techniques to enable SCADA communications over narrowband connections unlike any other SCADA RTU. For customers who connect their RTUs over wireless broadband technologies, MDLC can reduce data usage charges by 50%, freeing up bandwidth for photo or video surveillance capabilities. Quickly realize gains in productivity and safety with the easy integration of RTUs across operations, the seamless distribution of data among multiple clients, RTUs and control centers, and the unparalleled flexibility to take control of operations.

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Motorola M2M Modem and Communications Systems

- Motorola's M2M modem is the simple and affordable way to easily connect to and communicate with, operational technologies across the organization and enhance operational view and control. You can send and receive process automation commands to PLCs, monitor sensor data from a centralized control room and collect valuable information to better understand how assets are performing.
- Motorola Solutions digital two-way radio system, LTE broadband network or a combination of both, are cornerstone technologies in keeping operations connected. Extend the capabilities of these operations-critical technologies to communicate data for process automation and monitoring with SCADA RTUs and M2M modems. With integration experts working alongside partners, Motorola can design, build and deploy systems proven to ensure that the organization is continuously connected and operating with voice and data communications.

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IBM optimizes Spanish WWTP Operations

IBM joined forces with Aqualia Spain, the world's third largest private water management company, and developed a technology for operations optimization using sensors and analytics. The Lieda wastewater plant previously planned their settings and adjustments of resources on a seasonal basis. This was done based on experience and intuition. the goal was to use mathematics and analytics to improve the process, reducing the energy and resources used, while improving the compliance with standards for water treatment.

Starting in November 2014, the system was in use every day of the week, around the clock for one calendar year, with recommendations updated every 2 hours. The system use showed a dramatic 13.5 percent general reduction in the plant's electricity consumption. The plant also uses its resources more effectively, with a 14 percent reduction in the amount of chemicals needed to remove phosphorus from the water, and a 17 percent reduction in sludge production. Other benefits include significant improvement in total nitrogen removal, especially in low temperature conditions. In addition to these measurements, the plant observed a significant improvement in the control of effluent parameters and satisfaction with regulations.

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AggreGate SCADA/HMI from Tibbo

AggreGate SCADA/HMI and other products based on AggreGate IoT Platform solve numerous water/wastewater management objectives:

- Supervisory control of water treatment and reclamation plants
- Supervisory control of wastewater purification processes
- Remote monitoring of pumping stations
- Advanced automatic water meter reading
- Long-term usage statistics collection (daily/weekly/monthly/yearly minimums, maximums and averages)
- Usage trend analysis and production performance optimization
- Water/wastewater compliance reporting
- Centralized control of a large processing station network

AggreGate can integrate with legacy systems and either provide lower data acquisition layer by forwarding water usage/flow data to an ERP and other BI systems or, inversely, process/store/visualize flow-related data collected from an existing SCADA system.

Municipalities and water providers operating a large number of similar facilities (such as pump stations) may create a reference project based on AggreGate Platform. This project will include models and visualization components (widgets, dashboards) covering turnkey control and monitoring for a typical facility. This reference project may be quickly re-deployed multiple times, while a central server may provide supervisory control for facility management servers through AggreGate distributed architecture

Tibbo Systems specializes in control and monitoring software. It develops, deploys and services solutions based on AggreGate IoT Platform. Established in 2002, Tibbo Systems takes care of developing AggreGate Platform itself, as well as all vertical market products based on it.

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Sierra Monitor has Sensors for Wastewater

Gas Detection and Alarming

- The process of treating wastewater creates many toxic and combustible gases. Moreover, there are many enclosed spaces in a wastewater treatment plant where toxic gases can build up, or inert gases can deplete oxygen to endanger plant personnel. To ensure maximum wastewater treatment safety, these hazardous gases may be encountered:
- Combustible Gases
    - Methane
    - Pentane
    - Hydrogen
- Hydrogen Sulfide
- Oxygen Deficiency
- Carbon Monoxide
- Chlorine
- Sulfur Dioxide
- Processes within a wastewater treatment facility include pumping and lifting stations, influent screening, sludge processing, digestion, and final disinfection. Different processes within a wastewater treatment facility require different gas sensors. Areas with potential hazardous levels of gases include:

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Areas within WWTP with Hazardous Gas Levels

- Pumping station and wet well – Combustible Gases, Oxygen Deficiency, Hydrogen Sulfide
- Influent and barscreen room – Combustible Gases, Hydrogen Sulfide, Oxygen Deficiency
- Barscreen and conveyor room – Combustible Gases, Hydrogen Sulfide
- Barscreen container and grit screen room – Combustible Gases, Hydrogen
- Primary Clarifier – Combustible Gases, Oxygen Deficiency, Hydrogen Sulfide
- Primary wet wall – Combustible Gases, Oxygen Deficiency, Hydrogen Sulfide
- Grit chamber and wet wall – Combustible Gases, Oxygen Deficiency, Hydrogen Sulfide
- Sludge treatment – Combustible Gases, Oxygen Deficiency, Hydrogen Sulfide
- Sludge incineration – Carbon Monoxide
- Basement-generator area – Combustible Gases
- Digester-basement – Combustible Gases, Hydrogen Sulfide
- Digester-first floor – Combustible Gases, Hydrogen Sulfide
- Odor removal equipment – Chlorine, Hydrogen Sulfide, Ammonia
- Furnace room – Combustible Gases, Carbon Monoxide
- Filtration room – Chlorine, Hydrogen Sulfide
- Final disinfection – Chlorine, Ammonia, Sulfur Dioxide

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Sierra Monitor marries Sensors with IIoT Functions

- Detecting hazardous gases and issuing alarms are important steps, but it is equally important to take remediation actions.
- This can be done through integrating the gas detection and alarm system with the Supervisory Control and Data Acquisition (SCADA), the Programmable Logic Controller (PLC) or the Building Management System (BMS) responsible for automating the larger facility.
- For example, a common integration would be a Modbus RTU gas sensor with a BACnet/IP BMS. Other automation processes may include providing notifications as a local alarm to an employee's phone, tablet, and/or PC.
- As these systems are automated, the regulatory agencies require that the systems be “performance approved" and checked on a periodic basis.

Protection from gas hazards is not a one-size-fits-all proposition. Systems must be designed to provide the appropriate level of protection and response commensurate with the risk level and the resources available to install and manage the system.

Sierra Monitor’s Sentry IT fire and gas detection solution includes standalone sensor modules that can be integrated into the user’s safety and control system, controller based systems with extremely flexible logic for customized response, and enterprise wide systems that incorporate Industrial Internet of Things (IIoT) functions such as network connectivity, web-server graphics capabilities, and cloud data analytics.

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Kaeser Compressor Remote Monitoring for Aeration Blowers

Real-time monitoring of various sensor data allows rapid response to unusual operational states, but will also form the basis for optimum service planning: Thanks to intelligent forecasting tools, the user will know in advance what to expect. This capability ensures maximum compressed air supply dependability. Users also benefit from further cost savings, since service work is performed exactly when required

Sigma Air Manager 4.0 is the core of the compressed air station and provides the key technology required to take advantage of future services within the Industry 4.0 operating environment. As the central "brain" of a compressed air system, it assumes control tasks and streams data into the Kaeser Data Center.
This master controller opens up new possibilities to enable predictive maintenance of compressors.

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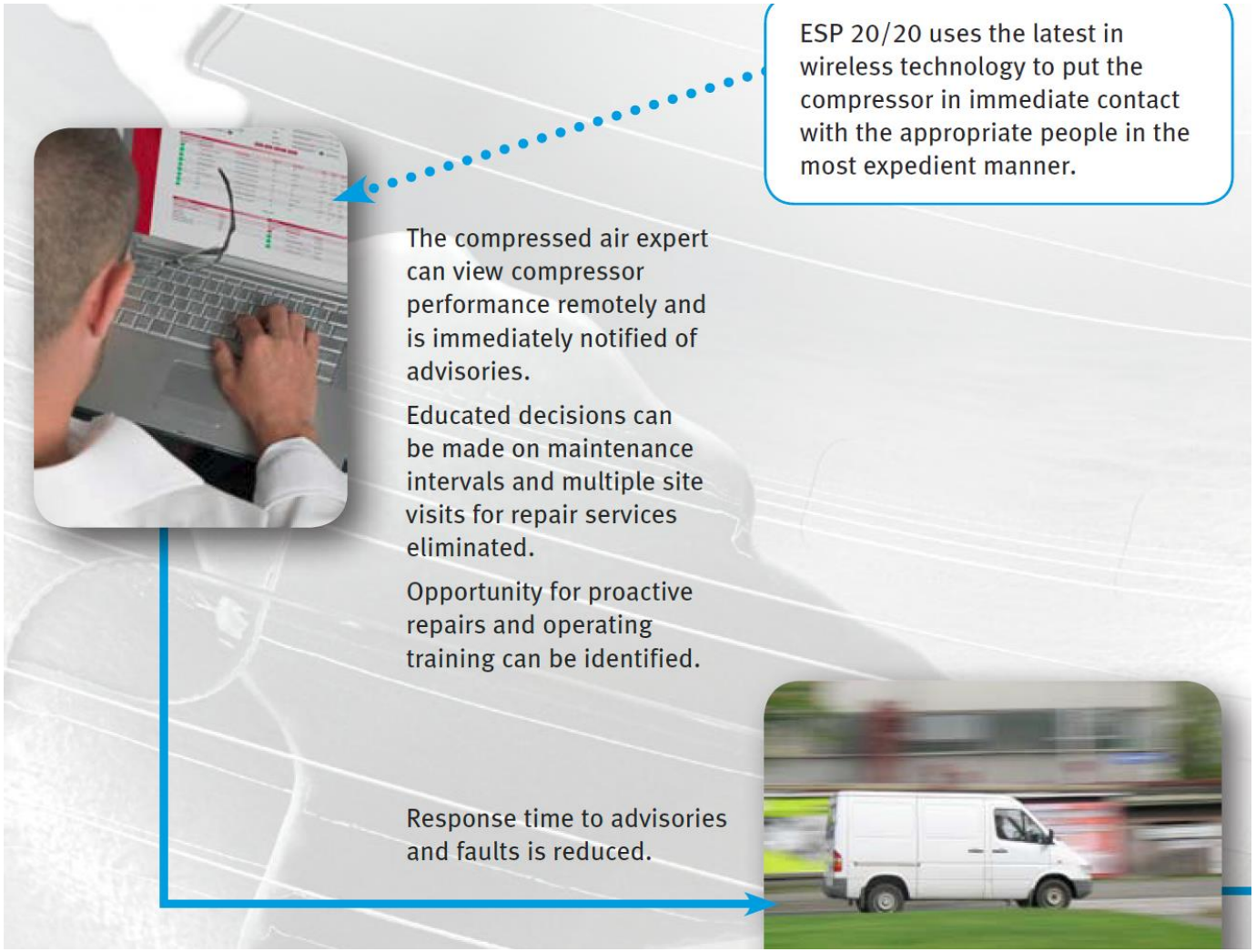
Gardner Denver Remote O&M for aeration blowers

The ESP 20/20 utilizes the latest technology to be more responsive without the intervention of valuable personnel. When an advisory or measurement is outside the operating parameters that are considered “normal,” they are sent to the compressed air expert automatically. Notifications can be setup to contact multiple support persons each having their own personal preferences on how to be notified for best response. Notifications can be sent via email or text to a mobile device, pager, and voice. This type of direct connection ensures the appropriate service person is contacted automatically in the method of choice. Extending this capability further, ESP 20/20 continually contacts the correct service personnel if an advisory is not responded to in an appropriate amount of time. Notifications are executed without having to involve additional personnel at the plant allowing them to focus on getting product out the door.



Chile - IIoW Example

IIoT in water and wastewater in Chile
will be empowered by the type of
IIoW shown on the following slides.

It will be easy to empower IIoT with IIoW in Chile

Chile has an ideal structure to leverage IIoT in its water, wastewater sector because

- Wastewater is reused and therefore both water and wastewater operations are conducted as one
- A limited number of financial entities do all the decision making
- Suez is a big player and not only operates the plants locally but has a European remote monitoring center to provide support
- Most of the decision makers are LinkedIn members and can be reached for webinars and other digital interaction

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The Substantial Reuse of Wastewater causes Interlinking between Industry and WWTP Plant Owners in Chile

- Chile has gone farther than any other country in the world in commodifying water and creating a market economy based on private water rights. The process started with the 1981 Water Code enacted by the military regime of the time, and was based on a strong pro-business bias. For the first time in Chile's history, land and water were separated in order to allow for the unconstrained purchase and sale of water. While water was defined as a "national public good," in the code, it was also defined as a "market asset," allowing the privatization of water through the granting of rights for free and in perpetuity to big corporate interests. Once water rights are granted, the state no longer has the power to intervene and the reallocation of these water resources is done through the buying and selling of water markets. The following excerpts from this excellent report by Chile Sustentable show that this process has been an unmitigated disaster for the people of Chile and for the water supplies and the ecosystem. First, it has led to the concentration of ownership of Chile's water by a handful of corporations, many of them foreign, the majority in the export sector. Seventy-five per cent of all mineral production is in the hands of private companies, most of them transnational. Three companies own 90 per cent of the water rights for power generation nationwide. The Spanish power company, Endesa, recently acquired by state Italian company Enel, controls more than 80 per cent of the total national water rights for nonconsumptive (water that is returned to the watershed) use.
- The agriculture sector uses close to 85 per cent of all water granted for consumptive (water that is not returned to the watershed) use, nearly 20 per cent of which is exported out of the country in the form of virtual exports. All agribusiness exporters are private. Second, this concentration of water and power over water in largely transnational corporate hands has led to an unprecedented assault on the country's surface and groundwater sources, which in turn is causing great ecological strain in many areas and creating tensions between local communities and the corporations. The report cites the "degradation of the country's most important watersheds" and the subsequent shortage of drinking water in many rural villages and indigenous communities.

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Suez has a Remote Monitoring Center for Water & Wastewater

Digital technology is a powerful driver in responding to the environmental challenges faced by local authorities. To support them in this endeavor and to enhance the performance of their water and sanitation services, SUEZ ENVIRONNEMENT opened a monitoring center in Le Pecq (Yvelines, northern France) for all of its remote meter reading and Smart Water infrastructures in France and overseas. These include intelligent management solutions for sanitation as well as water facilities

The Smart Operation Center is the first facility of its kind to continuously monitor the infrastructures of remote meter reading networks (for water, gas, etc.) and Smart Water solutions on a global scale. These solutions are based on the infrastructures for IT and telecommunications (software, servers, user portals, etc.), which must be monitored in order to ensure their proper functioning.

- The Smart Operation Center guarantees the performance of all of the infrastructures and provides reliable and up-to-date information for local authorities and water operators. This comprehensive monitoring system allows it to detect the signs of any incident as early as possible (leaks, meter failure, falling pressure levels, etc.), alert water services managers and reduce response times in resolving any possible issues.

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Over 99% of the population is served by wastewater plants which with one exception are privately owned. Six companies account for 97.4% of the total operations. Therefore the routes to market are simplified. The large players are

- Suez (Aquas Andinas)
- Ontario Teachers
- Marubeni
- SMAPA
- Grupo LUKSIC
- Hidrosan-Icafal-Vecta

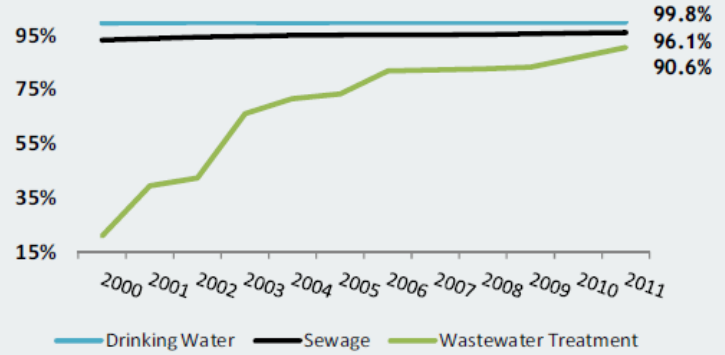
Consolidated Industry…

The water industry in Chile is a consolidated and privately owned industry with annual sales of US 1,500 million.

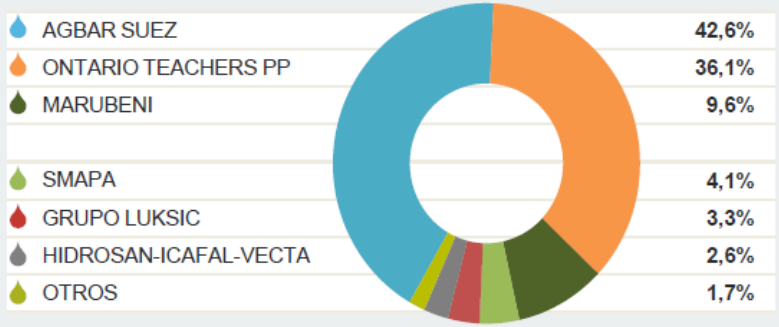
Industry Background

- In 1998, the Chilean Government began with the water industry privatization process
  - Aguas Andinas was privatized in 1999, being one of the few players to be awarded a non-expiring concession
  - Currently, over 95% of the population is served by privatized companies
- Stable and growing sales
- Industry annual turnover of around US1,500 million

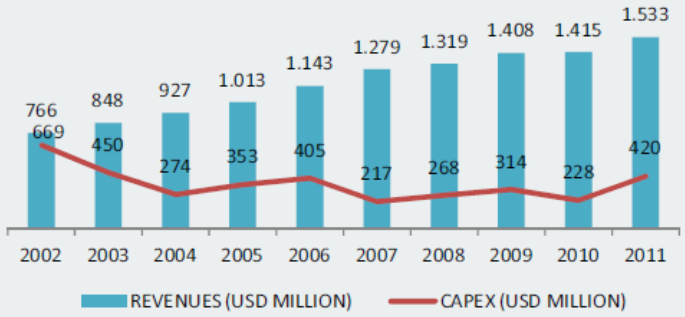
Industry Coverage Ratios (1)



Market Share by Controllers (2)



Industry Revenues (3)



Source: SISS

(1) As percentage of urban populations. For years 2000 and 2001, Sewage Treatment includes only main companies.
(2) Number of clients as of December 2011
(3) Calculated as Total Revenues for the Industry / Total Drinking Water Volumes for the Industry for each year. FX rate as of December 31 /2011, 521.46 CLP/USD

The Original Companies prior to Privatization

IIoW includes identifying all the plants and determining what components each plant has. These are then aggregated by financial entity. In the case of Chile there are only a few financial entities involved. So interconnection is much easier than in most locations

Region	Company
I	ESSAT
II	ESSAN
III	EMSSAT
IV	ESSCO
V	ESVAL
VI	ESSEL
VII	ESSAM
VIII	ESSBÍO
IX	ESSAR
X	ESSAL
XI	EMSSA
XII	ESMAG
Metropolitana	EMOS

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Aguas Andinas

42% of the Wastewater Facilities in Chile

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Aguas Andinas

42% of the Wastewater Facilities in Chile

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Aguas Andinas is the largest wastewater treatment plant operator. It is ultimately controlled by Suez. Decision makers in Spain and France influence the decisions such as blower selections. Because it is privately owned there is more incentive to improve efficiency such as in blower selection.

Aguas Andinas at a Glance

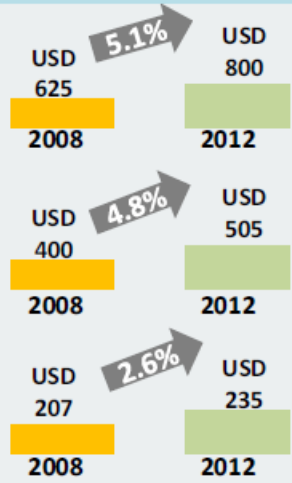
Summary

- Largest water utility in Chile
- Non-expiring concession and ownership of water rights
- Provides services to over 6.8 million inhabitants including the most densely populated area in Chile
- Integrated water cycle management:
  - Water abstraction and drinking water production
  - Drinking water storage and distribution
  - Sewage collection
  - Sewage treatment

Key Operational Highlights

- Operations under a mature and stable regulatory framework, supported by a sound macroeconomic environment
- High service coverage levels within its concession area and among the highest in the country
- Large and diversified customer base:
  - 2,0 million clients in water distribution
  - 1,95 million clients in sewage treatment
- Consistent strong cash flow generation

Financial Highlights (1)



2012Revenues: US 800 million

2012 EBITDA: US 505 million *(EBITDA Mg.: 63.2%)*

2012 Dividends: US 235 million

Sound Shareholder Base

- World class controlling shareholders
- Suez Environnement is one of the leading water and sewage treatment players worldwide
- Agbar is the #1 provider of drinking water in Spain

75% → Agbar → 56.6% → IAM → 50.1% → AGUAS andinas

(1) Nominal CLP at FX as of December 31, 2012 (478.6 clp/usd)

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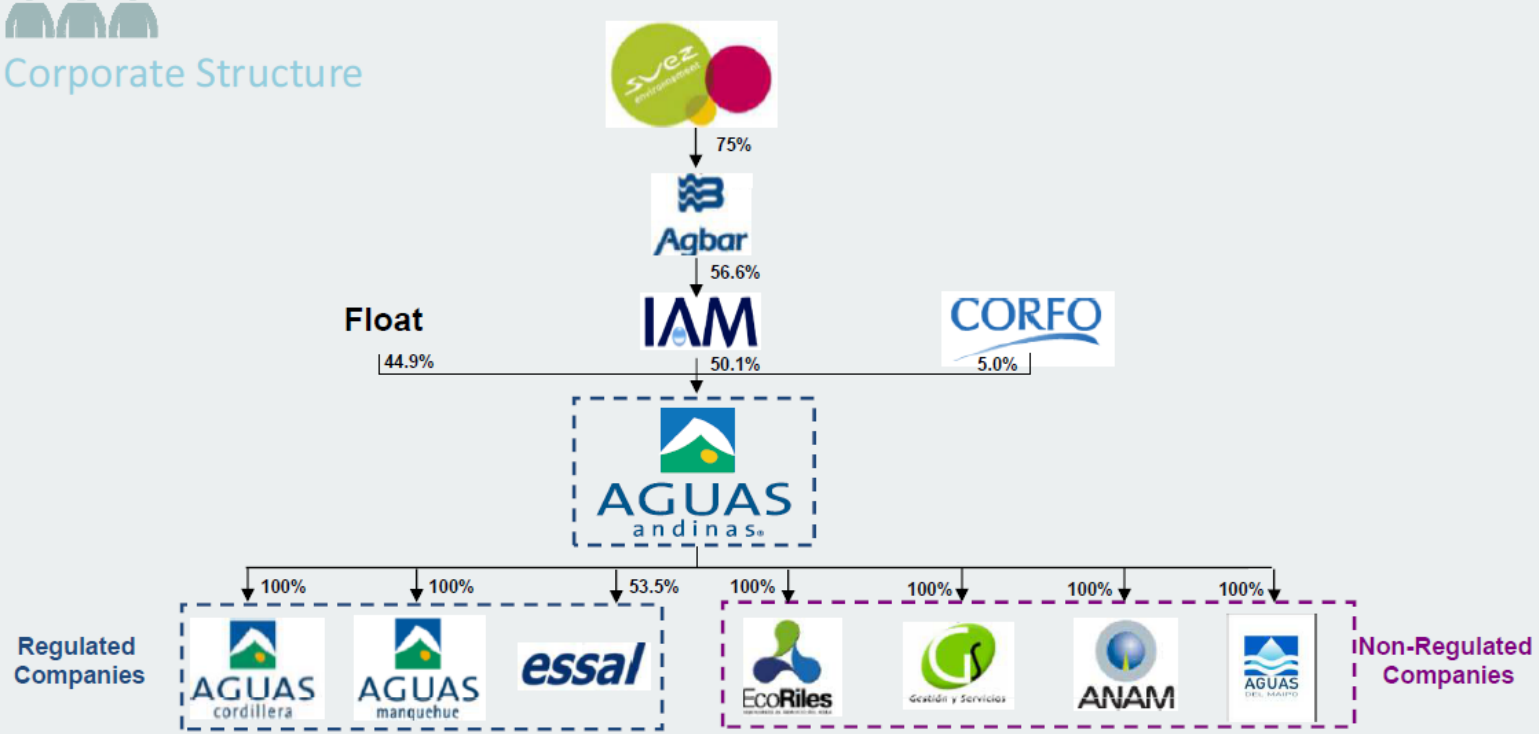
Corporate Structure



- Key Milestones:
  - 1999: Agbar (50%) and Suez (50%) acquire a 51.2% stake in Aguas Andinas
  - 2000-2002: Aguas Andinas acquires Aguas Cordillera and Aguas Manquehue
  - 2001: EcoRiles and Anam begin operations
  - 2008: Aguas Andinas acquires a 53.5% stake in ESSAL
  - 2011: Aguas del Maipo is created

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La Farfana, Largest Wastewater Plant in Latin America

- The La Farfana wastewater treatment plant, which was completed in record time and was designed by Degremont which is also owned by Suez.
- In order to treat urban water from 50% of the population of Santiago (population equivalent of 3.7 million people), Aguas Andinas, the company managing water and sanitation for the Santiago metropolitan region, assigned Degrémont the construction of the largest wastewater pollution removal plant in Latin America, with a capacity of 8.8 m3/s.

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LinkedIn Members from LaFarfana

Daniel Ramírez Ferran

- Jefe de Área Mantenimiento en Planta La Farfana (Previously was with Degremont which is also part of Suez)

Carlos Vergara

- Jefe de Planificación y Servicios de Mantenimiento en Aguas Andinas S.A

Jean Edouard Constant

- Group Construction Director at SUEZ
- Commissioning Manager Degremont
- September 2002 – December 2003 (1 year 4 months) Santiago Area, CHILELa Farfana Waste water treatment plant - 200 MEUR design and build projects for waste water treatment plant, including full process for both water & sludge treatment. Capacity of the Plant is 8.8 m3/sec representing 3.3 M population equivalent.

  Full responsibility of the management of the commissioning phase: definition of the commissioning philosophy and of test procedures, definition and follow-up of the commissioning schedule, management of the commissioning team, reporting to the final client Aguas Andinas.

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Essal is a Regulated Aguas Andinas Company

- Essal S.A. produces and distributes drinking water in Chile. The company is also involved in the collection and treatment of wastewater, sewage, and liquid industrial waste. It serves residential and industrial customers. The company was founded in 1990 and is based in Puerto Montt, Chile
- **Executives For ESSAL S.A.**
- **Mr. Hernán Vicente Konig Besa**
- General Manager
- **Mr. Michel Albié Shimono**
- Finance and Supply Manager
- **Mr. Franco Nicoletti Ortigosa**
- Director of Operations
- **Ms. Sandra Gaete Diez**
- Human Relations and Corporate Affairs Manager
- **Mr. Hugo González Bustamante**
- Planning, Engineering and Systems Manager

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LinkedIn Contacts at Essal

Hugo Enrique González Bustamante

Gerente de Planificación, Ingeniería y Sistemas at Essal

Hernán König Besa

Gerente General en Empresa de Servicios Sanitarios de los Lagos ESSAL

Paula Hormazabal

- Jefe Departamento Saneamiento en ESSAL S.A

Jose Luis Velásquez Pezo

- Jefe Departamento de Planificación y Expansión ESSAL

Francisca Jaar Monzón

- Jefe Zonal en ESSAL S.A.

Sebastian Sandoval Bastida

- Jefe Zonal en ESSAL SA

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Marubeni

9.6% of sewage treatment in Chile

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Marubeni- Aguas Decima and Aquas Nuevas

Marubeni considers water shortage a global problem and started its full-scale water business in 1990s, which was the earliest entry among major trading companies.

The largest leap was the acquisition of Chilean Aguas Decima S.A. in 2006. Same as UK, Chile is one of the few open markets where the full privatization of the water industry is legally approved. Aguas Decima S.A. was founded in 1994 as the first fully-privatized water business entity in Chile. Aguas Decima S.A. provides comprehensive water services, including purification, sewage disposal, and toll collection to 140,000 people in Valdivia city.

- Additionally, in 2010 Marubeni and the Innovation Network Corporation of Japan have jointly acquired Aguas Nuevas, the third largest water and sewerage utility in Chile. Aguas Nuevas has three subsidiary water companies and provides full water services in 48 cities in Chile, and currently supplies water to a total of around 1,270,000 people. This is equivalent to Fukuoka city of Japan.
- Marubeni will capitalize on knowledge of Aguas Decima and Aguas Nuevas in the water business as a platform to further expand its business in Central & South America and to reach its aim of becoming one of the industry's major players in the global water market, which is expected to become a 100 trillion yen market in the future.

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Marubeni, Agua Decima, Valdivia WWTP

Entity: Agua Décima

- **Location:** Chile
- **Population:** 101,500 eq/inhab
- **Flow:** 25,920 m3/day

KEY POINTS

- **Treatment**
- Coarse (ø 30 mm) and fine (ø3 mm) solids breakdown by mean of two automatic grids and two self-cleaning sieves
- Third emergency channel with hand operated screen
- Two sand/silt-grease trap channels 12 m long
- Two primary ø 25 m settlers
- Chlorine gas disinfection
- Sludge thickening in ø 7 m gravity thickener
- 2,100 m3 unheated anaerobic digestion
- Sludge dehydration by means of a 1.5 m band filter
- Deodorization of the installations by means of an active carbon filter

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Consultants and OEMS need to be interconnected through IIoW

Richard Dixon Szabó

- Country Manager Chile at MWH / Stantec

Chile

Mining & Metals

Raymond Phillipe

- water Sector Lead and Business Development Manager at MWH Global now part of Stantec

Santiago Province, Chile

Mining & Metals

Blower purchaser

Daniel Araya López

- Managing Director Latin America South for Xylem Inc located in Chile

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Additional LinkedIn Contacts to interconnect with key decision makers

Alejandro de la Barra Raveau

Ingeniero Coordinador de Proyecto en Aquaterra Ingenieros Ltda. / Magíster (c) en Ingeniería de la Energía – PUC

Edson Landeros Poblete

Civil Engineer and Magister in Business Management, Chilean nationality, 11 years of experience working in drinking water, **wastewater** and water resources management sector, including working experience in South America, Caribbean Zone, and Europe, for both public and private water and **wastewater** utilities including Aguas Andinas, the main water utility in Chile, CETaqua-Agbar in Spain, and WASA in Trinidad and Tobago).

Diego Olivares Meneses

Head of Research-Cetaqua Chile

R&D&I
Project Manager: waste recovery (energy valorization), water resources (new technologies) and process optimization (improve performance).
+ Projects with national and international financing.
+ Industrial Pilot Scale (TRL 6-7).
+ IP management.
Previously was with Aguas Andinas involved with Master Plans
Sewage System and WW Treatment Master Plan (2013-2014).
+ WWT leader: Description of current systems, Diagnostics and Proposal of solutions for future demand and new requirements. Planning of Engineering Works in a 15 years timeline. Budget and Prioritization.
New criteria and methodology for diagnostics and evaluation.

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