DECEMBER 2015
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New public-private model agreed for French town

Suez and the French town of Dole have announced that they have entered into a new type of public-private model as part of the provision of water and sanitation services for the town.

France's first two semi-public companies with a single purpose have been created, one each for water and wastewater, alongside the award of Euro67 million contracts to Suez for the delivery of water and sanitation services.

The two companies - Doléa Eau and Doléa Assainissement – are known as 'SemOps', based on the French Société d'Economie Mixte à Opération Unique. These start their activity on 1 January 2016 with the purpose serving the 25,000 residents of Dole with water and sanitation services respectively.

The town owns 49% of the capital of the companies, Suez 51%, while the Board is chaired by the town's mayor and the company CEO is a Suez employee. Both parties each have three members on the SemOp board.

Not only are SemOp undertakings created for a specific purpose, they are also fixed term – 13 years in the case of Dole. According to Suez, these new arrangements open the way for a new mode of shared management combining a local authority and a private operator, selected through a tender procedure. The set-up means the local authority is involved in each decision concerning the SemOp and has an equal vote with the operator on the actions to implement. ●

Inauguration of energy-efficient desalination pilot in Abu Dhabi

An energy-efficient pilot desalination plant to be powerd by renewable energy has been opened in Abu Dhabi, following the award of a contract to Suez by the Masdar Institute of Science and Technology in the middle of last year.

The project based in Ghantoot, 90 kilometres northwest of Abu Dhabi, covers the design, engineering, procurement, construction, commissioning, operation, maintenance and evaluation of the pilot plant over a period of 18 months.

Suez has reported that it had successfully passed water production and water quality tests, in terms of performance and compliance with Masdar's requirements. The plant reaches the potable water production of 100m^3 per day with an electrical energy consumption of less than 3.6 kWh/m^3, which Suez says means it therefore offers greater energy-efficiency than the current state-of-the-art desalination systems.

For the project, Suez has brought together some of its most advanced and innovative technological desalination partners to achieve the sustainability objectives, including Dow Water and Process Solutions, with its advanced and innovative ultrafiltration and reverse osmosis membrane technologies, Adionics, with its innovative liquid/liquid deionisation technology.

In parallel, together with the Masdar Institute of Science and Technology and ENGIE's Laborelec, Suez is conducting studies on seawater desalination using solar power, in order to develop seawater desalination plants fully powered by renewable energy. The main final target is to apply those renewable energy technologies on large scale desalination plant.

'Suez is proud to play an active role in the Masdar Seawater Desalination Programme and to contribute to Masdar's ambitious initiatives for renewable energy,' said Jean-Louis Chaussade, CEO of Suez. 'Within this project, Suez's objective is to identify new desalination technologies that will address sustainable access to water, both in the arid region and throughout the world. By doing so, Suez demonstrates its commitment to identify and develop global solutions for the sustainable management of resources, a key issue, especially in the region.' ●

Singapore PUB awards contracts for desal and ceramic plants

Singapore's water agency PUB has selected HSL Constructor Pte Ltd as the contractor for the construction of the country's third desalination plant. The plant, sited at Tuas and to be owned and operated by PUB, is expected to commence operations in 2017 and will add another 30 million gallons (136,000m^3) of water per day (MGD) to Singapore's water supply.

The open tender attracted bids from eight companies. At a tender price of S$217 million ($154 million), HSL Constructor Pte Ltd offered the most competitive price for the design and construction of the plant, according to PUB.

Currently, Singapore has two desalination plants, the 30MGD SingSpring desalination plant, and the 70MGD Tuaspring Desalination Plant. PUB has also awarded a consultancy services tender for a fourth desalination plant, which will be built at Marina East.

Desalinated water currently meets 25% of Singapore's water demand. With water demand expected to increase, PUB says that it intends to increase desalinated water capacity in order to continue to meet 25% of future water demand in 2060.

PUB also recently announced that its Choa Chu Kang Water Works is becoming the first in the country to use ceramic membranes thanks to upgrading works taking place in the latter part of the year.

PUB is collaborating with PWN Technologies to use its CeraMac system, with membranes supplied by Japan's Metawater. The new CeraMac plant at CCKWW is due to be operational in 2018 and will have a daily capacity 40 MGD, making it one of the largest ceramic membrane plants for drinking water treatment in the world. ●

water utility management INTERNATIONAL

EDITORIAL

Water Utility Management International focuses on the interests of utility executives, policy makers and advisors around the world engaged with the key management issues faced by water and wastewater utilities. As well as senior utility managers, WUMI will be of interest to regulators, consultants, contractors, academics, and financial, technical and legal professionals.

Utility reform and achieving efficiency are central themes of the publication, encompassing topics such as benchmarking, investment planning, consolidation, public / private sector roles, leadership, IT, and human resources. Other regular themes include financing, regulation, charging policies, procurement, corporate governance and customer issues.

PUBLISHING

Publisher
Michael Dunn

Water Utility Management International is published four times a year by IWA Publishing. Statements made do not represent the views of the International Water Association or its Governing Board.

IWA Publishing
Alliance House,
12, Caxton Street,
London SW1H 0QS, UK
T: +44 (0)20 7654 5500
F: +44 (0)20 7654 5555
E: publications@iwap.co.uk
W: www.iwapublishing.com

Design & print
Layout: IPL Print & Design Ltd
Printed by Hobbs the Printers, UK

SUBSCRIPTIONS

Water Utility Management International is available as either a print or an online subscription.

2015 price (4 issues):
£272 / €410 / $542
(IWA members: £220 / €329 / $417)

Contact
IWA Publishing (see opposite)

ISSN (print) 1747-7751
ISSN (online) 1747-776X

Xylem makes case for wastewater climate-friendly investment

Water technology company Xylem has released a report identifying a huge potential to cut greenhouse gas emissions associated with electricity use in wastewater treatment by applying currently available equipment in investments that are either cost-neutral or bring overall cost savings.

The report, based on a study by Vivid Economics, looked at the USA, Europe and China and investigated the application of 18 distinct electricity-related emissions abatement opportunities in wastewater management. According to the study, nearly half of the electricity-related emissions in wastewater management can be abated at a negative or neutral cost.

The study found that almost half of the electricity-related emissions could be abated with existing technologies, and that for 95% of this abatement the savings from energy efficiency would exceed the spending on the abatement measures. A smaller proportion of emissions could be tackled in the USA on this basis compared to Europe, because of lower electricity costs in the USA. China offers the greatest potential because of the opportunity to install complete new systems. The report claims that nearly 100% of the abatement opportunities examined would be at zero or negative cost, and it put the total abatement potential there at nearly 13 million metric tons of carbon dioxide equivalents annually.

Extrapolating the findings of the study globally, the report suggests that the potential global volume of negative cost abatement is nearly 44 million metric tons of carbon dioxide equivalents a year.

The report argues that the primary barriers to adoption are awareness of the opportunity and willingness to adopt existing solutions that have a higher initial capital cost and a lower ongoing operating cost. 'What's missing is the enabling framework to incentivize investment and accelerate widespread adoption of these advanced, sustainable solutions,' says Patrick Decker, President and CEO of Xylem in the foreword to the report.

The opportunities assessed in the study covered use of high efficiency pumping, variable speed pumping, variable speed blowers, high efficiency mixing, optimised control systems, and improved biogas production in wastewater transport, secondary treatment, and / or sludge treatment, use of efficient air scour blowers and filter system controls in tertiary treatment, as well as optimised new plant for secondary, tertiary, and aerobic and anaerobic sludge treatment.

According to the report, more than $25 billion in net savings can be generated with the adoption of high efficiency wastewater technologies in China alone. With the addition of the United States and Europe, the savings become greater than $40 billion, it claims.

Xylem says that two levers identified in the report would accelerate adoption of such highly efficient wastewater technologies: new financing models that incentivize investments in low-carbon technologies, which would assist with the initial higher capital costs that often come with these advanced technologies; and increasing the energy efficiency standards of wastewater equipment, which would ensure broader adoption.

The report concludes: 'Now is the time for the industry and all stakeholders in the climate change agenda to work together to overcome these barriers to adopting high efficiency wastewater treatment technologies, which will result in greater productivity of wastewater operations, and a meaningful step forward in tackling climate change.'

Xylem's Decker added: 'Infrastructure investments today can have positive environmental and economic consequences for decades. Importantly, the pragmatic solutions identified in this report pay for themselves and, in many cases, unlock new capital that can be invested in additional infrastructure improvements. As we address the effects of a growing global population and its accompanying strain on natural resources, the public and private sectors must come together to identify and implement new ways to realize the full potential of a low-carbon economy.'

To download the report, Powering the wastewater renaissance: energy efficiency and emissions reduction in wastewater treatment, visit: http://poweringwastewater.xyleminc.com/ ●

Medellin, Colombia, where fuzzy logic has been used to evaluate criticality of the distribution system (see page 12).

FEATURES

Phnom Penh, where a new Geographic Information System is being implemented. See page 22.

Willingness to pay for improved wastewater services in the Zapadna Morava river basin

To deal with wastewater problems, the Republic of Serbia adopted its National Environmental Approximation Strategy (NAES). According to the NAES document, in 2010, 68% of the population was connected to the public sewage system. In 2010, only 10% of domestic wastewater was treated before being discharged to the receiving waters. A study was carried out in the Zapadna Morava river basin, which covers 20 municipalities, with a total area of 15,752km^2, with the aim of providing insight into whether, and how much, the citizens were willing to pay for improved water services. **ANDRIJA NEDELJKOVIĆ, DUSAN KOSTIĆ AND NEMANJA BRANISAVLJEVIĆ** outline the results of this study.

Large population growth, intensive urbanisation and economic development were the cause of a significant increase in water consumption during the 20th century. This trend resulted in large quantities of wastewater, which is considered a serious threat to public health, environmental protection and economic development in the case of improper wastewater management practices. In 2003, it was estimated that 4% of health disorders and 1.6 million deaths were related to improper potable water and wastewater services and poor hygiene. In 2006, the World Health Organization reported as many as 236,896 cases of cholera, with 6311 deaths in 52 countries, which was a step back to statistics of 1990s (Ceric and Vucijak, 2011).

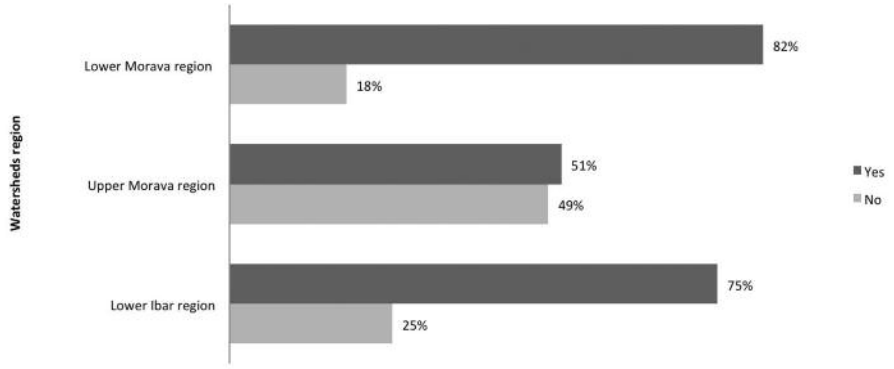
Given the general awareness about the deterioration in the quantity and quality of water, the European Union (EU) has undertaken several initiatives in recent years. Among them, the European Water Framework Directive (WFD) (2000/60/EC) is without doubt the most important piece of EU water legislation for the coming decades. It is a major regulatory reform of water resources management which consolidates and modernizes previous EU water legislation and, at the same time, widens the concept of river basin management in the EU territory (Del Saz-Salazar, Hernández-Sancho, & Sala-Garrido, 2009)

To deal with the wastewater problem, among other things, as a part of the EU integration process, the Republic of Serbia adopted a National Environmental Approximation Strategy (NAES). According to the NAES document in 2010, 68% of the population was connected to the public sewage system. In 2010, only 10% of domestic wastewater was treated before being discharged to the receiving water (usually a nearby river or stream). It is estimated that the total cost of meeting the environmental Acquis in the water section would be €5.6 billion ($6 billion). (NEAS, 2011).

Within the water services sector, the requirements for detailed demand analysis are now gaining ground. It is a mistake to assume that households always want lower prices for water and wastewater services. However, households often want better services and are willing to pay for them. Detailed demand assessment studies can help inform policy-makers about this willingness to pay and the consequent scope for cost recovery and sustainability (Water Prices in CEE and CIS Countries, 2002). The question that arises is how much more are residents ready to pay for improved water and sanitation services. It is certain that above a certain percentage, the bills for water and wastewater services may jeopardise the household budget.

In the last decade, in order to meet

Figure 1: Answers to question: would you like to change your current sanitation system?



EU standards, Serbia has started several programmes for improvement and rehabilitation of potable water and wastewater infrastructure that is in poor condition due to a lack of investment in maintenance and expansion of the systems in past years. Bearing in mind that potable water and wastewater infrastructure requires high investment, this has proved to be not only a technical challenge, but also an economic challenge.

Most of the projects are financed with the support of banks or some other form of loans, and it is in the creditor's interest to assess the economic feasibility of the project. In the case of Serbia, till now, several projects have been financed by KfW programmes, European Bank for Reconstruction and Development (EBRD) funds, Instrument for Pre-Accession Assistance (IPA) funds, or by a combination of several financial funds.

However, even in the cases when the project is financed from donations, it still has to be 'approved of' by the residents, who should also participate in paying some additional costs for system construction and its operation. If a project of this kind is not fully accepted by the residents, its operation may be rejected by the investors (Tziakis et al., 2009).

The suggested additional cost that should be covered by the residents has to be sufficient to support the sustainability of the project, and on the other hand, it must not be so high that the residents refuse to pay for it. Bearing in mind those two constraints, it is clear that additional analyses have to be undertaken in order to establish the financial feasibility of a project. The analyses that can provide the answers to the question of the price for the services that should be covered by the residents (users) are called willingness to pay analyses.

The data for the analysis is usually collected by conducting a survey that covers the households in the project area, according to their habits and their opinions of current services and their potential improvement.

Regarding types of current sanitary systems in the households of the Zapadna Morava river basin, different types of improvement were offered to the citizens. The households that were not connected to the wastewater system were offered improvements to their septic tanks or a connection to the wastewater system. If the households were already connected to the wastewater system, they were asked if they were willing to pay for the treatment of wastewater.

Materials and methods

Study area

The study was carried out in the Zapadna Morava river basin (ZMRB), which covers 20 municipalities. The total area of the ZMRB is 15,752km^2. The majority of the population in Serbia lives in urban areas (around 52%) and the rest, around 48% in rural areas. The average monthly expenditure is 43,884 dinars overall (€442.64 ($470.2)) based on the exchange rate on 13/05/2011). Table 1 shows the average expenditures in all three watershed regions.

Total expenditures were divided by the equivalent scale unit in order to take into account the economics of the household. The scale used was the new OECD scale (OECD-II):

The international norm for the maximum household capacity to pay for water and sanitation proposes 3% of income or expenditure for average households and 5% for households with a low income. Hence, according to the international norm, in the Morava region, households would be able to pay:

- Average households: 1317 RSD ($11.58) per month
- Poorer households (1st quintile, that is, the 20% of the households with a low income): 945 RSD ($8.3) per month

Table 2 shows the percentage of households where bills for drinking water and water and sewer bills combined exceed a certain norm of 3%, 5% or 7% of total expenditure.

The survey shows that in ZMRB, 68% of households are supplied with water from an urban water supply network, 9% get water from a rural (local) water supply network, and 17% from a protected dug well, or spring. Only 11% of all households regularly use bottled water for preparing food and for drinking, while 2% of households use it as a main source of drinking water. Water storage equipment is not common.

Almost all households in the West Morava region have a bathroom with running water (98%), while 2% do not have a bathroom at all in their dwelling. Households without a bathroom are found only in smaller settlements (smaller towns and rural areas) in the Lower Ibar region. Those households also have individual water supply systems and are not connected to the sewerage network.

Most households discharge wastewater into an urban piped sewer system (53%), and 3% of the households discharge wastewaters into a local/rural piped sewer system, which adds up to 56% of the households being connected to a sewerage network. Thirty percent of households use septic tanks, which is a significantly higher percentage in comparison with other alternative forms of wastewater discharge: cesspits are used by 5% of households, 5% of households discharge wastewater in their own yard, and 2% of households use a septic tank with a soak well.

Figure 2: Van Westendorp's Price Sensitivity Meter for emptying a septic tank

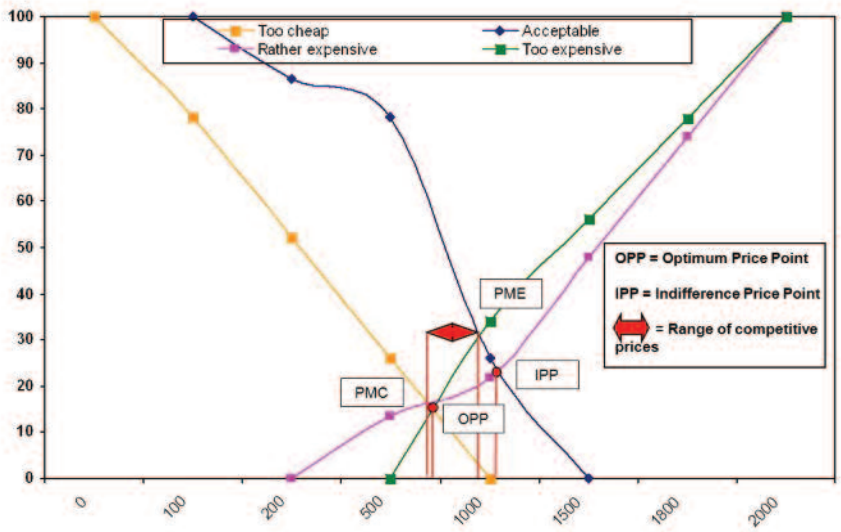


Table 1 - Average expenditures throughout the study area

	Total	Lower Morava	Upper Morava	Lower Ibar
No. of households in the sample	927	279	367	282
Average no. of household members	3.7	3.9	3.6	3.7
Average monthly expenditure (per equivalent scale unit)	43,884	46,745	45,609	38,799

Method

The survey was carried out by the IPSOS agency (http://www.ipsos.rs/), using the door to door method. Collected data were analysed by the Van Westendorp method (Van Westendorp, 1976). In the traditional Van Westendorp method, four price-related questions are asked, which are then evaluated as a series of four cumulative distributions, one distribution for each question. The standard question formats can vary, but generally take the following form:

- At what price would you consider the product to be so expensive that you would not consider buying it? (Too expensive)
- At what price would you consider the product to be priced so low that you would feel the quality couldn't be very good? (Too cheap)
- At what price would you consider the product was starting to get expensive, so that it is not out of the question, but you would have to give some thought to buying it? (Expensive/High Side)
- At what price would you consider the product to be a bargain—a great buy for the money? (Cheap/Good Value)

Results and discussion

The survey showed that, regardless of their sanitary system, 70% of households are satisfied with their current system (29% are very satisfied), while 30% are not. Residents of central towns, households connected to urban water networks and sewerage systems, and those living in apartment blocks expressed their satisfaction as above average, while those more prone to dissatisfaction with the sanitation system are citizens of rural areas, as well as households not connected to a sewerage system and households connected to local water networks or with an individual water supply system.

A similar percentage of citizens were satisfied with their monthly costs (55%) as well as with the initial costs for construction of the sanitation system (57%), but a somewhat higher percentage of them expressed dissatisfaction with the initial costs (34%) compared with the percentage of citizens who were not satisfied with the monthly costs (21%).

As for the expected improvements to the sanitation system, the results are as follows:

- 24% think that the priority should be connection to the wastewater system
- 9% think that the priority should be leakage and wastewater treatment
- 5% think that the priority should be reconstruction of the network
- 11% think that there is no need for improvement

The results of the survey show that 69% of the customers that are not connected to the wastewater network show interest in changing their current state. Regarding the interest of households in changing their sanitary system, certain regional differences were recorded. While among households of the Lower Morava and the Lower Ibar region there is great interest in changing the sanitary system, only about half of Upper Morava region households are willing to change their current sanitary system. The results are shown in Figure 1.

From the group of households that are willing to change their current sanitary system, 59% are interested in a wastewater system that includes transport and treatment, 39% show interest in a wastewater system that only includes transport, and 2% would replace their current system with a septic tank that only includes infiltration.

The main motives for improving their current sanitary systems are the health benefits (28%) and environmental protection and protection of drinking water (23%). The most significant data is that 85% of the customers that showed interest in improving their sanitary system are willing to pay for it. The average amount that customers who showed an interest in changing their sanitary system are willing to pay is 26,600RSD ($228.5) (median 20,000, $175.8).

Only six households that use septic tanks would replace their current sanitary system with a septic tank with infiltration. Out of these six households, only two were willing to accept the conditions offered for sanitary system replacement, and they were willing to pay 20,000 RSD ($175.8) in cash for septic tank replacement. The other four households were willing to pay 13,535 RSD ($119) maximum (median 10,000, $87.9). The range of competitive prices for emptying the septic tank, according to the Van Westendorp method, is between 700 and 900 RSD ($6.2 and $7.9). The Point of Marginal Cheapness (PMC) is at 700 RSD ($6.2), and the Point of Marginal Expensiveness (PME) is 900 RSD ($7.9). The price for emptying below PMC is considered too cheap, and the price above the PME is considered too expensive. The Optimum Price Point (OPP) for emptying the septic tank is about 720 RSD ($6.8), while the Indifference Price Point (IPP) is about 1,000 RSD ($8.8). Figure 2 shows the Van Westendorp's Price Sensitivity Meter for emptying a septic tank.

Households that would accept the offered model of connection to a sewer system would pay 20,978 RSD ($184.4) in cash on average (median 15,000, $131.8). The average monthly instalment that households are willing to pay for a connection to sewerage is 2,771 RSD ($24.4) (median 2000, $17.6). The highest percentage of households would pay up to 1500 RSD (35%) ($13.2), 27% of households would pay 1,501 to 2500

Table 2 - Percentage of households where drinking water and water and sewer bills combined exceed the proposed norm

		Norm (percentage of total expenditures)		
Percentages of expenditure	Base (n)	3%	5%	7%
Water	926	3.6%	0.4%	0%
Water and sewer	926	6.7%	1.6%	0.2%

RSD ($13.3 to $22) a month, while 30% would pay over 2500 RSD ($22) a month. Households that use urban water network connections are willing to pay the highest sum for a monthly instalment (3562 RSD ($31.3) on average), while the lowest sums are for households who use individual water network system connections (2272 RSD ($20) on average).

Households interested in getting connected to a sewerage system, but not interested in the offered system (these households represent 40% of those who had chosen to be connected to a sewerage system, that is 26% of the households not currently connected to a sewerage system), would pay an average maximum amount of 24,564 RSD ($215.9) (median 20,000, $175.8). These households are willing to pay part of the initial charge - 7902 RSD ($69.5) on average (median 5,000, $44). An acceptable average value of monthly instalment is 2373 RSD ($20.9) (median 1000, $8.8).

Of the customers who are connected to the wastewater system, 84% of them are interested in an improved sewer system. On the other hand, only 65% of them are willing to pay the monthly costs for it. Paying a monthly fee for improved sewerage that would include treatment of wastewater is considered as justified by 63% of citizens. The range of competitive prices for this service per month is 100 to 233 RSD ($0.88 to $x). The lower limit of this range shows that a service cheaper than 100 RSD ($0.88) would raise suspicions about its quality, while everything over 233 RSD ($2.1) would be considered too expensive. The amount acceptable to the majority of citizens is 137 RSD ($1.2), which is considered the optimum price. The Indifference Price Point for the service of improving sewerage is about 200 RSD ($1.76) per month. Figure 3 shows Van Westendorp's Price Sensitivity Meter for an improved sewer system.

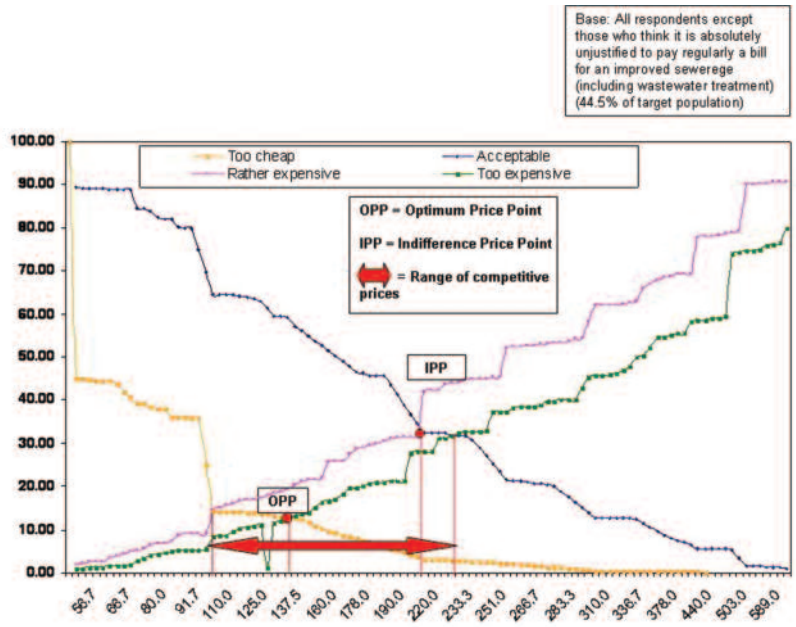


Figure 3: Van Westendorp's Price Sensitivity Meter for an improved sewer system

Conclusion

The majority of citizens of the Zapadna Morava region are aware of the advantages of sewer systems over septic pits, since 91% consider sewerage better for the health of household members than a septic tank, and 94% agree that a sewerage system is more convenient. According to the costs, opinion prevails that connection costs to a sewerage system are lower than the construction cost of a septic tank, but when it comes to the monthly cost opinions are divided. Namely, a higher percentage of the citizens think that connection costs to the sewerage system are lower than the construction cost of a septic tank (52%), but when monthly costs are included, there is approximately the same percentage of those who believe that a sewerage system is more expensive and those who have the opposite opinion (38% consider it expensive, 32% don't agree with this statement).

The majority of citizens of the Zapadna Morava region think that the discharge of untreated wastewater from sewers into a river or lake is not acceptable (86%), while a somewhat smaller percentage of them think that the discharge of wastewater from septic tanks into the ground is also not acceptable (77%), which shows a high level of environmental awareness. The results of the survey correspond to these statements. The majority of the households that are already connected to the wastewater system are interested in an improved wastewater system, which includes wastewater treatment. However, the percentage of those customers that are willing to pay for the improved system is significantly lower. ●

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Leveraging enterprise reporting software for water utilities

Enterprise reporting software provides a wide range of data management functions for organizations, specifically in the areas of gathering, organizing and distributing data to internal and external customers of a company. **GENTI BEQIRI** analyses enterprise reporting technology and its applications to water utilities services companies.

In the current business environment of achievement, consolidation and integration, one of the biggest challenges facing organisations in the public services industry is obtaining useful information from the massive amounts of data available to them. Utility companies, who are increasingly expanding their services and network, are faced with ever-growing warehouses of data spread over disparate platforms ranging from legacy systems to relational databases and text files. As a result, data must be accessed using numerous reporting and data retrieval tools, making it difficult for IT personnel to integrate data and meet the ever-increasing demand for efficient enterprise reporting.

When it comes to information needs, business leaders of utility companies demand large-scale reporting capabilities that provide efficient access to accurate data, presented in a flexible, meaningful format. This creates unique challenges for the IT personnel charged with fulfilling these requirements, and thus creates the need for more complete, enterprise-wide reporting solutions.

To meet this ever-increasing demand, many local and world-recognised companies like Microsoft, SAP, and Oracle have developed Business Intelligence (BI) solutions to provide enterprise reporting capabilities to organisations. These solutions deliver a single product for all reporting requirements, with straightforward deployment, maintenance and integration characteristics.

BI has been around for a long time, and over the years has taken on many different forms – reporting, OLAP, ad hoc, performance management, predictive analytics, data mining, and so on. For someone who's new to the concept of BI, these various solutions can be quite confusing. Many potential users struggle to understand the differences between the numerous technologies and methodologies, and find it difficult to prioritise them.

But the fact is that each facet of BI is important, and each plays a vital role in a company's overall information strategy. However, few organisations truly understand how these different tools and techniques should be used together to drive efficiency and effectiveness across the entire enterprise. After many years, we have learned that BI is used in three distinct ways – strategically, analytically, and operationally.

These three 'levels' of business intelligence, while unique in their own way, are not mutually exclusive. They should be directly connected to each other, working in concert. Strategic analysis drives analytical BI, while analytical BI directs the focus of operational initiatives. And these operational initiatives are what impact agility, productivity, cost-efficiency, and profitability.

Enterprise reporting technology

User experience and interface design in the context of creating software represents an approach that puts the user, rather than the system, at the centre of the process. This philosophy, called user-centred design, incorporates user concerns and advocacy from the beginning of the design process and dictates the needs of the user to be at the forefront of any design decisions.

The most important aspect of any web-based enterprise reporting solution is to address all of an organisation's reporting requirements in order that one reporting system can produce production reports such as invoices, statements, and legal reports as well as the broad range of business reports that help everyone in an organisation to understand their operations better and make effective business decisions.

Enterprise reporting delivers high quality reports to massive numbers of users. Its business reporting capabilities provide unprecedented flexibility to allow users from novice to advanced to create complex reports with drag-and-drop simplicity. Many organisations currently use multiple solutions to meet their reporting requirements. These solutions, which are most often deployed departmentally, create unique challenges because they must all be supported concurrently.

As they strive to decrease the cost and complexity of their reporting environment, IT managers have been looking for a single, web-based reporting solution that can address all of their reporting needs. They require a flexible solution that leverages existing IT infrastructure, is truly scalable, and has the ability to grow. The solution should be able to cover all reporting needs with one product. It should bring down the total cost of ownership of enterprise reporting. Bringing all reporting requirements together under one solution is a breakthrough in reporting software.

Enterprise reporting software provides capabilities that make basic departmental reporting easy, and complex global reporting simpler. Locale sensitivity and advanced multilingual capabilities allow users to deploy reports in any language. Global enterprises can bring divisions, departments, and country organisations together so they can all work from the same information online. Complementing these revolutionary capabilities, enterprise reporting software allows everyone from the first-time user to the advanced report author to broadly extend their power to create, distribute, and modify reports to everyone across the organisation.

For many small to medium-sized utilities, the complexity of data integration, processing and reporting is increasing faster than their information systems can handle. BI today is widely viewed as the key to managing performance and achieving success. But the quality of BI is directly dependent upon the quality of data integration - the way information from multiple sources is merged, extracted, transformed and managed in a dimensional environment to provide data that is

Picture credit: Mikko Lemola / Shutterstock.com

easy to understand. Poor integration will cripple BI applications, leading to user frustration and lack of widespread buy-in. Superior data integration, on the other hand, makes information readily available, simple to absorb and immediately useful to users throughout the organisation.

One of the most important components in data integration and processing for enterprise reporting solutions is the ability to process large volumes of data in a short amount of time. This is accomplished using powerful multi-platform, server-based engines that utilise metadata to work within existing data architectures to efficiently read data and deliver high throughput.

The use of metadata, or 'data about data', greatly improves the efficiency of data searches by telling the engine how organisational data is related, and how these relationships can be evaluated to process even more complex filter and search operations.

Equally important to data are the actual report design capabilities provided by the reporting software. Key components to enterprise report design tools include the following:

- Dependency checker: the ability to identify data dependencies or critical relationships between data elements
- Dynamic image locator: enables pictures and graphics to be placed in a report through a link in the database, eliminating the need to store images within the database
- Hierarchical grouping: the ability to create hierarchical structures in reports to improve the readability of data groups
- Visual report designers/wizards: the ability to quickly design interactive reports using an intuitive, drag-and-drop interface and object-oriented explorers
- Charting and mapping: the ability to create charts, graphs and maps to improve the presentation of data in reports
- Format options: the ability to create reports in standard formats such as Microsoft Excel, PDF or HTML
- Custom templates: the ability to create user-defined templates that can be re-used for future report designs

Strategic, analytical, and operational BI

Just how do the three levels of BI relate? In a sense, they perform as a cycle. Let's start with strategic BI. The primary goal of strategic BI is to drive the performance of the company as a whole, as well as the individual departments and business units that produce and deliver the company's products or services. Management collaborates and agrees on a strategy, and functionality such as strategy maps, scorecards, reports, and dashboards are used to communicate the strategy in the form of measurable goals.

Within that same strategy, several critical success factors will exist. For example, customer satisfaction scores, market share, profit margins, or overhead costs. And the status of those factors will reveal the progress – or lack thereof – towards reaching the overall goal(s) of the strategy. This approach is much like a car's dashboard, where gauges that are in the red zone or flashing lights tell the driver that something is wrong, and where the problem may lie. By closely monitoring those factors, companies can immediately detect where problems exist and take swift corrective action.

Once the strategy is defined, analytical BI comes into play. While strategic BI sets the foundation in the form of key performance metrics, analytical BI is employed to identify the source of an issue once it has been uncovered. Tools like analytic dashboards, OLAP, predictive analytics, and ad hoc queries are used to determine the location or cause of a major problem. For example, if profits are declining, is it because of low sales or increasing expenses? If customer churn rates are on the rise, is it because of poor product

quality, or lack of success in customer loyalty initiatives? With analytical BI, companies can investigate the factors that impact business performance from many different angles.

The results obtained from analytical BI activities then drive operational initiatives. Operational BI facilitates the kind of day-to-day decision-making that happens at the lower levels of an organisation, and enables the attainment of strategic goals. The immediate availability of this type of operational information directly impacts the company's ability to reach high-level objectives such as increased sales or greater profitability.

Applications to the services sectors

With increased demand for better services and customer care, and broader information databases, utilities face significant data management challenges. They must be able to quickly and efficiently sift through outsized amounts of information. As older applications begin to show their age, many utilities have found that software improvements are a necessary step to increasing the efficiency and effectiveness of their systems. Enterprise reporting systems can help increase customer profitability, enhance customer service, manage risk and reduce operating costs through sophisticated analyses against data assets.

The software has also made it possible to standardise more control tasks to more efficiently analyse different business areas. Also, businesses have been able to begin to move away from manually created reports and generate more through the software.

Within the insurance industry, deregulation has substantially increased customer competition as customers begin to view insurance offerings as a commodity that can be tailored to their individual needs. To address the issues of consolidation and deregulation, traditional banks and insurance companies are shifting from a product-centric to a customer-centric approach, where the focus is on ensuring that the most profitable customers receive targeted marketing outreach and optimal customer service.

Enterprise reporting applications play a crucial role for companies shifting to a customer-centric focus, by providing a unified view of customer interactions across all products and service offerings. In other services, organisations are able to improve customer profitability by identifying the most profitable customers and leveraging that information to execute targeted marketing programmes for maximum impact with minimum costs. Using enterprise reporting applications, customer service representatives are able to easily cross-sell and up-sell new bundles of insurance products.

The RZB – Raiffeisen bank, which is one of Albania's largest banks – implemented an enterprise reporting initiative to integrate its separate main systems for financial and management accounting. To achieve this, RZB needed to centralise all of its financial transactions using a single accounting logic, stored in one accounting general ledger and accessible in all relevant formats for external and internal reporting.

RZB managers now benefit from faster availability of month-end figures, automatic generation of reports to meet all external and internal reporting requirements, and produce accounts in Albania and International standards. They also now benefit from enhanced teamwork through an open system.

Enterprise reporting technology benefits

Reporting creates a common denominator for easier decision making across every department of a company that allows it to determine if expected goals are being met. According to international research, managing BI and the reporting process was identified as a key challenge for most organisations, as well as ensuring that data was clean. Other findings included that the greatest payback and ROI for reporting solutions is in creating reports for different type of user, simplifying the overall process (replacing manual processes), and distributing reports to everyone. Having everybody share the same data, achieving faster and cheaper distribution of information, and better control over information delivery, were highlighted as the big wins of a reporting tool.

During the past few years, the BI market has seen a move towards enterprise-wide BI, which has generated some key implementation challenges including supporting the unique needs of different types of users, the frequent lack of consistent BI processes and standards at a company level, and the growing burden on internal IT staff. These trends have driven interest in self-service models, both to empower users to be able to access, create and deliver information on their own terms, and to allow IT to offload tasks such as routine report development, technical support and even training to users themselves.

Most BI and reporting tool vendors have segmented their users as Enterprise, Casual, Business, Power or IT as defined below:

Enterprise Users – able to read a table of numbers or a simple graph on paper or web-page, do not need the ability to write computer code or learn to use a computer application other than a browser, and do not produce information content for themselves or others.

Casual Users - have the interest and ability to manipulate information content and navigate a complex report, may use parameters to filter or sort content, and are often interested in understanding cause and effect, exceptions and trends. They occasionally produce their own information content with end-user oriented reporting tools.

Business Users - often use spreadsheet programs such as Excel to analyze and manipulate data, query data on reports on an ad hoc basis and often produce content for themselves or others.

Power Users - able to use sophisticated analytical software and understand complex data structures, including multi-dimensional data. They routinely produce information content for analysis, and communicate content as well as analysis results to others

Information Technology – work in IT departments and are tasked with producing information applications for Information Consumers to use. They control the data sources and are able to use programming languages as well as application tools to provide information at any level of complexity, given detailed specifications and sufficient resources.

BI software offers complete enterprise reporting coverage, which means that one reporting system has the flexibility to let each group of users work with the information they need, the way they want; all of this without been overwhelmed by additional features or confusing interfaces. Each report recipient can easily access and share the information they want according to their preferences. For example a sales manager can drill into

client reports, and top executives can access a business dashboard for a glance at summaries of critical information about their organisation.

Reports produced with BI software give managers in utilities visibility across heterogeneous data sources, whether they are relational or OLAP. Users can create reporting applications in one type of environment such as development, and deploy them on production databases. This type of data source flexibility gives organisations a comprehensive view of their business through their reports. The data sources that BI can access include relational databases, other OLAP sources, widely deployed ERP systems, enterprise data warehouses and so on.

An additional benefit related to this feature is that BI has a single application server rather than separate servers for reporting, analysis and score carding, which translates into fewer applications servers for IT to manage and more time to concentrate on other crucial activities.

BI software delivers a zero footprint, browser based interface for all reporting functionality. It eliminates the need for IT to install and manage client desktop software. The easy to use interface ensures users can access and work with the reports they require to be effective on their job.

An additional benefit of BI allows users to create reports that use graphics or special maps to present data in different forms such as areas, network, or different levels of customers. Users can combined these with interactive charts such as horizontal bars to build multiple queries into the same chart, as well as individual portions of the chart. This functionality allows user to drill up or down through chart elements to see the essential details of the big picture of the data they are accessing.

In the past, BI reporting software has focused on the needs of the 'power users', sometimes leaving aside the full range of business users. Now BI has the capacity to offer self-service reporting for everyone that needs to author reports, as well as to provide support to teams, which allows groups to collaborate when creating reports. This allows power users such as business analysts inside a financial entity to create and enhance reports easily and share information with other team members, diminishing the workload in IT departments.

One of the most important concerns when choosing a reporting solution like BI is scalability. Scalability refers to the ability of a system to perform well in the face of increasing user demands. Companies are testing BI to handle an increasing number of concurrent users. Concurrent users are those who are actively sending requests and waiting for reports.

Career impacts

The technology is seen as being of value because:

- Applicability to utilities
- Relevance to strategic decision making
- Relevance to all units within an organisation, including its customer base

As stakeholders of such business organisations, our ability to access information will prove critical to our ability to make effective business decisions. For example, the general manager of a utility might be responsible for managing the operations of the company and report to different stakeholders, each with their own separate systems and databases. With its ability to integrate disparate data sources and create customised reports, enterprise reporting tools could greatly assist in generating reporting across all three business lines, giving a broader picture of the performance of the company's operations.

Additionally, the day may arrive when we are faced with actually managing the selection and implementation of enterprise software within our own organisations. To accomplish this successfully, it will be important to carefully evaluate the user base, understand the data structure of the organisation and work closely with IT personnel to ensure we select the most cost-effective and business-appropriate reporting application. Enterprise reporting will no doubt be an ever-present tool used in organisations going forward.

Information is by far one of the most critical assets of an organisation. This technology is universal in its application to financial organisations, as well as any organisation housing large amounts of data with a need to consolidate information for effective decision-making.

Conclusion

In today's complex business environment, reporting is no longer just about simple representation of data; reporting is also about how efficiently data can be accessed, formatted and delivered. Utility services companies typically house information across numerous platforms and databases, creating inherent challenges when it comes to enterprise data integration and access. As organisations continue to become larger and more complex, the demand for accurate, meaningful, enterprise-wide data will continue to increase. Unless organisations take steps to alleviate this issue, IT departments will be unable to keep up with the information demands of the company, and business may suffer.

To meet this ever-increasing demand for information, organisations are implementing BI systems with enterprise reporting tools. When selecting an enterprise reporting tool, organisations need to evaluate the product's scalability and flexibility to meet tomorrow's business needs, its interoperability with the firm's existing IT data infrastructure, and its ability to provide tangible benefits to its user base. By providing the ability to integrate organisational data, generate reports according to business needs and efficiently deliver information to stakeholders, these systems have proved to be a critical link to not only how effectively business management can make decisions, but also how well an organisation can communicate across business lines and with its customer base.●

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Evaluation of the criticality of secondary water distribution system pipes in Empresas Públicas de Medellín using fuzzy logic

This article presents the results of a study undertaken to classify the pipes of two circuits of Empresas Públicas de Medellín ESP (EPM) aqueduct into levels of criticality, through the use of fuzzy logic methodology and taking into account physical pipeline variables, critical operations variables and external factors that affect the performance of the system. This study is the continuation of a series of works undertaken to deepen the knowledge of the secondary distribution infrastructure of the EPM aqueduct. The advances gained in the Gallo (2014) project were considered in developing this project. **MARÍA PATRICIA SALAZAR GIRALDO AND MIGUEL ÁNGEL RAMÍREZ VÉLEZ** look at the various stages of the study, its outcomes, and its applications of fuzzy logic.

Empresas Públicas de Medellín ESP (EPM) is Colombia's largest utility company; its corporate purpose is sustainability through a strategy of growth and profitability of operations with corporate social responsibility.

Framed within the profitability of operations strategy, the aim of this project was to determine the level of criticality of two circuits of the secondary water distribution system pipes, and to propose a conceptual scheme of actions for maintenance and investment that will mitigate the risks, with the aim of efficient use of resources.

The study was carried out on two circuits that largely reflect the complexity of the system. Their selection took into account the outcome of a recent study made by EPM's Department of Asset Management, whose aim was to classify the aqueduct circuits, considering the premises of the organization's asset management strategy (Rojas & Úsuga, 2015). This paper presents the result of one of the circuits.

Methodology used

Background check and choice of methodology

At this stage some investigations relating to the evaluation of water supply and sewerage infrastructure were researched, and the methodology to be used was defined, taking into account the type of system object of the analysis, the information and tools available.

Collection and analysis of information

At this stage useful information was collected for the study that related to the physical characteristics of the pipelines, the operational variables and environmental information related to the areas of risk of movements of mass, according to the Plans of Territorial Planning (POTs) of the municipalities where the infrastructure is located.

Application of the methodology

Identification of variables: at this stage the physical, operational and environmental variables that affect the performance of the infrastructure were chosen. This activity was carried out in a workshop with experts.

Construction of fuzzy sets: for each variable a diffuse set was defined, representing the various States in which the variable was classified. States are expressed with language values (such as Low, Medium, and High). This activity was carried out by consulting technical experts. Fuzzy sets are mathematically represented by the membership functions.

Calculation of the values of membership: the values of the variables of each pipeline were applied to the membership functions of the diffuse set defined for each variable. In this way the degree of belonging to different States (with a value between 0 and 1) was determined. This process is known as Fuzzification.

Aggregation: this consisted of linking pairs of variables by applying a set of IF-THEN rules. Entrance values to the relationship matrix are the membership grades calculated in the previous step. The outputs conform to a new fuzzy set.

Defuzzification: the final answer is obtained through a mathematical calculation, which in this case is the centroid method.

Conceptual proposal of strategies and activities: in this stage different actions of treatment were raised depending on the resulting criticality and the risk of the POT.

Results and discussion

Conceptual framework

The following are details of some of the research carried out on this work topic.

Hernandez (2011) proposes a replacement index per sewage network section.

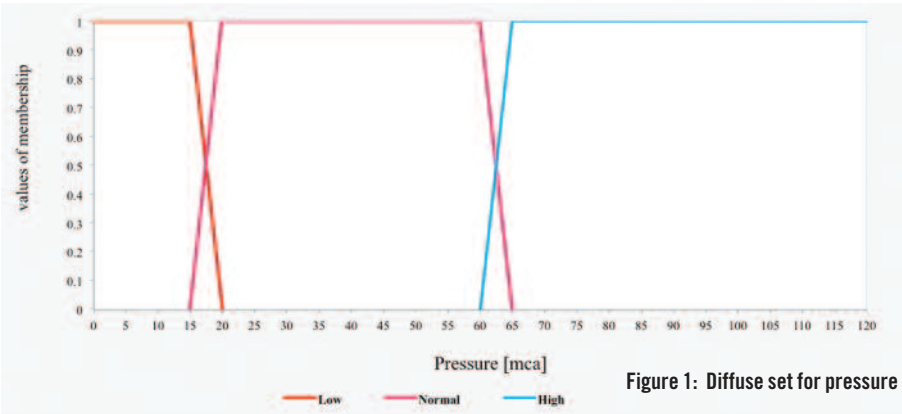


Figure 1: Diffuse set for pressure

This index is calculated from the basis of indicators that reflect the structural and environmental condition of the pipes. These indicators are weighted according to the level of importance assigned by experts in the system.

Hurtado (2008) provides in his PhD Dissertation a review of existing methodologies for modeling faults, where he describes the statistical methods that he found more appropriate, such as Cox, Kaplan-Meier, Nelson-Aalen, lognormal, and applies them to a service company that provides drinking water to a Mediterranean Spanish population. The study found 'that the factors influencing the survival and the risk of network failure, beyond age, including the constituent material of the pipe and working conditions of the network' (Hurtado, 2008).

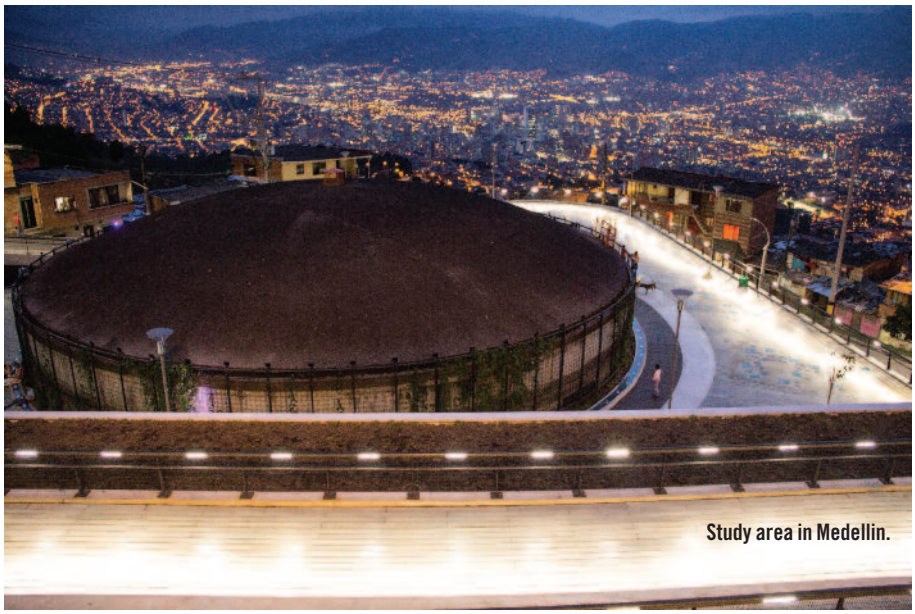
Parra (2013), in his PhD Dissertation, builds a flexible mechanism for ranking intervention in water and sewage systems based on the application of the Fuzzy Logic method as the primary focus of the methodology. The model that he formulates takes into account expert judgments, manages uncertainty through the entire process, and additional variables can be included. He carried out the above methodology on a supply network in a population in the Spanish Mediterranean area.

Velez (2012) applies the mathematical method of fuzzy logic to calculate the pipe deterioration rate of a sanitary basin belonging to a wastewater collection and transportation system in the Aburrá Valley/Valle de Aburrá.

Methodology adopted: The Fuzzy Logic method was chosen for the implementation because of the complexity of the target analysis. The model solution is not simple, and it is necessary to apply the knowledge of system operators, whose concepts, while based on experience, contain technical inaccuracies and some uncertainty (Galindo G.).

Table 1 - Variables

Variables	Order of importance
Age	1
Material	5
Diameter	4
Length	9
Pressure	2
Flow	7
Depth	3
Damages	8
Risk areas	6



Study area in Medellin.

Fuzzy Logic is characterized by providing the ability to compile 'know how' about the behaviour and importance of each of the criteria chosen for the study. The 'know how' is compiled from the managers, and the criteria are related to the following network information: pipe age, failure history, and operating pressure, among many others.

The information and criteria above can be included, and it can also capture the degree of uncertainty that expert staff may have about each criterion through the mathematical process in each of the three basic stages (fuzzification, aggregation and defuzzification) to the final results, making them much more suited to the reality of the system (Parra, 2013).

Information collection and data analysis

The information for the circuit network model contains, for each pipe, collected material data on age, diameter and installation depth. The pressure information was obtained from the hydraulic model, and risk areas for mass movements were obtained from the Management Plan and Management Aburrá River Basin (POMCA).

The circuit that is the object of this study is located in the northeastern area of Medellín, and consists of 29,074km of network. The network pipe materials are PVC (96.10%), ductile iron (2.32%), steel (0.56%) and cast iron (0.10%). The diameters of the pipes are between 100mm and 400mm. The average circuit pressure has a 69m head, with 26.63% being between 20 and 60m head. The age of the pipe varies between 10 and 50 years.

The study has been carried out on a sample of 1962 pipe sections, which constitute approximately 70% of the pipes of the circuit network. Pipes that do not have information about any of the variables represent 30% of the same circuit in the study.

Application of the methodology

Identifying variables: A list of several variables was built during a workshop with the engineers, who are members of EPM's Operation and Maintenance of Water Supply unit (UOMPA). This was a list of the variables that affect the performance of the pipes, and they were determined in order of importance, in order to choose which have a higher incidence. Table 1 shows the results of the survey. Age, pressure, depth, diameter and material were chosen as the five variables with the higher order of importance.

Construction of fuzzy sets: Linguistic values, which represent the different states of the variables, were defined during the workshop with the engineers, who are members of the UOMPA, and the values of those statements are true, being certain fuzzy sets. In Table 2 the defined fuzzy sets for each variable are presented.

The values of the fuzzy numbers were defined using expert opinion, in which uncertainty is involved, and it is at this point that the method becomes meaningful, because areas of overlap between states are defined. Figure 1 represents the regions of overlap belonging to the fuzzy set for the observed pressures.

Calculation of membership values: The variables of the 1962 pipe sections analyzed were applied to the membership functions of the fuzzy set defined for each variable. When the data is in the area of overlapping membership it has two values, one for each fuzzy number; the

Table 2 - Fuzzy sets

Variables / Material \ Age (years)	States and values: New		Young		Medium		Old	
Steel	0	10	8	20	15	30	25	40
PVC	0	10	5	20	15	40	35	50
Asbestos cement	0	10	8	20	15	30	25	60
CCP	0	15	8	20	18	30	28	40
Ductile iron	0	10	6	15	12	20	18	50
Molten iron	0	10	8	15	13	20	18	30
Diameter (mm)	**Lower**		**Intermediate**				**Higher**	
	0	150	100	300			250	600
Depth (cm)	**Superficial inadequate**		**Optimum**				**Inadequate depth**	
	0	1	0.8	1.4			1.2	2
Pressure (mca)	**Low**		**Normal**				**High**	
	0	20	15	65			60	120

Table 3 - Membership values for the age variable

ID	Age (years)	New		Young			Medium			Old	
		Area 1	Area 2	Area 1	Area 2	Area 3	Area 1	Area 2	Area 3	Area 1	Area 2
4523248	15,55	0	0	0	0	0,89	0,11	0,00	0,00	0	0
4577166	17,97	0	0	0	0	0,41	0,59	0,00	0,00	0	0
9182826	5,27	1	0	0	0	0,00	0,00	0,00	0,00	0	0
9182831	5,27	1	0	0	0	0,00	0,00	0,00	0,00	0	0
9182832	5,27	1	0	0	0	0,00	0,00	0,00	0,00	0	0
9182833	5,27	1	0	0	0	0,00	0,00	0,00	0,00	0	0

sum of these two values is equal to one. In the regions that have overlapping membership, the value will be one. Table 3 shows some results for six steel pipes that were evaluated with the Age variable.

The following steps of the method are applied iteratively for each pipe section, as shown in Figure 2, in order to obtain the results, since this identifies criticality.

The workshop with the experts defined the relationship between the following pairs of variables: age-pressure and age-depth, used to obtain the level of vulnerability of the pipeline, and the pressure-diameter relationship, representing the measured impact upon failure. The vulnerability is understood in this study as the degree of susceptibility to failure.

Before proceeding with the calculation of aggregation, it was determined that the age-depth pair has a higher level of inaccuracy in quantifying the level of vulnerability than the age-pressure pair, so it was decided not to include this in the analysis.

For each pair of variable sets, some rules of the IF-THEN form were defined. Table 4 shows the list of the different rules for the age-pressure variable pair (for each material) and in Table 5 the rules for the pressure-diameter-pair are presented.

The membership values calculated in the previous stage are input values to the matrix of relationships in each pair of variables; the outputs form a new fuzzy set in each case, one to describe the vulnerability and the other to estimate the impact.

Through defining the set of rules that relate the pairs' vulnerability-impact, the matrix is built to determine the risk, as shown in Table 6.

The aggregation process only takes the membership values that are in each of the two related variables as active rules, taking the lowest value of them. When you have multiple active rules that result in the same range or qualitative classification, the maximum value of all the rules is taken, and that will be its membership to the fuzzy number of the result set that will be used to perform the defuzzification.

Defuzzification: The membership values calculated at the stage of aggregation are the heights that the fuzzy set of responses project. Figure 3 shows that the heights of each membership value project horizontally to cut the fuzzy number, in this way an area is created.

The last step is to apply a calculation method to obtain a single value for the resulting area, and then a response is obtained as an output. For this study the centroid methodology was applied.

Conceptual proposal for risk manage-

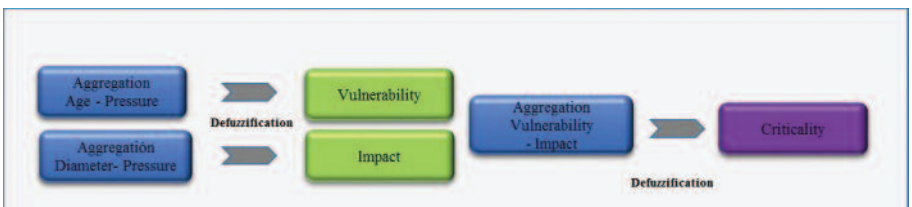


Figure 2: Iterative process of implementation of the methodology.

Table 4 - Vulnerability matrix: Age-pressure

Steel		Pressure	
Age	**Low**	**Normal**	**High**
New	Very low	Low	Medium
Young	Very low	Low	High
Medium	Low	Medium	High
Old	Medium	High	Very high
PVC		**Pressure**	
Age	**Low**	**Normal**	**High**
New	Very low	Very low	Low
Young	Very low	Low	High
Medium	Low	Medium	High
Old	Low	High	Very high
HD		**Pressure**	
Age	**Low**	**Normal**	**High**
New	Very low	Very low	Very low
Young	Very low	Very low	Low
Medium	Very low	Low	Medium
Old	Very low	Low	High
HF		**Pressure**	
Age	**Low**	**Normal**	**High**
New	Very low	Very low	Very low
Young	Very low	Low	Medium
Medium	Very low	Medium	High
Old	Low	Medium	Very high

Table 5 - Impact matrix: diameter-pressure

		Pressure	
Diameter	**Low**	**Normal**	**High**
Lower	Very low	Medium	High
Intermediate	Medium	High	Very high
Higher	Medium	Very high	Very high

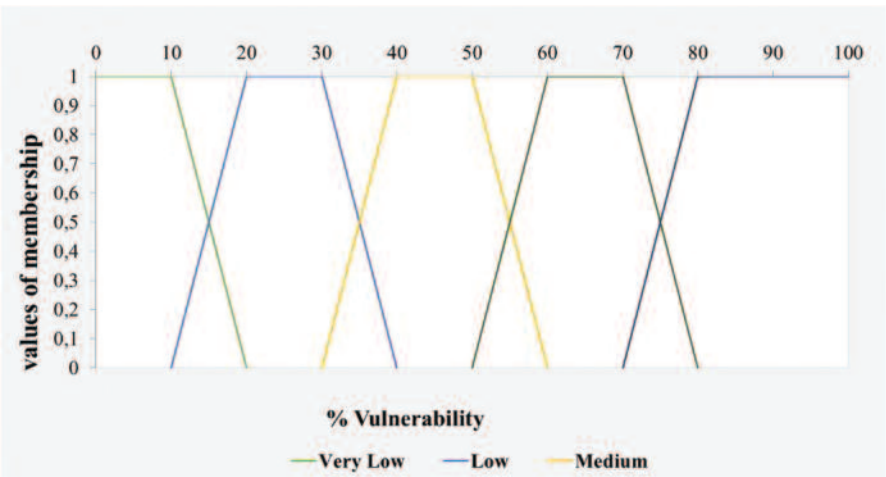
ment: The value of the criticality is a measure of the level of inherent risk provided by the physical condition of the pipes and system operation.

Even with maintenance and investment strategies that involve reducing the vulnerability or impact, and therefore, risk mitigation, we must establish an order of priority to make efficient use of resources. The proposal presented for this purpose is based on related criticality levels resulting from exposure to different risk areas (POT).

In Figure 4, the following implementing categories of actions are defined, in accordance with the level of mitigation required:

- Blue Zone: does not require a preventive plan, make corrections when damages occur
- Green area: perform preventive actions Yellow Zone: carry out preventive actions and network optimization
- Orange Zone: perform preventive actions and evaluate new alignment or material change actions
- Red zone: perform optimization that includes new alignment or material change.

Figure 3: Areas for the calculation of centroid



Preventive actions include checks on sectors, sealing circuits and sub-circuits to verify the lack of hydraulic mixing in sectors and therefore avoid increasing pressures to levels above the norm, in some places in other sectors where the pressure could change, so the water supply service could be affected.

Preventive activities should also consider timely identification of the sites most at risk, or those sites where there have been events such as landslides or flooding, and have them inventoried to be included in a plan for infrastructure monitoring visits.

Actions for infrastructure optimization seek to improve system performance related to variables such as pressure, which should incorporate elements regulating pressure, and renewing end-of-life networks, with installation under controlled quality and compliance issues such as depth.

The study seeks to define alternatives where possible alignments outside the POT risk areas are rated as 'high' and 'very high' or the replacement of rigid pipe by flexible pipes, in order to ensure a better performance against ground movement.

Results analysis

The average criticality level of the circuit is 49%, with a minimum value of 7.78%, and a maximum of 87.33%. In all, 63% of the total length has above average criticalities, which reveals the maintenance and investment requirements. High levels of criticality present in a large percentage of the pipes, which validates the high-level circuit criticality with regard to the other circuits in the system.

Once crossing information between pipes and the area classification is included in the Territorial Planning POT, a proposal for intervention based on five strategies, as shown in Table 7, was generated. In total, 53% of the pipes must be managed through prevention and optimization activities. A further 16% require modification or change to the alignment of materials; only 14% require preventive action, and 16% require attention only when damage occurs.

Strategies matrix		Criticality				
		Very low	Low	Medium	High	Very high
Risk area POT	Low	It does not require a preventive plan. Carry out corrective actions as required	It does not require a preventive plan. Carry out corrective actions as required	Carry out preventive actions	Carry out preventive and optimization actions	Carry out preventive and optimization actions
	Medium	Carry out preventive actions	Carry out preventive actions	Carry out preventive actions	Carry out preventive and optimization actions	Carry out preventive and optimization actions
	High	Carry out preventive actions	Carry out preventive actions	Carry out preventive actions	Carry out preventive and optimization actions that include a new alignment or change of material	Carry out preventive and optimization actions that include a new alignment or change of material
	Very high	Carry out preventive actions and evaluation of new alignment	Carry out preventive actions and evaluation of new alignment	Carry out preventive actions and evaluation of new alignment	Carry out preventive and optimization actions that include a new alignment or change of material	Carry out preventive and optimization actions that include a new alignment or change of material

Figure 4: Conceptual proposal of strategies.

Pipes of 200mm and 300mm diameter require optimization and preventive actions, these representing 9% of the total.

The analysis of new alignments seeks to remove pipes in areas with a high risk of slipping; to replace rigid pipe with flexible pipes, and look for better performance against ground movements.

Conclusions

The Fuzzy Logic process analysis allowed the criticality of the pipes by integrating variables to be determined; however, few of those variables are representative of the performance of the system.

The conceptual framework includes strategies and activities to orientate interventions and allocate resources in places where it is most urgently required. Further studies of those proposed strategies should consider the result of a new iteration of the methodology, which gives greater strength to the results of calculations.

The Geographic Information Systems (GIS) was a useful tool for the project, since most information and maps were developed based on these results. For further projects, we recommend automating the methodology in order to include other variables in the process of aggregation, which will give greater certainty to the results.●

Acknowledgment

This study development has been carried out with the collaboration of the following individuals and departments inside EPM:

Wilmar Licona Velez, engineer, and the Urban Development Unit Linked to the EPM Water and Sanitation Unit, for their willingness to share their knowledge and collaboration to provide us with the basis for preparation of the study.

Team Leaders and members of the UOMPA Operation and Maintenance of Water Supply Unit, for their participation in technical workshops carried out in 2014.

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Table 6 - Risk matrix: vulnerability - impact

Risk matrix level Vulnerability	Impact Very low	Low	Medium	High	Very high
Very low	Very low	Very low	Very low	Low	Medium
Low	Very low	Low	Low	Medium	Medium
Medium	Low	Low	Medium	High	High
High	Medium	Medium	High	High	Very high

Table 7 - Summary of estrategies

Estrategy	No. Pipes	Length	%
1	206	3,727.00	16.38%
2	222	3,336.62	14.67%
3	509	11,941.76	52.49%
4	195	1,779.92	7.82%
5	164	1,965.71	8.64%
Total	**1296**	**22,751.01**	**100.00%**

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Hearing from the people on the collective or private governance of urban freshwater in Australia

One of the most pressing challenges confronting sustainable management of water resources is access to safe water supply and sanitation services for all. Traditionally, dealing with water security and providing people with access to affordable and safe water has been done by government. However, for the last couple of decades, there has been increased involvement of the private sector to finance, develop, manage and operate water infrastructure facilities, particularly the new ones such as desalination plants and water treatment plants. But the terms 'privatisation' and 'contracting out' are always highly controversial topics. In Australia, the debate is ongoing. **GANESH KEREMANE, JENNIFER MCKAY AND ELNAZ ETTEHAD** draw on the empirical data from three online surveys conducted in Australia and document community and water planners' perspectives on who should be governing Australia's water resources. The results indicate a strong preference for the public sector, particularly the federal government.

Access to safe, affordable water is essential for human life, and is one of the key indicators of progress towards reducing poverty. But given that the world is experiencing a historically unprecedented transition from predominantly rural to urban living, one of the most pressing challenges confronting sustainable management of water resources is access to safe water supply and sanitation services for all. It is estimated that nearly one third of urban residents, particularly in developing regions, lack access to improved water and sanitation (UN, 2014).

Furthermore, by 2050 the world will be 34% rural and 56% urban (UN 2015). The same report also highlights that rapid and unplanned urban growth threatens sustainable development, when the necessary infrastructure is not developed or when policies are not implemented to protect the environment and ensure that the benefits of city life are equitably shared. Tackling these challenges requires proper governance arrangements, with appropriate institutional structures that are able to manage water and wastewater systems.

Traditionally, dealing with water security and providing people with access to affordable and safe water has been delivered by government; globally 95% of water services are still provided by public sector entities (Hall and Lobina 2006). However, for the last couple of decades, both developed as well as developing countries have involved the private sector to finance, develop, manage and operate water infrastructure facilities. This is largely due to reasons such as lack of financial capacity, technological constraints and the need for better management or operational skills. At the same time, it is also important to note that not every country that has tried privatisation in the water sector has had success, and there have been failures due to a variety of reasons including poor performance of private companies, disputes over operational costs and price increases, soaring water bills, difficulties in monitoring private operators, a lack of financial transparency, workforce cuts and poor service quality (Gunawansa and Bhullar 2011).

In Australia, water is a state and local government responsibility, and to date the governments have stayed away from full privatisation of water utilities, largely due to strong public opposition to water privatisation. While the governments have refrained from privatising existing systems, there are examples of public-private partnerships (PPPs) for new services like water treatment plants and desalination plants. But in reality, PPP and various contracts (O&M, concession etc.) are the possible forms of privatisation, because all these terms refer to the transfer of management control to the private sector, at various degrees (Memon and Butler 2003).

Furthermore, the terms 'privatisation' and 'contracting out' quickly generate public opposition and are always highly controversial topics. In Australia, on one hand the pro-privatisation advocates argue that 'while the (privatisation) idea is a very, very sensitive issue politically, there is no logical reason why governments need to own the maintenance companies that maintain the supply of water to customers… they can all be owned by the private sector' (Wiggins, 2015).

Table 1 - Delivery models for major desalination plants in Australia

Desalination plant	Public entity	Private sector	Type of contract
Sydney Desalination Plant	Sydney Water	Blue Water Joint Venture and Sydney Desalination Plant Pty Ltd (SDP)	Design-Build-Operate-Maintain
The Victorian Desalination Plant	Melbourne Water	AquaSure	Finance-Build-Maintain-Operate
Gold Coast Desalination Plant	SeqWater	Gold Coast Desalination Alliance	Design-Build-Operate-Maintain
Adelaide Desalination Plant	SA Water	AdelaideAqua	Design-Build-Operate-Maintain
Perth Seawater Desalination Plant	Water Corporation of Western Australia	Degrémont Joint Venture	Design-Build-Operate
Southern Seawater Desalination Plant	Water Corporation of Western Australia	Southern SeaWater Alliance (SSWA)	Design-Construction-Operation

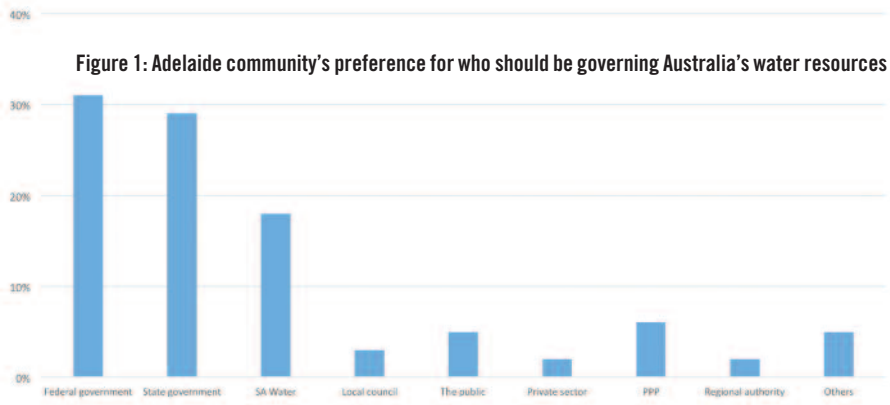


Figure 1: Adelaide community's preference for who should be governing Australia's water resources

At the same time, there are also critics who believe corporatisation, outsourcing, and commercially-driven subsidiaries are essentially privatisation by stealth (Welsmore 2001). Besides, there are also concerns that increased private sector involvement in providing essential services might compromise the public interest (Kerry et al 2000). Given this, it will be interesting to understand the views of the urban community and water planners about water governance arrangements in general, particularly their perception of who should be governing Australia's water resources, and what they think of private sector involvement in the water industry. In so doing, this article draws on empirical data from three online surveys conducted in Australia, and documents different perspectives on who should be governing Australia's water resources. The article proceeds as follows. It provides a brief on the water resources management situation and water privatisation in Australia. It then focuses on methodological and data considerations. Research results and discussion follow, with the article ending with concluding remarks.

Water resources management in Australia

The water industry in Australia operates under state laws and as a result, different states and territories have introduced such reforms at different rates and in different ways. Because of power sharing, each state government has created its own unique system for the allocation and use of water, and so the bodies providing water, gas and electricity have become powerful in each state, with little evidence of working together (McKay and Halanaik 2003).

Furthermore, water management in the states and territories is the responsibility of various government agencies, water authorities and water utilities. Responsibility for regional and local water management lies with various organisations, including Catchment Management Authorities, rural water utilities and local water utilities. These organisations undertake a range of regulatory, administrative and governance functions.

Accordingly, across Australia there are different institutional models for urban water management. For example, in both Western Australia and the Northern Territory, the water service provider owns and operates its assets. In South Australia, the water service provider owns the assets, but operation and maintenance of the infrastructure has been outsourced through a long-term contract to a consortium of private firms, ALLWATER. In the Australian Capital Territory, the water and sewerage assets and business is owned and operated by ACTEW Corporation (ACTEW), which is owned by the ACT government.

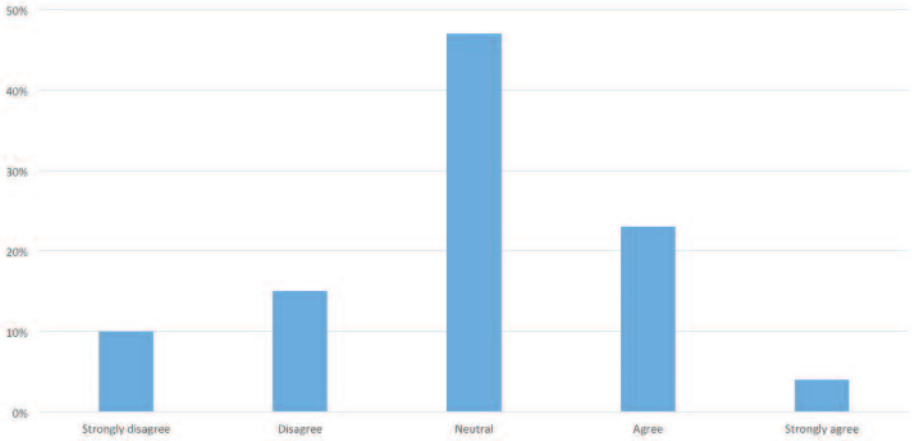
With respect to ownership and operations, state or local governments own all the water utilities in Australia. With the exception of some irrigation schemes, there has been little privatisation in the water sector. However, there has been restructuring and institutional role separation within the public sector departments. The public sector departments have been transformed into corporations, subject to the same laws that govern the private sector, and with clear commercial objectives (Srivastava 2004). Further, a number of water utilities have contracted out their design, construction, and various operational roles to the private sector through service or management contracts.

Water privatisation in Australia

Over the last two decades, Australia has seen increasing levels of privatisation. The list includes our national bank, airline, and most of the telephone company. The electricity and gas industries have been largely privatised in Victoria and South Australia. While the beginnings of the push for privatisation of public assets in Australia dates back to 1975-76, the real boom came in the 1990s, with Australia being greatly influenced by the United Kingdom's privatisation paradigm of the 80s. However with respect to privatisation in the water sector there has been no full privatisation of existing water supply services.

Nonetheless, the governments have entered into long-term contracts with global water companies, particularly for new services like water treatment plants and, more recently, desalination plants. But some of Australia's early experiences with private sector involvement in management of water utilities, particularly O&M of traditional water service functions, were disastrous. For example, the South Australian government's decision in 1995 to corporatise and outsource its metropolitan water services to transnational corporations was marred with scandals in the contract process and a major sewerage treatment failure following 40% of the workforce being made redundant (Ranald and Black 2000). This was the first privatisation of a

Figure 2: Adelaide community's response to statement: Private finance should play a bigger role in the Australian water sector to increase economic efficiency



major water service system in Australia.

Similarly, Sydney's water was corporatised in 1995 (Perkins 2002), the contract to build and operate the water treatment plant at Prospect (which treated 85% of Sydney's water) was awarded to Australian Water Services (a consortium of Suez Lyonnaise des Eaux and Lend Lease). Then the 'great Sydney water crisis' happened and the government and Sydney Water came under heavy attack for the way in which the event was handled (Stein 2000). These events demonstrated a sharp decline in trust in the ability of corporations to protect public health and manage the water systems effectively. Consequently there has been strong public opinion against outsourcing water services in Australia.

But the millennium drought changed the way the urban water sector thought about the security of supplies, and forced the governments to re-think their supply options/strategies. As a result the CoAG initiated a range of actions to develop the national urban water reform framework in 2008, and development of the National Urban Water and Desalination Plan was one of these initiatives, which involved construction of desalination plants in major capital cities. But construction of major water infrastructures requires a considerable amount of financial investment and technical considerations, and that is where the private sector come in. For that reason, there has been considerable involvement of the private sector in delivering large water infrastructure projects such as desalination plants, ranging from designing the structure to financing and owning it (Infrastructure Australia 2008). For example, the major desalination plants operating in Australia are delivered using different contractual methods as shown in Table 1.

Method

As mentioned earlier, this article draws from our previous research on water governance in Australia, three studies in particular - two community surveys and one survey targeting the water planners across Australia. Of the two community surveys, the first one was conducted in 2015 and included respondents from Adelaide, while the second survey conducted in 2010 included respondents from three cities in Australia (two in South Australia and one in Queensland). Both surveys used e-mail lists bought from the permission-based and research-only internet panel of a marketing company. This meant only those people who had subscribed to receive e-mails from this company for research purposes were sent the survey link. However, a point to be noted is an obvious limitation of using online surveys, which is the potential sample-selection bias because the people taking the survey may not be representative of the population in general (Damurski 2011).

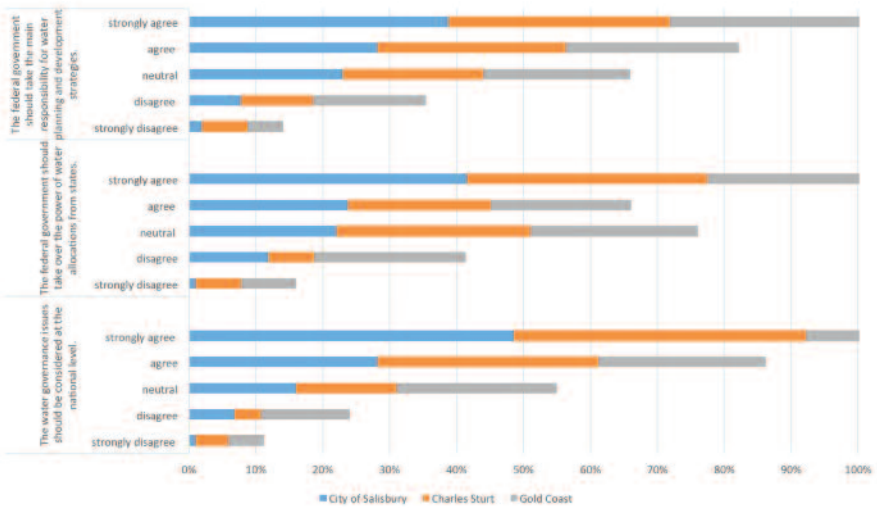


Figure 3: Community attitude towards federalism in Australian water management

In the case of the water planner's survey, people who participated in the survey have been cast in the role of drafting the water allocation plans corresponding to their regions in order to accommodate and fulfil the legal requirements to achieve ecologically sustainable development (McKay 2007). In total, 23 water planners from across Australia were identified by a snowball exercise. The water planners were selected as expert professionals involved in the planning process in various water management authorities around the country. All the respondents had years of experience in the public sector, held senior positions in their organisation/department, and had one or more university or postgraduate degrees in environmental science, hydrology, law and geography, water science and business administration.

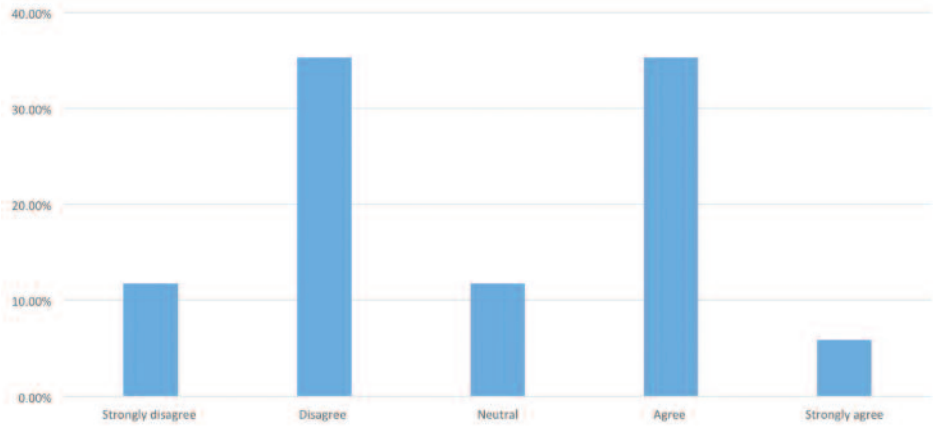
Results

As mentioned before, this article is based on the empirical data from three online surveys including two community surveys and one survey of the water planners. Accordingly the results are presented under two headings - community perspectives and water planners' perspectives.

Community perspectives on water governance

The first community survey of the residents in metropolitan Adelaide focussed on water governance issues, particularly in relation to desalination delivery in Australia. While the survey was comprehensive, only selected responses that address the question of who should be governing Australia's water resources and generally what they think of private sector involvement in the

Figure 4: Water planners' response to the statement: Water governance responsibility between the federal, state and local governments is defined clearly in Australia



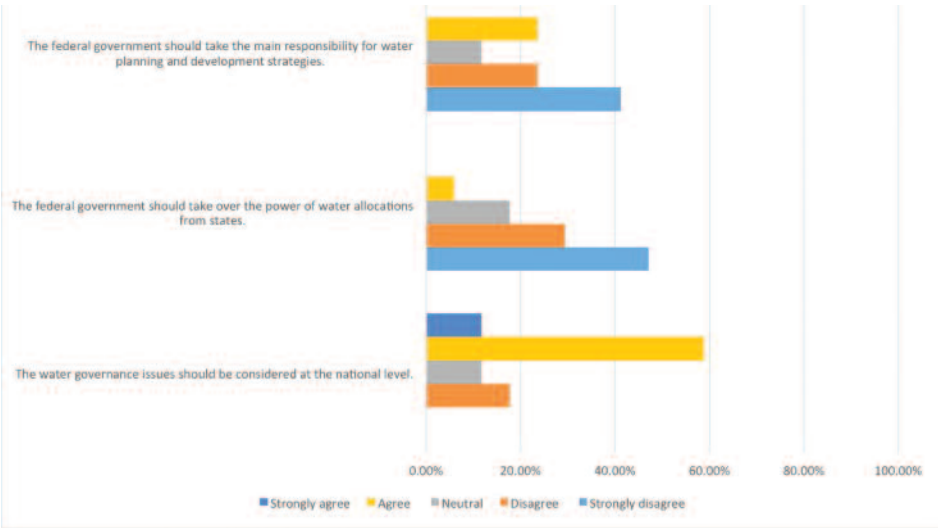


Figure 5: Water planners' attitude towards federalism in Australian water management

water industry are presented in this article (see Figures 1 and 2).

The findings indicated that more than 30% of the respondents wanted the Federal government to be in charge of Australia's water resources, followed by the state government. The respondents clearly did not want the private sector to entirely take over the responsibilities, even though a small percentage (around 6%) were happy with public-private partnerships. Futhermore, the respondents put forth some suggestions, and most of them preferred a collaborative arrangement between the federal and the state governments, such as having a 'council of representatives from state and federal stakeholders'.

Considering that water privatisation in Australia is mostly in the form of long-term contracts to global water companies, the respondents were asked to indicate their agreement /disagreement with the statement 'Private finance should play a bigger role in the Australian water sector to increase economic efficiency'. Figure 2 presents the responses, and it is interesting to note that the percentage of respondents agreeing to the statement was slightly higher than those who disagreed with the statement. But majority of the respondents were neutral, indicating that there is a need for more transparency and public consultation and public reporting of the decision(s) throughout the procurement processes.

These findings are similar to those of the second online survey conducted in 2010, which explored perceptions of three urban communities in South Australia and Queensland. The survey included questions related to water governance arrangements and the local water planning processes. The majority of respondents participating in this survey agreed that the federal government should take the main responsibility for water governance (Figure 3). The respondents also agreed that federal government should take over the power of water allocations from the state, and be the main authority dealing with water planning and development in Australia.

These findings are in line with those of Brown (2007), who reported that the bulk of Australians support federalism in Australia, and believe it is time for many areas of state government regulation to give way to uniform national plans. The study (Brown 2007) further argued that many citizens favour the idea of Canberra taking power because of the inability of the current states to deliver on many crucial issues, and are no more likely to do so in the future. The findings of this study support this argument in the context of water governance, since the communities clearly favoured a federal system of water governance. But the abolition of the National Water Commission (NWC) in 2014 is a step in the opposite direction, and understandably in the submissions made to a Senate inquiry on the National Water Commission (Abolition) Bill 2014 there was overwhelming support for retaining the NWC (Hanman 2014).

Water planners' perspective

The water planners' survey, unlike the community survey, targeted senior officials in the Australian government departments who have been cast in the role of drafting the water allocation plans corresponding to their regions. As mentioned earlier, the participants were expert professionals involved in the planning process in various water management authorities around the country. The survey largely dealt with questions related to water planning and conflict resolution processes, but included a couple of questions similar to the second community survey. The results are presented in Figures 4 and 5. When the water planners were asked if water governance responsibilities between the federal, state and local governments are clearly defined, around 47% indicated their disagreement with the statement, while around 40% agreed with the statement (Figure 4).

Furthermore, to understand water planners' perception of who should be governing Australia's water resources, they were presented with identical statements as in the community survey (Figure 5). The majority of the respondents favoured a federal system of water governance. The water planners believed it was time for many areas of state government regulation to give way to uniform national plans. However, on the question of who should be responsible for allocating water resources, and planning and developing sustainable water development strategies, respondents favoured state governments over the Commonwealth. This is in contrast to the community survey, where the majority of the respondents in all three cities believed federal government should be responsible for allocating water resources, and planning and developing sustainable water development strategies.

Conclusion

The urban water reforms that have taken place in Australia since the 1990s have reoriented public sector service provision from a traditional administrative approach to delivering services on a commercial or quasi-commercial basis (Brown et al 2000). Within the water sector though, the governments to date have shied away from full privatisation/privatisation of existing systems mainly due to strong public opinion against privatisation, but there is increased involvement of the private sector through outsourcing, particularly in newer services such as water treatment plants and desalination.

However, there is much debate about these contracts in relation to ethics and accountability, and concerns have been raised about compromising public interest. This article, drawing from data from three online surveys conducted in Australia, has attempted to understand

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community and water planners' perspectives on this issue. The findings indicated that the urban communities, as well as water planners, favoured a federal system of water governance, suggesting that there is an important place for a national focus for thought leadership in water policy. This role was previously taken by the National Water Commission, which as an independent agency provided advice to the Australian government on national water issues and coordinated water reform in Australia.

On the issue of private sector involvement in water services delivery, Australian governments have been limited to outsourcing newer services such as water treatment plants, and more recently desalination plants to global water companies. However, previous experiences of outsourcing have been unpleasant, and there are lessons to be learnt. While water privatisation was and is always a highly controversial topic, and touches on the much broader arguments for and against private control of formerly public services, it is important to take note of an interesting trend being observed worldwide of re-municipalisation of water facilities. Re-municipalisation is the process whereby public sector entities reclaim control of water utilities from the private sector, and proponents of this idea (Lobina and Hall 2007; Hall et al. 2013) argue that it offers opportunities for building socially desirable, environmentally sustainable, quality public water services benefiting present and future generations, and that re-municipalisation is here to stay. ●

Acknowledgements

The funding and support of the National Centre of Excellence in Desalination Australia (NCEDA) and the National Centre for Groundwater Research and Training (NCGRT) is greatly appreciated. The authors would like to thank all participants who gave their time to participate in the online survey supporting this work.

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Creating the water network GIS for the city of Phnom Penh

Earlier this year, an important project got underway in the Phnom Penh, capital of Cambodia, to create a new geographic information system for the city's water network. **KEVIN NIRSIMLOO** and **BENOÎT MARDUEL** provide details of what the project will involve and the early activities in the programme of work.

In May 2015, a vast project started in the capital city of Cambodia: creating the city's water network Geographic Information System. This ambitious project was assigned by the Phnom Penh Water Supply Authority (PPPWSA) to French engineering consultancy Altereo after an international tender at the beginning of the year. Its scope is: to define a GIS data model and migrate existing descriptive data; reorganise workflows in link with the future GIS within all the departments of PPWSA; to supply a mobile application, base maps, GPS equipment and assistance for mapping water customers and infrastructure; and to train administrators and end-users.

Phnom Penh, served by PPWSA (all pictures: Jean-Baptiste Soulard and Benoît Marduel, Altereo)

The Phnom Penh example

With its 1,500,000 inhabitants, 1800 km of water mains, 270,000 service connections and 145 million m³ annual water supply, Phnom Penh, the economic and political centre of Cambodia, possesses an extremely efficient water supply system.

Whilst the average non-revenue water level is more than 25% in France, for instance, it doesn't exceed 6% in Phnom Penh. The city has become the leading example in Asia in this respect. And PPWSA has been playing its part for 35 years. Several grants from the Agence Française du Développement (AFD) aiding constant work in the field by PPWSA has resulted in a spectacular drop of NRW from 72% in 1993 to the current 6%.

Today, all the service connections are metered, PPWSA delivers a 24-hour service, and the recovery rate flirts with 100%. The city presently has four drinking water production plants (mainly extracting from the Mekong), producing up to 550,000 m³ per day. Water is directly injected into the network by frequency-modulation pumps. 80% of the cost of water is due to the excessively high cost of energy in Cambodia. Smart pumping systems have led to a 20% reduction of the water bill within a few years. Water sells for less than €0.2/m³, subscription and meter included (€3 for a bimonthly bill of 15m³, amounting to less than 1% of an average family's revenue).

The challenges are therefore great for Altereo to match the GIS solutions to the requirements of such a well-performing utility in the midst of an expanding city. The network lengthens by 500 m per day; there are 12,000 to 20,000 new customers each year, and the production capacity rises by 7.5 million m³ per year.

The GIS solution introduced

Altereo proposed its latest generation of GIS for this project. KIS Water is a 'full web' solution offering the whole feature panel traditionally proposed by desktop GIS software. KIS stands for knowledge information system. Water KIS will give the PPWSA managers and operators a complete 'water supply' toolbox, ranging from navigation and topology features (paths, valve closure simulation, catchment areas, etc.) to the management of workflows (complaints, interventions, bursts, etc.). Furthermore, KIS Water will be a turnkey solution delivered to PPWSA.

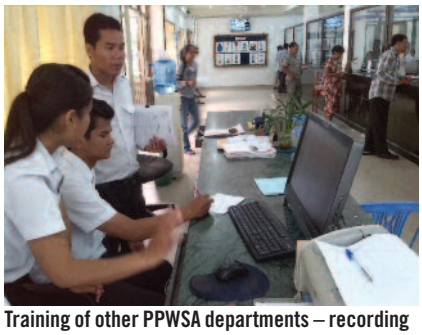
In addition to this, KIS Admin is an additional module for customisation. GIS specialists and system administrators will have a simple and ergonomic tool to model and integrate data, manage users and rights, and also set up applications, forms and even workflows. It will allow PPWSA to directly carry out the evolution of the system according to new requirements, including data exchange with third-party applications in different formats.

KIS is available in French and English

KIS interface being prepared in Khmer, with the complete application in a classic internet browser.

Theoretical training with Khmer documentation, to be followed by the realities of field operation.

Practical training work revealing field realities, with customer meters buried under trash.



Training of other PPWSA departments – recording customer complaints.

languages and a special Khmer version was developed for PPWSA.

The team

The idea was to roll out a compact project (of six months) with a compact team. Altereo dispatched one experienced engineer full-time in Phnom Penh. He has a double-competency profile: water network engineer and at the same time well versed with GIS and utility workflows. He is assisted by four PPWSA staff who were appointed to him on the very first day.

KIS has been designed such that it can be deployed by a water network engineer who understands the job rather than by IT specialists. The most important part of the mission is to understand how the utility functions, map its workflows, adapt them, and program them into the system. The KIS Admin module allows someone with a non-IT profile to do this quite easily.

This engineer on site was in permanent contact with the company's development team back in France and in China, the latter having the advantage of being in the same time zone. The deployment required only a few missions on site by two IT specialists, one for IT architecture, the second for interface adaptation.

The GIS installation

The installation phase onto PPWSA servers required a support mission by two Altereo IT specialists who had been in permanent contact with the team and had been preparing the setup from the beginning of the project.

The creation of user profiles

Four types of GIS user profiles were proposed and created:

- Profile 1: IT administrator – in charge of system technical administration (one staff)
- Profile 2: GIS administrator – in charge of system administration, data capture and update and use of all features (three staff)
- Profile 3: GIS craftsman – in charge of data capture and update and use of all features (four staff)
- Profile 4: GIS consultation level – use the GIS on a daily basis for operation and maintenance activities, reporting or engineering purpose; don't have the rights to edit data in the GIS.

The migration of existing data

PPWSA had a lot of existing GIS data of variable quality:

- GIS shapefiles of the pipelines for each of the 12 districts with topological errors
- GIS shapefiles of valves for each of the 12 districts with topological errors
- A base map created with low-resolution GPS as there was no municipal cadastre
- Partial GIS shapefiles containing meters, hydrants and other equipment without being exhaustive

Altereo undertook completely the data migration and topological correction, involving proper drawing and joining of arcs and nodes, attachment of nodes to pipelines, attachment of valves to pipelines, etc. This was followed by a huge workload of manual corrections: adding tanks, pumps, all other network objects, footprints of as-built documents and necessary links with PPWSA's new leakage management software.

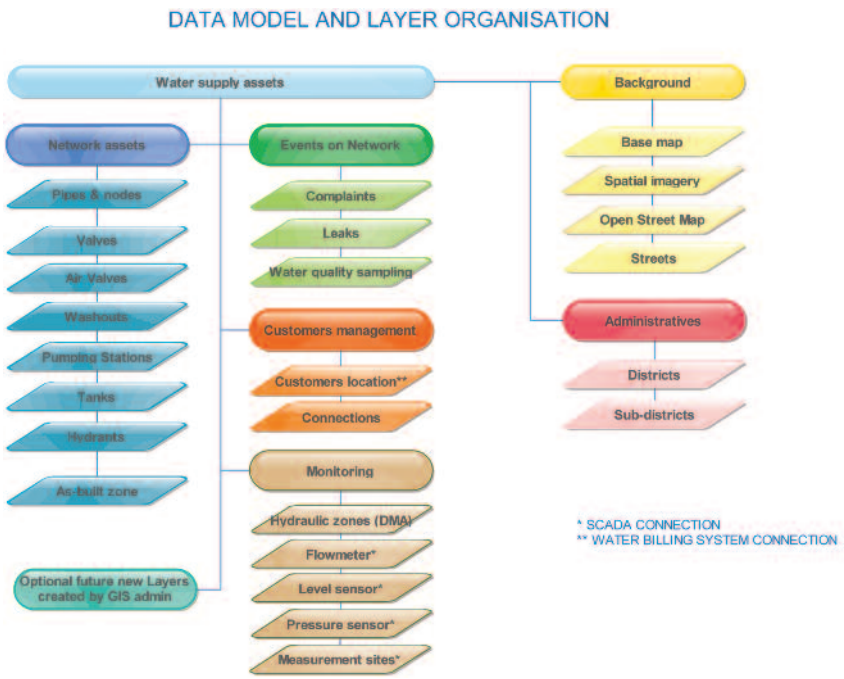
Considering that is was not possible to stop the existing systems and workforce, the migration process was carried out over a whole holiday week.

The customer mapping challenge

There was no previous information on service connections and customer mapping. Altereo provided the aerial map and supervised the customer mapping process.

One of the first challenges that awaited the team and PPWSA was the positioning of each of the 270,000 customers. The objective? To access within the GIS the location of each and every customer, and moreover, to interrogate the huge billing database from the GIS interface.

The final data model.



KIS interface with PPSWA networks and Google Street View applet positioned on a busy street leading to the Phsar Thmey market, one of the city's landmarks.

For this indeed titanic task, 110 PPWSA agents were trained in groups of 10 so as to undertake this task during the following months. Customers were positioned with the help of GPS devices and maps during the fourth of the meter reading campaigns (held every two months) of year 2015.

The agents received theoretical training, and they also witnessed the gap between what is in the handbooks and what occurs in the field (see photograph of real world meter conditions).

At the end of the process, the count was stopped at four and a half months of field work for 53 full-time agents.

Despite the peculiarities see in the field, after five weeks into the project, the Altereo team was already convinced that PPWSA is a model of an efficient public utility, able to constantly question itself and evolve.

Additional stages

A number of additional surveys, trainings and meetings were carried out during these first months of the project. These included, for example, training on high-resolution GPS, and training of other PPWSA departments on the recording of customer complaints and the drawing of new service connections.

Training on high-resolution GPS.

The intermediate results

Intermediate results of the project show the Water KIS application deployed in PPWSA with data on the city network of Phnom Penh. Translation is partial, and fine settings and bug-correction are still under way.

To date, in summary, KIS is an acronym for Knowledge Information System and it is an enhanced Geographical Information System (GIS) dedicated to the management of topological networks (water, sewer, electricity, etc.) and other types of data layers. The system is fully based on Web and Open Source technologies and remains very flexible. It can be customised to fit the client's specific requirements: importing and creating layers, creating relationships between components or creating forms through an interactive process builder. KIS is installed on a server and can be directly and fully operated from any device connected to the Internet: Computer, Smartphone, Tablet, GPS, etc. (no degraded web viewers or mobile versions).

In Phnom Penh, KIS client is running on Chrome (from v.40) and Firefox (from v.35). Client devices (computer, tablet, smartphone, etc.) connect to a web server which dispatches user requests. Communications between client devices and the KIS GIS are established with an application server (Tomcat) and a map server (Geoserver). User authentication is done by Apache and Tomcat. To ensure optimum system security, data sent from the web server to the application server is not visible or accessible from a client workstation.

In the case of PPWSA, two Geoservers are installed to provide a faster service: one Geoserver to process raster files like satellite images and the other Geoserver to process vector layers (pipelines, objects, etc.)

The customer database is directly connected with KIS under the KIS database manager. KIS natively connects to all types of databases (PostGIS, MySQL, etc.) which gives it maximum flexibility.

KIS is connected to PPWSA's new SCADA and its Sensewater module. KIS can thus feed data to the SCADA through webservices (e.g. number of customers per sector, length of mains per zone) and likewise the SCADA can feed data to back KIS: leakage levels per sector, average flows per day/week/month and display cartographic results.

The final data model is represented in the figure.

Details of the project's completion and the final results and usage will be provided at a later stage.●

Altereo team Benoît Marduel (lead engineer on site), Rémi Bruguier (IT/interface, China) and François Tritz (IT/architecture, France) in front of statue of Goddess Phra Mae Thorani, symbol of PPWSA. According to Buddhist mythology, Goddess Phra Mae Thorani is represented as a young woman who, wringing her long bundle of hair, drowned Mara and his army with a torrent of water from her hair. Mara was the demon sent to tempt Buddha while he was mediating under the Bodhi tree. Water symbolises the merits accumulated by Buddha in his past lives, his perfection and his generosity.

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