This article provides a brief overview of Non-Revenue Water (NRW) activity in Romania, Bulgaria and Turkey. It is based on the author's involvement in the development of operational performance improvement programmes in these utilities. Water loss control activities in our water utilities in South-east Europe are still oversimplified and without proper recognition and support from top management level of the utility company. This neglected position of people responsible for leak detection...
In the recent years an increasingly higher attention was paid to water losses management by water companies in Romania, especially due to the Sectorial Operational Programmes implemented at national level. The main reason for the inclusion of this activity in almost all the projects was the high level of losses (better said non-revenue water) in distribution. Although this situation is widely regarded as a „As required“, the question that naturally derived is why it took these programs to resolve a situation that should have not existed in the first place?

The truth is that water loss management is not a new thing, water companies in Romania having such a concern since their creation (even I recently read a report in 1930 which set a campaign of pressure and flow measurements on night time in the district “Obor” in Bucharest) and all these results were not up to expectations. Maybe the expectations were too high (or unrealistic) or simply water companies had no vision necessary to achieve them? I could not find a clear answer to this question, but I can analyze the situation based strictly on practical experience gained by working with different water companies in the country as an expert consultant for reducing water losses.

First, instead of traditional water balance which take into consider only the water entering the system and billed consumption was introduced terminology and methodology recommended by the best practice manuals of the International Water Association (IWA), which has a clear distinction between physical water losses and non revenue water. Therefore, to calculate the water balance we need some information and data with a high degree of accuracy and confidence. Unfortunately, in all cases, the companies of water did not have a history of this information because they were not considered relevant until then. The direct consequence was that both consultants and water operators were forced to rely on simplifying assumptions, the most common being the equivalence of non-revenue water with physical losses of water. It is obvious that in this case the calculated target indicators lead to unrealistic situations (both in favor as and against of the operators of water).

Secondly, assuming that the values of the indicators are based on accurate data, confusion still persists between the actual distribution network and the company/ water branch managing the network. In this case the water operator must ask themselves if NRW (non-revenue water) expressed in percent is useful for the distribution network or if ILI (index of physical infrastructure losses) is useful for the company/ water branch? No matter what the situation is, these indicators should be compared with some “standard” values to tell whether network or the water company is in a good or bad situation. Here we have another problem, namely the compared matrix, and the result can be completely different depending the matrix chosen (it is enough to compare values to the NP 133 / 1-2013 and The National Operators Manual for Water and Sanitation to prove this).

Third (and not necessarily final) it seems there is a general tendency to repeat the mistakes mentioned above and the explanation is not so simple as I wanted to be. It is time to present the “anti-fragility” concept of a proposed system by Nassim Nicholas Taleb. I will use an analogy that the author himself has used it repeatedly to explain this concept. Imagine a package with FRAGILE ZIP inscription that I have just picked-up from the post office. If we dropped the package and its contents then we have deteriorate the package and lost the respectively value, in which case we will learn from mistakes and the next time we will use a ROBUST package (in an accident case we will not lose the value of his content). Nassim Taleb suggests a third type of packaging, with a special property that in deterioration case will bring earnings and no losses. This package bears the inscription ANTI-fragile.

Note that the author does not believe necessarily that this action of destruction is intended for the dedicated purpose to have gains, but rather a normal response to the environmental feedback. It is obvious that when the destruction of a component gets some income for the system you have no longer any stimulus to remediate the component situation.

Turning to the issue of water losses I have reached the conclusion that from this standpoint the water supply systems went from a fragile state (where physical losses generated losses) directly to an anti-fragile state (where physical losses can generate income - To think only about the funds received that are designed and proportionate with the physical losses estimated), although the intention of implementing so many operational measures is to bring them to a robust condition. Time will tell if whether we should change dramatically the road where we are (going from the anti-fragile system to a robust system) or, paradoxically, a way to robust system first passes through an anti-fragile one.

Once upon a time, or better said, was and will always be a Granny who had a loving granddaughter, named Little Blue Riding Hood. Network Granny was old, almost 100 years old, with daily weights, hard dealing with heavy traffic congestion, full of trucks. She had high Pressure, and she lived alone in an earth made house. And adding to that she was haunted by wolves, like Faulty Wolfus, hungry creatures. All those weights have weakened her health. And she did not go for a health check at doctor, because it did not hurt so badly. “Better go to the pharmacy instead of a doctor, the chemist is also a doctor”, she used to say.

The granddaughter loved her grandmother and she was doing everything she knew to keep her in good health.

One day her mother met an Expert Hunter, who was aware of grandmothers’ condition. Hunter advised her to buy a car. The Hunters’ advice was more complex than that, showing her that is not enough to have a car, you will need also a licensed driver, gas, mechanics, spare wheels, and the whole system should work as one.
The mother wanted more simple methods: “we will buy a car, Little Blue Riding Hood will get a driving license, she will use the horn to scary the wolves, and we will buy also a tonometer and pills for Granny’s’ pressure.

A moth, two, three have passed and Granny’s condition was the same. The grandmother was terrified by the increasing wolves’ number, by the nearby noises and by disease – her runny nose was visibly, her head was aching due to lack of water.
With tears in her eyes, the mother called the Hunter and asked him:
– Granny is not well. What can be done?
– There are a lot to be done, but is not so simple. Are you shore you want to go further?

– So let me tell you how my abroad aunt proceeds.
– What can your aunt do differently than me? I did everything i could better: I bought the most expensive car, the most sophisticated horns, why I cannot banish the wolves? asked the mother
– My aunt has learnt some essential things and has put them into practice. To succeed you need to know where it hurts, how bad it is and to interfere where is critical. You will need help and is time that the whole family to understand and get involved.
– Uff, if I only knew how your aunt deals with the wolves!
– I will tell you, I have been watching her for a long time, said the Hunter. She was exactly like your Granny, hunted by wolves. Now only a few more upset her. Look what it should be done. We need a surveillance system SCADA, mounted on each path DMA. There are darker paths and lighter paths, so we will need high performance systems. If we will know with what kind of wolves Granny is dealing with, we can put traps which will banish them. We will have a tracking system of all the neighbours which are walking nearby, which one is leaving and coming, who is having a picnic and who leave garbage behind. These will help us keep Grannys’ view safe from all those things that upset her, like waste, woods theft. We need continuous surveillance and quality and instant interventions.

– That means a lot of money..said the mother
– Actually it means to know where to interfere and to obtain the results you wanted. You can never change what you do not know, and you will never know the wolves’ number and the damages caused by them, if you don’t monitor the forest. Observing my aunt I found some amazing results. There is no need for a high investment; it can be start by pieces. In this way all the problems can be solved, in small steps.

Flower teas, for example are recommended and have to be harvest in their own time. There are four flowers with miraculous powers, flowers that we need to know and use.
1. The first is Reparations Flower. This one is good any time. It recommends high quality flowers, with an efficient and instant response.
2. The second is Activate Flower. It is good in memory lose cases, we need to know what kind of food we have in our storeroom, and at what date we have bought them, for not having spoiled food.
3. The third is Pressure Flower, which helps the arteries a lot
4. Wolfus Identification Flower is the forth and cannot be missing, it helps to find the hidden wolves

– Now I get it.
– But take this advice: you need to find your own tea recipe in order to obtain an efficient and successful tea. Little Blue Riding Hood picked the flowers described by the Hunter. She and her mother have prepared a lot of infusions until they found the best combination for the Granny. Everyone had given a helping hand to footpaths cleaning and surveillance system assembling, at traps positioning. And like this everyone helped Network Granny to get back on her feet and to banish the hungry wolves.

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NON-REVENUE WATER ACTIVITY COMPARISONS IN ROMANIA, BULGARIA AND TURKEY

Introduction

This article provides a brief overview of Non-Revenue Water (NRW) activity in Romania, Bulgaria and Turkey. It is based on the author’s involvement in the development of operational performance improvement programmes in these countries, all of which have involved water loss reduction components. It also draws on general and specific aspects in the NRW field that have been promoted through national and international programmes that have been supported by the respective Water Associations. It looks at a number of initiatives that have been undertaken in the countries being reviewed.

Situation in Romania

Romania has benefitted from considerable investment in the water sector since the mid-1990’s and as such has received technical support in the field of NRW activities. This has resulted in comprehensive leakage strategies being developed across the country that are now well established and have been adapted to suit the implementation of regionalisation within the water sector. All strategies have included the establishment of leakage reduction departments that adopt an active leakage reduction approach. The strategies are linked to action plans that target reductions in the levels of NRW and are an integral part of investment programmes.

Prior to recent investments, water networks were generally in a poor condition, being constructed of cast iron, steel and asbestos cement. Pipes were of poor manufacture and poorly constructed. This is particularly so for those systems developed during the 1960’s and 70’s for the industrial boom in the major cities. Consequently leakage levels are high, typically in the range 40 -60% and in some areas even higher.

The Romanian Water Association (ARA) actively supports the water operators and has been involved in introducing a number of initiatives that support NRW reduction. One such initiative was the Water Leakage Challenge that has now been running successfully for 7 years. The ‘Challenge’ brings together leakage detection teams from across the country to locate potential leakage sites identified by one of the country’s Regional Operators. The Regional Operator hosting the event is the previous year’s winner of the competition. Such has been the success of the event that it has also attracted visitors from neighbouring counties. The main benefit of the competition is that it brings together practitioners in the leakage detection field to compete and discuss common problems and establish networking.

Training has also supported the drive to reduce NRW levels using training establishment facilities developed in Timisoara and Cluj. This also gives participants the opportunity to network as well as benefiting from expertise being provided by operators, consultants and equipment suppliers.

Additionally, pilot projects have also been developed as part of consultancy support to support reductions in NRW levels which have delivered substantial benefits. It is important to note that these have been managed and delivered by the operators to ensure that maximum benefit is delivered to the water company.

Pilot Projects

Botosani – Demand Management Pilot

This pilot exercise was carried out to gain a full understanding of water demand in high rise apartment blocks and to demonstrate the benefits of metering and improving customer awareness. For the exercise two apartment blocks were selected and assessment of the situation made at three stages:

1. Initial assessment, with no metering (water was charged based on occupancy and a national notional water consumption), no maintenance repairs being carried out, limited apartment information available.
2. Interim assessment, after a customer awareness campaign had been launched and meters installed in individual apartments.
3. Final assessment when total metering completed, apartment block repairs carried out and increased customer contact established.

The results obtained were impressive. On the first apartment block the per capita consumption reduced from 500 litres per person per day to 150 litres per person per day and on the second apartment block from 450 litres per person per day to 90 litres per person per day.

This pilot exercise was carried out as part of the Municipal Utilities Development Programme – Phase II (MUDP II) and involved the Water Operator of Botosani and Consultants, Royal Haskoning.

Satu Mare – Tasnad DMA Pilot

Tasnad is a small town in Satu Mare County and has a population of 9000. The water supply system is self-contained and comprises two pressure zones. For the pilot exercise the higher pressure zone was selected which supplies half of the town. On commencement of the study, water losses were thought to be high and supplies were discontinuous.

A programme of works was developed which included:

- A Technical Manager was assigned by the Water Operator to take responsibility for the pilot exercise
- A metering programme was introduced
- Funding for rehabilitation works of the water network
was advanced
- Active leakage control practises were introduced
- Boundary valves were verified
- Regular progress reviews were held

A substantial amount of work was carried out which included:
- 465 meters replaced (22% of zone total)
- 30 defective fittings identified and repaired or replaced
- 274 water main repairs carried out
- 117 connections repaired or replaced
- 1224m of water main replaced

The results achieved at the end of the pilot exercise were as follows:
- Continuous supplies were made available in the zone
- Energy usage was reduced from 80.7 KwH to 53 KwH
- The cost of implementation measures was 12400 Euro
- NRW was reduced from 58% down to 23%

This pilot exercise was carried out as part of the ISPA Financial and Operational Performance Improvement Programme (ISPA- FOPIP) and involved the Water Company of Satu Mare and Consultants, Royal Haskoning.

Situation in Bulgaria

Bulgaria has received limited support in the field of NRW since the mid 1990’s, primarily from World Bank funded projects. Initially these targeted 15 water supply and sewerage companies where NRW training formed a component of a broader FOPIP technical assistance. In 2004 legislation was introduced to encourage the reduction of water losses and this started the process of targeting Water Operators to reduce the levels of NRW year on year. However it has to be said that the levels stipulated by the National Regulator are unrealistic considering the state of the water networks, level of investment needs in the water sector and tariffs that are currently levied. This is reflected in a level of NRW across the country of approximately 60% in 2008, despite the legislation introduced in 2004. Pipes are generally of steel, cast iron and asbestos cement and of poor manufacture. Current levels are considered to be much the same due to the slow level in obtaining investment needs. Recent pilot exercises have indicated that in some areas NRW levels are well in excess of the national average.

Since that time the Government has looked at restructuring the water sector on a regionalised basis but this has still to happen. In Bulgaria there is currently one private concession for the city of Sofia with the remainder of the countries water assets managed by a combination of Government owned, Municipality owned and jointly run Government and Municipality companies.

The Bulgarian Water Association actively supports the Water Operators in the drive to support reductions in the levels of NRW. It holds an annual conference in November of each year with a focus on water loss reduction which is always well attended and supported by national and international experts. Cooperative links have also been established with other Water Associations in Central and East European Region.

Pilot Projects

Water loss reduction in Razgrad

This project involved monitoring of 4 District Meter Areas (DMAs) in the city of Razgrad with a population of just under 6000 (15% of the total of Razgrad). The approach followed the International Water Association (IWA) methodology and involved DMA monitoring, preparation of a water balance, applying active leakage control principles and pressure management.

Significant savings resulted from the pilot project. The DMA’s system input was reduced to 25.7 litres/second which represented a system input reduction of 5% and a cost saving of 146 Euro/day. The project costs involved amounted to 13920 Euro which gave a pay-back period of 95 days.

The project was carried out as part of a Dutch Government initiative to follow up on the installation of a SCADA system provided for the Razgrad water system and involved the Water Company of Razgrad, consultants Aquapartner of Bulgaria and Aquanet of the Netherlands.

Ruse – Water balance

In Ruse a detailed water balance was made for two villages within the supply area of the Water Operator. The villages of Peychninova and Bosilkovtsi were selected for the exercise. Detailed population counts were made and meters configured to register transmission main flow in addition to that invoiced to customers. The results of the exercise were as follows:

Peychninova -
- Population = 395
- Transmission main losses = 12%
- Billing and distribution losses = 65%
- Per capita consumption = 117 litres per person per day

Bosilkovtsi -
- Population = 715
- Transmission main losses = 10%
- Billing and distribution losses = 67%
- Per capita consumption = 130 litres per person per day

This pilot exercise was carried out as part of Financial and Operational Performance Improvement Programme (FOPIP) and involved the Water Company of Ruse and Consultants, Royal Haskoning.

Situation in Turkey

Turkey suffers from aging pipe network systems. It is estimated that approximately 50% of the countries nets were laid down over 50 years ago. The pipe materials are predominantly steel, cast iron and asbestos cement which have degraded over time and contributing to large levels of water loss from the networks. Typical losses are in the order of 60% but losses of up to 80% have been reported.

Some of the larger cities in the country have established maintenance programmes for the water networks and secured funds to carry out mains replacement but generally there have been insufficient funds made available to tackle the leakage problems. The lack of funding, a problem generated through inadequate...
water tariffs, also results in high customer usage and wastage, there being little incentive to conserve water. Consequently, repairs to private networks and storage facilities remain undone for prolonged periods resulting in significant water loss.

Illegal connections also form a significant contribution to NRW in the country. The exact contribution to NRW is not known but thought to be high and in addition to the associated water loss due to uncontrolled installation, also results in revenue loss to the Water Authority.

The Turkish water sector has historically been municipality based but this is now changing with the establishment of Water Operators being based on Greater Municipality areas. This is the first stage of a regionalisation process and could impact on how the approach to NRW activities is undertaken.

In 2011 the Turkish Water Institute was established with it mandate to provide support to the national and international water sectors. Its main focus will be in Central Asia, the Middle East and Eastern Europe. Although relatively new into the field it has the opportunity to link with the established water associations in the Region to support NRW initiatives.

**Pilot Project**

*Akcaabat - Water balance*

Akcaabat is a town with a population of approximately 40600 located on the Black Sea coast in the Trabzon Greater Municipality. 95% of the population were connected to the water supply. As part of a larger investment project a water balance was prepared to assess priorities and the level of NRW. Due to the high differential ground level of properties in the water supply area (0-700m), 12 pressure zones were in operation, fed through a series of pumping stations to supply reservoirs. From the reservoirs the supply zones were fed by gravity which also included a number of pressure reducing valves. The water balance was prepared in line with the IWA model and is detailed in the table below:

In Akcaabat there were 27 different domestic and non-domestic tariffs but water was supplied free to mosques and Municipal sites. This un-billed authorised consumption equated to 12.1% of system input. A further 2.6% of system input was attributed to apparent losses. Therefore the real losses equated to 38.7% of the total NRW.

This pilot exercise was carried out as part of the Technical assistance and Supervision for Water and Wastewater of Akcaabat Municipality and involved the Water Operator of Akcaabat and Consultants, Rambol.

**Concluding Remarks**

The situation of NRW and associated water loss is one that will never go away. Assets, both above ground and below ground, deteriorate with time that will contribute to water loss unless suitable maintenance and replacement programmes are in place to minimise the effect. Revenue meters will under-record with time resulting in revenue loss and distorting water balance calculations unless recalibration or meter change programmes are in place. Billing systems, which

<table>
<thead>
<tr>
<th>System Input</th>
<th>Authorised consumption 1929652 m3</th>
<th>Billed authorised consumption 1534725 m3</th>
<th>Billed metered consumption 1534725 m3</th>
<th>Revenue water 1534725 m3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unbilled authorised consumption 394927 m3</td>
<td>Unbilled metered consumption 169819 m3</td>
<td>Unbilled unmetered consumption 225108 m3</td>
<td>Non-revenue water 1756332 m3</td>
<td></td>
</tr>
<tr>
<td>Water losses 1361405 m3</td>
<td>Apparent losses 86167 m3</td>
<td>Unauthorised consumption 32173 m3</td>
<td>Meter faults 53994 m3</td>
<td></td>
</tr>
<tr>
<td>3291057 m3</td>
<td>Real losses 1275238 m3</td>
<td>Pipe leakages 451434 m3</td>
<td>Leakages at WTP 0 m3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Leakages at service reservoirs 823804 m3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
generate a great deal of the information on which NRW calculations are based also need to be regularly audited. Without such a process in place, errors either manual or fraudulent, can result.

It is important that the practitioners’ who have responsibility for minimising NRW are supported in this goal by being given the monitoring and location equipment necessary as well as managerial and back-up support to complete the job. Dialogue is also important between practitioners’ as many water leakage problems have a common base. Forums for such dialogue are already well established and need to continue with the support of Water Associations and Technical Institutes.

A lot of good work has been achieved in recent years aided by the developments of new technology and following best practise principles and this needs to be built upon in the future.

Acknowledgements

The author wishes to express his thanks to all the Water Operators with whom he has worked in the field of NRW in the countries covered by this paper. Considerable thanks are also due to the Water Associations of Romania and Bulgaria who continue to provide support and be the vehicle knowledge exchange in the water sector. Special thanks are also due to local and international consultants and the International Financing Institutions with whom I have worked as part of the operational and technical improvement programmes.

Andy C Bowden

WATER LOSS CONFERENCE BUCHAREST 2015 OVERVIEW

In 2015 Bucharest hosted a very important regional event on the management of water losses. The Water Loss Management Conference on 15-17 June held in the capital was part of a series of regional conferences from the International Association Water (IWA) on reducing the waste of water. The Water Loss Management Conference 2015 offered the opportunity to present and discuss the latest developments, strategies, techniques and best international practices both in the assessment, management and reducing losses of water, and to control and improve water metering.

The suggested topics for discussion covered most interesting current topics related to the strategies of water companies to reduce losses, efficient water management of assets, efficiency management of operational and commercial failures and pressure, performance indicators, analytical tools, data collection, hydraulic models, efficiency in companies and capital investment planning, medium-term, high-impact projects to reduce water losses, best practices and case studies. The program was divided into 11 thematic sessions:

Session 1 – NRW Regional Activities. Moderator: Bambos Charalambous
Session 2 – NRW Strategies. Moderator: Philip Giantris
Session 3 – Recent Good Practices in Leakage Management. Moderator: Jurica Kovač
Session 4 – transferable Good Practices and Knowledge on NRW. Moderator: Cor Merks
Session 5 – Efficiency in Water Networks. Moderator: Marco Fantozzi
Session 6 – Leakage Detection and Reduction. Moderator: Nicholas Petroulias
Session 7 – Water Measurement and Audit. Moderator: Diana Robescu
Session 8 – Focus on Romania. Moderator: Jan G. Janssens
Session 9 – Improving Performance NRW. Moderator: Michael Dorus
Session 10 – Software Modelling and Water Loss Assessment. Moderator: Georgi Hristov
Session 11 – Innovative Concepts. Moderator: Ion Bica

The organizing committee contained popular personalities from the water loss area, including IWA members of the Water Loss Specialist Group working with water industry specialists and academics from Romania. More details can be found on the website dedicated to the event:
WHERE ARE WE GOING WITH LEAKAGE IN 2015?

External drivers on water companies have focused on leakage from pipe networks – and on efforts to reduce it - for many years. But, with a greater understanding of the effect of network operations on the infrastructure - and continuing advances in technology - has ‘network management’ replaced leakage management? Have leakage managers become network managers, reflecting the dynamic between asset knowledge and leak detection?

And can network managers use the advances in ‘smart’ technologies to make better use of – and integrate - the mass of data coming in from the range of sensors in the network? With such advances, can we expect to achieve zero leakage during this century? Or are water companies too reluctant to invest in innovation – and technology advances – for ‘smart systems’ to be fully understood and their capabilities fully appreciated?

These are some of the questions posed during the process of setting the agenda for the 2015 Global Leakage Summit. For each Summit a selection of past delegates are asked what questions and current issues they would like to see highlighted – and what ‘hot topics’ they would like to hear debated. Some of these are highlighted in the following sections:

**LEAKAGE TARGETS**

High on the agenda for UK water companies this year is the question of how the regulators view leakage targets. With most companies reaching – or going below - their leakage targets, are the regulators becoming less concerned about leakage, and should they now look at leakage beyond targets and enforcement? Regulators can be expected to adjust some of the regulatory barriers and opportunities, and place more emphasis on customer satisfaction – for example customers’ perception of how quickly water companies find and fix leaks. Should companies now be focusing on the appropriate level of leakage, taking other drivers – like customers and politicians – into consideration? For many years, companies have used the economic level of leakage (ELL) for setting and reaching leakage targets. But how well do we understand leakage? Background leakage and unavoidable losses are a considerable part of ELL – but can we quantify them more accurately?

**ZERO LEAKAGE**

With smart systems, smart sensors and software for predicting and continuously monitoring leakage, we have the potential for becoming aware of leaks more quickly and reducing leak run time. We also have the potential for better pipe material and installation technologies – should we now focus on leak prevention - and reducing background losses – as well as repairing bursts?

And is ‘zero leakage’ becoming less of a dream and more of a reality? Companies like Tokyo Waterworks Bureau, Vitens in the Netherlands and PUB Singapore are in low single figures when using percentage of system input volume as a performance indicator – what are they doing to achieve this? Is it a case of ‘money no object’ to achieve zero leakage? Certainly, Tokyo Waterworks has invested heavily in pipe replacement, and in installing stainless steel service connections, but has maintained 3% leakage by effective leakage prevention, staff training and technology development (Figure 1). What can other water utilities learn from the Tokyo Waterworks ‘near zero leakage’ experience?

![Figure 1: Effect of pipe replacement on leakage at Tokyo Waterworks Bureau (Source: Masaru Sakuma, JWWA)](image-url)
Vitens NV, the largest water company in the Netherlands, a country with traditionally low leakage levels, created an ‘Innovation Playground’. It set a goal to explore and invest in the development of intelligent water supply -testing new monitoring technologies, sensors and ICT solutions, and using social media like Twitter and Facebook for reducing leak awareness time and for faster leak response strategies.

**CHANGE MANAGEMENT**

For many other companies leakage is still a big issue. Irish Water has recently been formed by the amalgamation of 34 water companies and local councils. Customers are not used to paying for water – and leakage levels are twice those of UK water companies. The challenges - and barriers to change - facing this company, and compounded by the introduction of customer metering, are huge. A change management programme is particularly appropriate, both for communicating with customers and changing their perceptions on introducing a company-wide customer metering programme – and for reducing leakage to an acceptable level.

Another company undergoing a change management programme to address Non Revenue Water (NRW) is CAGECE, the Water company of Ceara, Brazil. The company first started using a computerised loss control system (Siscope) in 2005 to improve network operations and leakage management (Figure 2). Teams were set up to find unreported leaks, to prevent theft of water, and to replace ageing customer meters. This was a big step for the company, involving many activities within a change management process.

![Figure 2. CAGECE leakage team finding unreported bursts (source: Monika Konatar)](image)

Kisumu Water Company, Kenya, has embarked on a programme of self analysis - analysing barriers, encouraging change, and moving forward with a performance improvement plan.

The company acknowledges in their 2012-2016 strategic plan that NRW is one of their major weaknesses, and is concerned that the loss of 53% of system input costs the utility over US$ 1 million per month. The audit revealed some performance gaps in NRW management and scope for internal system improvements. Based on the audit findings, key action plan recommendations have been proposed.

**CALM NETWORKS**

With the increasing use of ‘smart’ sensor technology to receive and manage data from all parts of the network faster and more efficiently, water companies are moving towards ‘calm’ networks to reduce pressure transients and stress in the pipe network.

All valve operations, pumping routines and pressure management systems are set to operate at the optimum level - for energy efficiency, pumping efficiency and pressure management, including the monitoring and elimination of pressure transients by high speed continuous pressure transient measurement.

Two examples of calm networks are Mantova water utility, Italy, and Bahamas WSC. Network calming has been progressively implemented in Mantova, using network models to redesign and introduce optimisation of pressure management areas and the creation of DMAs. Bahamas WSC is implementing a long-term programme (10 years) of automated pressure management reduce transients and bursts in a fragile network, and to significantly reduce water losses, the major cause of system inefficiency. The achievement of 24/7 service is a key step in connecting more people to the existing water supply network with improved water service.

An innovative programme for calming networks is being introduced by Bristol Water, UK. ‘Dynamic’ DMA Management means breaking away from traditional DMA design by using open DMAs - boundary valves closed at night and open during the day - combined with high speed data logging to rank DMAs in order of resilience.

**REAL TIME LEAKAGE MONITORING**

Becoming aware of a leak before it propagates into a burst is essential for cutting down the time a leak can run, up to the time of repair. One company has taken this concept a step further, by combining real time leakage monitoring with in-pipe repair technology. Hagihon Company Limited (Jerusalem Region Water and Wastewater Utility) uses continuous on-line multiple leak detection via fixed and mobile sensors, precise leak location via a smartphone app and mobile sensor, and an innovative non-destructive in-pipe repair technology. Highly sensitive, acoustic vibration correlating sensors are installed on fire hydrants (Figure 3). Daily correlation analysis by a learning algorithm can identify potential leaks of 1.5mm.

**SMART ASSET MANAGEMENT**

As well as faster leak awareness time and ‘find and fix’ times, accurate records of underground assets are crucial for driving down leakage to lower levels. This means faster awareness times - identifying leaks as they propagate - but how quickly can you become aware of a leak? The latest technologies available today introduce the ‘smart’ concept to the management of buried assets, both today and into the future. Case studies illustrating...
three different uses of smart asset management are on the Global Leakage Summit agenda:

With 1500 flights a day and 7 million passengers a month, Heathrow Airport is the UK’s hub airport and the major European airport. It is the size of a city with all the problems of a dense buried infrastructure. Heathrow has a £0.5 billion asset management programme, part of which involves RFID tagging of buried assets. The solution for underground utility detection, verification and location involves recording asset locations using tablets and smartphones integrated with RFID markers, creating, uploading and saving records of underground utility data to a cloud database and relocating the RFID marker to provide ‘spade-width’ accuracy.

Working with a leak detection contractor Dwr Cymru Welsh Water has developed ‘Work Mobile’ - a mobile leak detection fleet for efficient integration of asset location, leak detection and work planning. The system has revolutionised the way data gathered in the field links to GIS and corporate systems – for efficient integration of asset location, leak detection and contractor work planning.

Anglian Water had seen an increase in bursts between 2008 and 2012 – they could see there was a connection between changing weather patterns and burst rates but could not prove it. A project using independent consultants, including the Met Office and Cranfield University, analysed soil types and recent weather patterns in the region, in an attempt to explain how water mains are affected under more extreme weather conditions.

**INTEGRATED DATA MANAGEMENT – HANDLING ‘BIG’ DATA**

There has been an evolution in sensors and communication systems for flow and pressure management - and other parameters in the network such as weather data, customer use patterns etc. However, the question facing all utilities, and highlighted in other presentations at the Global Leakage Summit, is:

If a water utility continuously receives ‘smart’ information and data from the network, how does it cope with all this ‘big data’ coming in? And how does it handle and interpret the data to collate it into an end result? Smart water metering will undoubtedly be a part of any enhanced sensor network. But how will smart metering be utilised to solve company specific problems?

Sutton and East Surrey Water (SESW) is one of the UK companies that has been addressing this question with its ‘Vision of Networks for the Future’. The company is developing a Smart Network built on four platforms:

- Enhanced Sensor Network – for greater sensor density and variety
- Enhanced Communication – the use of long range radio to provide information backhaul
- Enhanced Data Processing - the use of big data techniques to understand the information
- Enhanced Display - the use of innovative mapping solutions to display information

SESW is also working towards using smart meters to optimise customer demand patterns by the use of tariffs and incentives. This will potentially minimise customer energy/water costs, help the company manage demand and to better interpret night flows.

At Bangalore Water Supply and Sewerage Board (BWSSB) the level NRW in the distribution network is 45%. BWSSB worked with IBM India to create an operational dashboard, based on the IBM Intelligent Operations Centre (IOC), which serves as a ‘command centre’ for monitoring, administering and managing the city’s water supply networks. The IOC solution incorporates GIS for a real-time view of flow meters, allowing large changes in flow rate to be detected.

EPAL is the water utility that serves Lisbon, where the Water Efficiency Network Optimisation (WONE) Medicação methodology has been implemented. WONE combines network monitoring and customer monitoring and has delivered significant water loss reduction, including continuous telemetry monitoring of the distribution network, active leakage detection based on practical performance indicators, leakage estimation and repair validation in-house using software application and a customer alert system (Waterbeep) for identifying changes in consumption patterns and customer-side leakage.

**PLASTIC PIPES PANEL**

Can we ‘design out’ leakage from pipe networks? We have new plastic pipe materials but we still have to make joints and service connections – and there are failures. But what is the extent of these failures and what can be
done to minimise them? Are the problems exacerbated by the pricing structure in a competitive market?

Is the answer to extend the workforce and skill base, improve pipe laying and jointing techniques, provide more training and certification and have better quality control and supervision? Two UK companies present their view:

Bristol Water focuses on the ‘partnership view’ – working together with its Network Maintenance contractor to reduce the risk of PE failures;

United Utilities demonstrates how to make plastic pipes ‘leak free’. The company had a successful independent audit with very few PE pipe failures. What’s the secret to success?

**THE 2015 GLOBAL LEAKAGE SUMMIT**

All of these questions, and more, will be debated at the 2015 Global Leakage Summit, 17-18 March 2015, at the Thistle Marble Arch, London, with a pre-conference workshop on 16 March. Now in its 7th year, the Summit continues to disseminate state of the art concepts and technologies for this speciality topic: http://www.global-leakage-summit-2015.com/ or write to: malcolm.farley@lbcg.com

‘First published in Water 21, February 2015’
In inland areas, most consumption and leakage from public water distribution networks eventually returns to surface or ground water, but at different locations from its original source. Treating raw water to potable standards, and moving it to where it is required, requires significant capital cost and energy. High consumption and high leakage are now both receiving increasing attention throughout Europe, to promote water conservation, safeguard the environment, and reduce energy embedded in potable water.

The structure of the European water industry varies widely from one country to another. Some countries have several thousand water supply organisations, others have relatively few (e.g. UK 25, Netherlands 10). There is a mix of public and private ownership, and water utilities vary in size from those supplying a few hundred customers, to several million. Some utilities provide water and sewerage services; some water only. Some are responsible for abstraction, treatment and distribution, whereas others manage the distribution network only. The limits of responsibility for underground pipework ownership are different, depending upon the location and extent of customer metering.

In some cases, e.g. Scotland, Malta, there is a one-to-one relationship between Water Utility and primary regulator, but it is more common for a regulator to deal with many organisations. Regulatory functions may be split between different organisations responsible for quality, environment, price, and service; or they may be combined into a single body. Other legislation and policies, varying from one country to another, affect the performance that can be achieved. In 2014, despite increasing use of the IWA Standard Water Balance in Europe, there was no common agreement on choice of the most meaningful and appropriate leakage performance indicators for setting targets, or tracking progress, or comparing performance within and between, Utilities and countries.

In 2014, as part of the Work Programme 2013-2015 of the Common Implementation Strategy (CIS) for the Water Framework Directive (WFD) and Floods Directive, the Working Group Programme of Measures (WG PoM) was asked to work with the EU water industry to accelerate and spread good practices on leakage management. The objective was to raise attention and increase knowledge and thereby allow Member States to identify whether action is needed, and if so, provide guidance in doing so effectively.

A drafting group of the WG PoM, with policy makers, economists, environmental experts, and non-revenue water (NRW) experts including members of the IWA Water Loss Specialist Group, prepared three EU Reference documents “Good Practices on Leakage Management” (Main Report, Case Study Document and Dissemination Plan). Input and peer review were received from various stakeholders (e.g. EurEau) and discussions in WG PoM.

The 25 policy recommendations and other material in the Main Report summarise evidence based good practices, supported by consolidated findings and analysis of 16 diverse Case Studies from 14 European Countries, and proven practical concepts.

The 25 recommendations, which are not legally binding obligations for Member States, recognise that sustainable management of leakage requires a thorough understanding of the complex interplay between the many key technical factors influencing leakage, together with other Political, Economic, Social, Technological Legal and Environmental (PESTLE) factors. There is no ‘one size fits all’ solution. Ten of the policy recommendations are for all Stakeholders; 7 for Policy Makers and Regulators; and 8 for Utilities.

The Main Report, Case Study Document, Dissemination Plan, and ‘At a Glance’ 2-page leaflet containing further information, and other relevant material are available free of charge through the web links at the end of this article.

The Case Studies

The Case Study accounts used in the development of the main report are:

Properties with roof storage tanks on Malta
Empowering people by transfer of knowledge and solutions, at the office and in the field

The Case Study document (161 pages) begins with a summary of key issues relating to ‘Leakage from a Water Utility Point of View’. This is followed by ‘What Can be learned from each Case Study Account’, in which there is a short introduction with bullet points highlighting key issues arising from each Case Study. This is followed by five summary Tables of Context statistics for all Case Studies:

- Case Study Account River Basin, availability of water, sources and bulk supplies;
- Utility/System Infrastructure, pressure/pressure management, repairs, ALC/DMAs;
- Assessment of Annual Leakage Volume: Sources of data used for assessment;
- Energy, Economic and Regulatory information;
- Assessment of Annual Leakage Performance.

Power Point presentations of the Case Studies for Austria, Belgium, Italy, Malta, Portugal and Mentoring (Serbia and Croatia) can also be downloaded free of charge (see web links at the end of this article).

The full Case Studies then follow, mostly in a standard format summarising relevant data and information in a structured manner, and mostly using a customised Excel Worksheet for calculating the IWA Water Balance and Performance Indicators. This clearly identifies bulk imports and exports, and shows both System Input Volume (including water exported) and Water Supplied to a distribution system (excluding water exported). The formula used for Unavoidable Annual Real Losses is in volume per year, and uses total service pipe length, main to meter, which is the data format most frequently available in Europe.

The data and information template, together with a free Excel Workbook (EURWB&PICalcs) which now includes some relevant aspects of the Main Report recommendations, could be used by other European Utilities and countries which have not yet contributed Case Studies in the structured manner used in this study. (see web links at the end of this article)

The Case Study document concludes with two articles from the Netherlands:

- ‘Comparison of Flow pattern distribution method’ and ‘Advanced Network Modelling’.

The Case Studies suggest that European countries roughly fall into three categories:
- Those using a mature approach to leakage management for 20 years or more;
- Those with some Utilities which are now actively identifying significant leakage reduction opportunities and achieving large sustained reductions in leakage;
- Those which need to reduce excessive leakage, and which have yet to embark on a significant leakage reduction programme.

As a result of this diversity, water regulation varies from country to country. There is no standard method of estimating and reporting leakage, setting targets for leakage, monitoring progress or comparing performance between and within Utility systems.

Many of the Case Studies clearly demonstrate sustained substantial reductions of annual leakage volume using combinations of practical techniques and analysis concepts promoted, and in some cases developed, by the IWA Water Loss Specialist Group. Several of the Case Studies reinforce the conclusion that the sequence of application of the techniques is very important. Management of excess pressure is confirmed as the foundation of effective leakage management, and choice of ‘fit for purpose’ performance indicators is fundamental to measuring and monitoring progress and performance.

The Main Report

The Main Report (116 pages) consists of:
- Table of Contents, List of Case Studies, Acknowledgements, Terms and abbreviations;
- Section 1: Introduction: outlines the Background and Structure of the Reference documents, with a European perspective, and provides for a Dissemination Plan;
- Section 2: Policy recommendations: 25 Policy Recommendations reflect key underlying dynamics of leakage, and form a basis for successfully addressing leakage management and performance. Effective implementation requires specific, local expert actions;
- Section 3: Holistic approach to leakage management: outlines environmental, political, social, economic,
technological, legal and regulatory perspectives;

• Section 4: Understanding leakage and Leakage management: Leakage management from a Utility viewpoint; technical background; 4-component approach (pressure management, speed and quality of repairs, active leakage control, infrastructure management and design, performance indicators for leakage;

• Section 5: Good practices on leakage management by Utilities: what can be learned from each Case Study, and Case Study summary tables;

• Section 6: Methodologies for getting started: Water balance and night flow analysis; guideline maximum defaults for assessed NRW components; ‘fit for purpose’ Zonal performance indicators; system size categories; UARL and ILI/Snapshot ILI for initial evaluation of priorities; European ILI data set; using combinations of ILI, Pressure and Burst frequency for further analysis; getting started in small systems; additional PIs and context indicators; getting started in larger systems; preparing a business case; setting targets; preparing programmes; leakage management is forever;

• Appendices A1 to A4:

• Political, Social, Economic, Technological and Environmental Perspectives;

• Appendices B1 to B9: Tools, technologies and methodologies

• Simplified Water Balance; Intended consequences of using % SIV as a leakage PI; Pressure management; Major reference documents; WION to prevent real losses in the Netherlands; USTORE and spatial analysis; Benchmarking of Water Utilities; Performance-based contracting; Marketplace for innovative ideas;

• Appendix C: Author profiles;

• Appendix D: List of references.

‘Fit for Purpose’ Leakage Performance Indicators

Inappropriate traditional performance indicators are still widely used in Europe. There has been no consistent logical Europe-wide approach to setting leakage targets, tracking progress in individual systems, and comparing technical performance of different systems. In fact, no single leakage performance indicator can adequately meet all these objectives Policy recommendations B, E, F and G are summarised in the following Table:

Leakage expressed as a % of System Input Volume is simple to calculate, but has several limitations in interpretation, as seen in Appendix B and the Belgian and Bulgarian Case Studies. Some EU Member States have already stopped or reduced use of % of SIV as a leakage performance indicator. It is a ‘Zero-sum’ calculation, which cannot identify actual decreases in both consumption and leakage volume in the same period, leading to under- or over-estimation of true achievements in reduction of leakage volume.

Reduction of excess pressure is the foundation of effective leakage control

Pressure strongly influences burst frequency and leak flow rates on mains and service connections, expenditure on active leakage control, and repairs and asset replacement costs. The basic foundations of effective leakage management are the management of excess pressure and pressure transients, and limiting the run time of all detectable leaks whether reported or unreported. The sequences in which pressure management, active leakage control, leak repairs and pipe replacements are carried out is very important, if wasted expenditure is to be avoided (see Bulgarian Case Studies). Design of highly sectorised distribution systems to operate effectively at comparatively low pressures can produce remarkably low leakage levels of leakage (see Danish Case Study).

<table>
<thead>
<tr>
<th>OBJECTIVE</th>
<th>GOOD PRACTICE PERFORMANCE INDICATOR FOR LEAKAGE, FIT FOR PURPOSE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Volume per year</td>
</tr>
<tr>
<td>SET TARGETS AND TRACK PERFORMANCE, FOR AN INDIVIDUAL SYSTEM</td>
<td>YES, for large systems</td>
</tr>
<tr>
<td>TECHNICAL PERFORMANCE COMPARISONS OF DIFFERENT SYSTEMS</td>
<td>NO</td>
</tr>
<tr>
<td>DRAW GENERAL CONCLUSIONS FROM SINGLE OR MULTIPLE SYSTEMS</td>
<td>NO</td>
</tr>
</tbody>
</table>

* Choose services connection density > 20/km; if not, choose mains; or base choice on country custom and practice
Guidance for ‘Getting Started’ requires consideration of system size.

Case Study systems range in size from 700 to 2.3 million service connections. A sequence of economic leakage management actions for ‘Small’ Systems (less than 30000 service connections) can usually be identified systematically and quite quickly using combinations of the PIs and context factors in Section 6. Very small systems (less than 3000 service connections) can achieve very low technical leakage levels (ILI < 1.0, see Austrian Small Utilities Case Study).

For larger systems with more than one separate water supply system, there should be some method of prioritising Zones for investigation and action, taking water resources considerations into account. Analysis of sustainable economic level of leakage (SELL) can produce very different target leakage performance for individual Zones (see Scottish Case Study). These are then added to get the Utility leakage target in volume terms.

Dissemination Activities October 2014 to June 2015 (new draft by AL)

Web links to access free copies of documents, and associated material are as follows:
EU Reference Documents: https://circabc.europa.eu
How to access EU Reference Documents on circabc.europa.eu; ‘At a Glance’ Leaflet; Case Study Power Point presentations, Standard Case Study Format.
EUWB&Picalcs http://www.leakssuite.com/eu-good-practice-on-leakage-management/

Presentations at Conferences and Workshops
Romania: IWA Regional Conference Water Loss Management, June 2015, Bucharest,
USA: IWA International Conference Efficient, April 2015, Cincinnati, (Ohio)
UK: SWAN Smart Water Networks Forum 5th Annual Conference, April 2015, London
UK: SMI Conference on Smart Water Systems, April 2015, London
UK: CIMEM NW & North Wales, Leakage Management meeting, Feb 2015, Warrington
UK: SBWWI Leakage and Metering Conference, December 2014 Kenilworth
Italy: IWA Conference WaterIDEAS2014, October 2014, Bologna

Allan Lambert
Lambert A, Charalambous B, Fantozzi M, Kovacs J, Merks C, Trow S
Final Draft 1e dated 23rd February
MANAGING WATER LOSS CONTROL TEAM
IN WATER UTILITY COMPANY
IN CONTEXT OF SOUTH EAST EUROPE

Abstract

Water loss control activities in our water utilities in South-east Europe are still oversimplified and without proper recognition and support from top management level of the utility company. This neglected position of people responsible for leak detection and other task related with water loss issue has for outcome low motivation and insufficient results in water loss control activities.

In addition, we have problems of inappropriate staffing, lack of education and regular upgrades in new knowledge and skills, non-existing communication among practitioners from different water utilities, poor communication within own company, etc..

Most important problem in these circumstances is undeveloped water loss control program. Without proper motivation, organisation and leadership it is hard to expect results and most importantly wide, complex and efficient strategy.

In this paper our intention is to address this issue, present overview of typical problems in water utilities in South-east Europe, but also examples from successful water utilities from our region and how they managed to solve this problem.

As one of key tools for needed improvements is presented concept of Change Management and how it can be used for improvement of status for teams (people) within water utilities responsible water loss control activities.

Key elements of implementation of change should have following elements;

• Awareness – why change is needed
• Desire – motivation for change
• Knowledge – resources for change
• Ability – how to implement change
• Reinforcement – support the change

At the end are our opinions regarding following question related with water loss control teams in the utilities;

Who must be subordinate to the organisation chart?

Who should lead this office?

What powers should have?

What performance indicators would be good to have?

What personnel and what equipment is needed?

Keywords

Water Loss, Team, People, Organisation, Support, Change Management

INTRODUCTION

Managing water loss control team in water utility company in context of south-east Europe is important to recognise in two levels of practical (effective) influence; managerial level and field workers level, and each side has different positions, influences and drivers for action. Positions of these two levels will be analysed in this article and how to improve current practice. Crucial part for successful improvements is communication with top managers and regarding this element will be given some ideas for consideration. Here is important to mention that awareness regarding losses issues from top management level is often very limited from couple of reasons; most of these people are politcally elected (water utilities are public companies owned by local municipalities), with short period on top position (often 4 years), with limited knowledge about water distribution issues (and about water losses even less) and often without managerial skills. Considering these divisions and circumstances it is not surprising to witness high level of losses and slow process of development.

Another important issue is technical improvement of the distribution system (introduction of DMAs, pressure management, monitoring, etc.), but these elements of water loss control in this paper will be addressed in relation with human resources. Our main focus are people and their effectiveness.

SITUATION TODAY

Water loss control activities in our water utilities in South-east Europe are still oversimplified and without proper recognition and support from top management level (general managers-directors) of the utility company. Typical circumstances can be presented in couple of groups;
Organization
- prevailing passive leakage control (dealing only with reported leaks)
- in large utilities present dedicated teams for leakage control but without strategic planing (also often only dealing with reported leaks)
- in small utilities often non-existent dedicated teams for leakage control (technicians responsible for various tasks)
- in general without proper coordination with other parts of the utility
- without proper documentation (maps, records, data bases)

Equipment
- old and insufficient equipment (often only ground microphones, occasionally leak locating correlators, rarely mobile flow meters, pressure loggers, pipe locators)
- without programs for regular renewal of the equipment
- equipment used with minimal capabilities - for example no use of sound filtering on listening equipment
- advanced equipment (flow meters, pressure loggers) if present is rarely used
- Knowledge
- without knowledge beyond personal experience (based on field work)
- familiar with basic functions of the equipment
- without advanced knowledge in water loss control (IWA methodology)
- without education programs
- without opportunity to participate on conferences and fairs
- Communication
- without dedicated reports
- without regular meetings
- without strategic programs and plans
- Rewarding - salaries
- often people responsible for leak detection have same salaries as other technicians (plumbers)
- without rewarding program
- This neglected position of people responsible for leak detection and other tasks related with water loss issue has for outcome low motivation and insufficient results in water loss control activities.

Low motivation leads to bad habits and in many utilities is present attitude among people that can be present with following statement “you can not pay me as little as I can work little”. In addition even if someone (managers) want to introduce and implement changes (improvements based on new approach, organisation, discipline, control) what they will face is strong resistance from workers (why change, do we have any benefit from it, anyway our working position is not in jeopardy considering we are employees in public company with strong protection from workers unions).

In addition, we have problems of inappropriate staffing and non-existing communication among practitioners from different water utilities.

Most important problem in these circumstances is undeveloped water loss control program. Without proper motivation, organisation and leadership it is hard to expect results and most importantly wide, complex and efficient strategy.

First important step forward in changing current situation involves recognition of it. Presented groups of problems is also list of opportunities.

HOW TO IMPLEMENT CHANGE

As one of key tools for needed improvements is concept of Change Management and how it can be used for improvement of status for teams (people) within water utilities responsible water loss control activities. We have available many models for change management and for this paper we would like to present ADKAR model. This model was tested by one of coauthors (Jurica Kovac) in number of utilities and it has been proven to work.

Key elements of implementation of change should have following elements:
- Awareness – why change is needed
- Desire – motivation for change
- Knowledge – resources for change
- Ability – how to implement change
- Reinforcement – support the change

Manager can use this model to identify gaps in change management process and to provide effective coaching for employees. The ADKAR model can be used to:
- diagnose employee resistance to change
- help employees transition through the change process
- create a successful action plan for personal and professional advancement during change
- develop a change management plan for your employees

It is important to realise that change needs to be implemented following series of steps, that will lead to desired goal. In implementing change we will need change champion. Someone within the utility who has understanding and leadership position. This person (usually mid level manager already involved in maintenance issues and responsible as well for water loss control activities) will have so called 360 degrees influence; leading change process and influencing people in all directions considering company structure (workers below, other managers in his level and top manager(s) above him).

1. Awareness – why change is needed
It is necessary to inform people about reasons you believe the change is necessary. Review these reasons and rate the degree to which the person you are trying to change is aware of the reasons or need to change (1 - 5 where 1 is no awareness and 5 is total awareness).

Our goal is to rise level of understanding that losses are important among all people in the water utility. People first need to understand why change is needed (and with special emphasis on perspective what will happen if we do not change).

2. Desire – motivation for change
Next step needed is to list the factors or consequences (good and bad) for each person (involved in change process) that will create desire to change. Consider these motivating factors, including the person’s conviction in
these factors and the associated consequences. Rate his/her desire to change on a 1 - 5 scale.

In respect to water losses we can motivate workers that new approach will lead to less reactive activities and more proactive and preventive activities, and in this way reduce stress and urgency of activities. Also new approach will make work they do more interesting and even lead to promotional opportunities. Important aspect to create desire must be development of benefits measures (rise in salaries based on results, other benefits like free days, rewards like opportunities to go on conferences and seminars). Regarding those above measures (top managers), they will have improvements in company functioning, reduced costs, better costumers relations.

For people to change, they need internal drivers (motives) and this way we can reduce resistance to change.

3. Knowledge – resources for change

Next step involves building capacities among people with skills and knowledge needed for new approach in work. List the skills and knowledge needed to support the change, including if the person has a clear picture of what the change looks like. Rate this person’s knowledge or level of training in these areas on a 1 to 5 scale.

In this area evidently IWA methodology should be foundation for knowledge build-up, but also we need to expand and integrate additional new know-how (for example here presented Change Management methods, general company management, document management). Of course important will be also new skills about technology (DMAs, pressure management, measuring, monitoring, leak detection, pipe location, GIS, mathematic modelling, AMR).

4. Ability – how to implement change

Considering the skills and knowledge identified in the previous question, evaluate the person's ability to perform these skills or act on this knowledge. Rate this person’s ability to implement the new skills, knowledge and behaviours to support the change on a 1 - 5 scale.

Here is very important understanding of required time for implementation. Learning and applying new skills and knowledge takes time. Use of new technologies requires investments. We need to have clear vision and strategy (plan) how to implement change, what are the goals, how we will know when we reached them (performance indicators, evaluations, milestones). We are living in a constantly changing environment (new knowledge, new technologies, economic situation, social situation, political influences) and our capacities for adaptation and flexibility will be very important.

5. Reinforcement – support the change

This is critical element of change. Without carefully planned and then dedicatedly implemented reinforcement plan, previously conducted steps can fall short. List the reinforcements that will help to retain the change. Are incentives in place to reinforce the change and make it stick? Rate the reinforcements as helping support the change on a 1 to 5 scale.

Within reinforcement elements most important is support from top manager (general manager of the water utility). With his/her support we can count on structural change needed within the company, finances, guaranteed rewards scheme, improved communication (regular meetings, practical use of performance indicators) and recognition that our measures and activities have purpose.

In majority of water utilities in our region involvement of general managers creates difference between successful and unsuccessful companies. This issue is very delicate especially considering that many general managers are politcally elected to manage public utilities. Here we can advise following; first of all water losses (and with losses related repair works, lost income, high maintenance costs, etc.) must be presented through financial perspective (not just in m3 but also in Euro or local currency). Next step is to establish regular update of informations regarding costs produced by high water losses (monthly balance). Then, regularly we must present success examples and financial outcomes (with cost-benefit analysis). Change Champion must realise that he/she is the only one who can do this promotion toward top manager. No one can or has capacity for this. Eventually one alternative exist; to hire outside consultant/expert who will influence top manager. This is often very successful option. Reason for this is rather simple and sometimes absurd; top manager has high level of distrust in lower management and in combination with own arrogance and low level of personal knowledge in the subject of water losses creates impossible conditions for change. Here can be very important role of outside consultant (beneficial will be water loss expert/ or company, but who has also knowledge in change management), since he comes with credentials and can overcome communication disfunction within the utility.

IMPLEMENTING CHANGE

When we have defined and organised Change Management process as described in previous chapter, next phase is implementation.

Implementation should be organised with following elements:

1. Making sense of change

We must be result oriented what in water loss management is easy to do. Important to mention is that anticipated results must logical and rational (do not overestimate your capabilities, this can ruin your credibility toward top manager). Start small, build experience and confidence, build trust from top manager, build communication channel.

2. Using tools for change

We must be aware that some management tools are necessary for successful change process. Here is list of them (many tools exist and here is possible selection, for more research Project management);
Planing
• Roles and responsibilities
• Time
• Finances
• Communication plan
• Sponsor roadmap
• Coaching
• Resistance management
• Training

Explaining each of these tools is beyond scope of this paper, and those of you interested will need to look for explanations in widely available management resources (Google is best place to start).

3. Measuring progress

We just need to measure, monitor and gather data, produce PIs and evaluate results after particular improvement measure was implemented (volumes of water, burst frequency, financial aspects, KPI - for guidelines use IWA Performance indicators). We must have ability to compare situation (PI) before and after some measure was implemented. So, start measuring and data collecting as soon as possible (before starting to change things). This way you will gather valuable data to compare with when results come.

4. Gaps diagnostics

In previous chapter was advised to evaluate people regarding ADKAR model. Use this evaluation (from 1 to 5) to analyse gaps. This will help you to understand difficulties and to consider different options. It is necessary to develop gap monitoring plan.

5. Corrective actions

For every problem exists solution. Important advise; develop good communication channel between all sides involved. Most of the problems in companies are related with poor communication and misunderstanding.

6. Create Change Managers

Recognising people within you company with capacities and motivation to lead change process is very important. Creating change process is one thing (and can be initiated and developed by one person), but running it is different. We need more people motivated to take responsibilities and even more important, those who will take initiative. Every person is important, no matter what position he/she holds. Good ideas and recommendations can come from anybody. Those people must be rewarded and encouraged (important element of Reinforcement planing). The more people rise-up to the level of change developer, higher more chances your plan will proceed and accomplish long term sustainability (and goals of course). Having more people actively involved (not as passive executors) improves one of the key elements in any project - communication.

7. Results recognition

Public recognition for accomplished results is final and also critical success factor. Contributors in success must have public recognition in own company. Here is again important role of top manager. He/She must express satisfaction and admiration with people (teams and whole departments) who have accomplished good results. This should be done each year, and if and when particular projects are finished and results are know. In water utilities is complicated to establish good financial reward scheme, and minimum what can be done very easy (and with no costs) is to have public recognition.

Of course this needs to be based on clear rules and with consideration regarding all employees in the utility. Best way is to establish PIs system for each employee and function, and emphasis should be given to those who have added value to their work (innovation, motivation, etc.). Evaluation should be organised in a way that beside PIs, additional values can be rewarded from colleagues, supervisors and coworkers.

EXAMPLE OF SUCCESS

Pula Water Utility, Croatia, 900 km network

Equipping, organising and training personnel (trainings, seminars, conferences, literature, etc.) for activities of leakage detection are part of the regular annual improvement program and are identified from year 2004 as a key element of the strategy. The management of the company has a clear understanding that only trained, organised and motivated people can achieve results, and technology is only a tool that can help in that. Communication among key managers and with general manager is regular (daily) and proactive.

Leakage control has been organised using a special service team for leakage control fieldwork (2 teams with 4 workers in total). They use all today available equipment; ground microphones, correlators, mobile flow and pressure meters, pipe locators. Important to mention is that ground microphones and other frequently used equipment is regularly replaced every 5 years.

Targeted night-time acoustic testing of pipelines is carried out extensively each year in May and June; the oldest parts of the system and elsewhere where frequent leaks were detected are necessarily examined. These tests are conducted by a team for leakage detection and another team works during the day to resolve reported leaks. The rest of the year two teams cover the activities of leakage detection and unreported leakages i.e. monitoring the DMA zones (and testing in zones when an increase in the minimum night flow is noticed).

Results

From 2004 till 2013 NRW was reduced from 34,5% to 22,8%. Considering problems in presenting losses in %s Waterworks Pula introduced use of other indicators based on IWA methodology (ILI, CARL in litres/service connection/day) and for 2013 ILI was 2,9 (among the best waterworks in Croatia). The volume of NRW in 2004 was 3,77 Mm3, and in 2013 it was 1,94 Mm3, making a difference of 1,83 Mm3 (48,5% savings in volume), but making also a financial impact by reducing expenses for more than € 700,000 in one year!
Water Loss Management is complex and continuous activity. For utilities to succeed (and that means to maintain losses on acceptable level) it is important to recognise that people make change. Technology helps, but without good and motivated people there is no long term success.

Here we have some general recommendations for water utilities;

**Importance of Water Loss Team**

In todays water utilities becomes evident need to have permanent Water Loss Control Teams. In small utilities maybe this team requires only one or two persons, but it must be recognised that water loss control is one of most important activities in any water utility.

Top Managers must realise that water loss control is not just leak detection, but today involves many additional activities like; flow and pressure measuring, pressure control valves control and maintenance, data gathering, data analysis, reporting, use of advanced tools like GIS, SCADA, AMR, involvement in network design (DMAs, PMAs, pumping protocols, measuring locations) etc.

**Position and Influence**

Water Loss Team should be part of Maintenance Department or closely related with it. In addition, people responsible for water loss control should be actively connected with Planning Department since they have first hand experience with the network and can give valuable recommendations in new network design (and reconstruction of existing network).

As mentioned before, active communication (horizontal and vertical) is crucial and from this point everything else proceeds. So water loss team members or leader must have excellent and regular communication up to the top manager in the water utility.

**Leadership and staffing**

It is advisable that jung engineer (technical sciences) lead water loss team, considering complexity of responsibilities and needed know-how, but in small utilities this role can be performed also by someone without university degree. Important to emphasise is that very important foundation for anybody involved in water losses is good knowledge about water network (pipes, valves, basic hydraulics) and perfect solution to start with, is to have older employee who knows network well and new jung employee who is friendly with new technologies and computers. To become expert in water loss control takes time (couple of years).

Number of people in a team depends on the network size, complexity, level of losses, number of DMAs, pressure management, available leak locating and measuring technology, level of knowledge, costs, etc. For sure 2 persons is minimum and maximum is relative as mentioned.

**Equipment**

In todays conditions and with networks becoming larger and older various technology is needed for water loss control teams. Following equipment is necessary;

- Ground microphones
- Leak locating correlators
- Mobile ultrasonic flowmeters
- Mobile pressure loggers
- Metal detectors
- Pipe detectors
- Leak noise loggers

Number and variations for mentioned equipment depends on the network and people responsible. Important is to have established policy of regular replacement of old or used-up equipment (for example for ground microphones every 5 years, for correlators every 5-7 years, mobile meters every 7-10 years).

**Education**

Education must be constant and planned. Our water networks become more complex every day, and in the same time technology we use for water loss control become more sophisticated as well. Water loss issue requires various know-how and time factor is very important (personal practical experience).

**Performance indicators**

Various performance indicators can be used (for more details see IWA PIs), depending on level of development in particular water utility, but for beginning key numbers to look for are; volumes of water according to IWA water balance, ILI, CARL, pressure, MNF.

Very important is to collect data about leaks (reported and unreported) and establish Burst Frequency Index for pipes and service connections.

**CONCLUSION**

Managing Water Loss Control Team in Water Utility Company in Context of South East Europe is very complex issue. High water losses we have here are mainly related with neglected position and importance of people responsible for leaks detection.

It is possible to change this situation and we gave some recommendation how this can be done.

It is important that key people and top managers in water utilities realise that water loss control teams are essential and crucial for successful control and reduction of water losses. Companies who are successful in water loss control have very good management in all aspects of water supply and water loss control teams are highly valuable and respected.

**Alin Anchidin*, Jurica Kovač**

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MANY PEOPLE FAIL BECAUSE THEY DO NOT REALIZE HOW CLOSE THEY ARE TO SUCCESS. THE LUCK HAS TO FIND YOU WORKING
ROMANIAN WATER LEAK DETECTION CONTEST

Veni, vidi, vici
21 teams from water companies in the country have competed on 13-14 May 2015, at the eighth edition of the Contest for water loss detection, organized by the Romanian Water Association through the Centre for professional training in the water field. Apserv Satu-Mare, winner of last year’s edition, hosted the contest, that has become a tradition for the Romanian companies in the field of water and sanitation.

There is an interesting detail related to this edition of the event, namely that the first edition was held here in 2008. The promoter of this competition, George Sava, technical director at the time for the company Apserv of Satu-Mare recounts what happened: „In 2008, when I had the idea for this national contest, I was in Sibiu, at a workshop dedicated to water losses, supported by Andy Bowden in England … Along with Mr. Vasile Ciomoș, president of the Romanian Water Association at the time, I started this project, which apparently was a success, being among the few or only one of its kind in Europe. Mr. Ciomoș, always receptive to new ideas immediately proposed its organization in Satu-Mare, being involved in popularizing and organizing this annual event. “

The Competition initially consisted of two trials – presenting the strategy to reduce water losses and a practical test on the ground, identifying the defects in three sections, as George Sava explained. From the 2008 edition, it remained customary that the winning company would host the next edition of the competition. And so the contest returned to Satu Mare, after 8 years.

What brought new 2015 edition
The novelty of this edition was the use of two devices on certain sections of soil type microphone, able to measure the distance at which the defect locates at an intermediate point to minimize the measurement error, and the local police presence at the trials location for circulation direction. A novelty was also the unplanned rain which hampered the hearing.

On the four sections each team had 30 minutes available to identify losses. There have been points that indicated noises and were found to be blind noise. Each crew was dotted and downgraded according to the results indicated. According to ARA Technical Commission President Ion Bica, the competition was difficult enough, but the teams entered in the competition were well prepared. „This competition is beneficial to all and helps us learn from each other. In a way, we are all winners. But we must do a hierarchy, and the mission of the jury was very difficult because all the teams were well prepared. The jury pointed downgraded the wrong things and well made. The competition from Satu-Mare was well organized and we thank the organizers „, added Ion Bica, at the opening of the awards ceremony.

And the award goes to …
If you were to look only at the final ranking, I remain under the delusion that this duel was won. In reality, each participant has something to gain from this competition has the opportunity to self-assess, to understand the specific situations identified or unidentified faults.

This year’s winners were Razvan Vaida, Balica Marinel Mirea Alexandru Rusu and Balea from Somes Water Company, closely followed by Aquatim team, winner of the first edition of Satu Mare in 2008. In third place, on equal points, were teams from Bistrita and Botosani. Since the difference is, most often, a few centimeters, it is fair to say that every competitor deserves congratulations!

Next year, Cluj will host the event, and on this occasion I propose that this competition to be named in the memory of CIOMOȘ Vasile, who along with Mr. George Sava initiator of the competition, made so popular and expected this event.

Nassim Nicholas Taleb, Black Swan: „Whenever I see a shirt with a picture of Einstein, I cannot help but think about the Poincare. Einstein deserves our bows, but he hid out shadowed many others. In our consciousness is very little space, it’s a place where winner takes all. “

Alin Anchidin
Water Loss Detectives
NON-REVENUE WATER ACTIVITY COMPARISONS IN ROMANIA, BULGARIA AND TURKEY

Prize for the „Detectives“ from Aquatim

The Water Loss Detectives, publication issued by the company Aquatim, was recently appreciated at the conference „Installations for construction and environmental comfort“, organized by the Association of Plumbing Engineers in Romania, held in Timisoara, 23-24 April. AIIR granted the distinction „Engineer Ioan Mut-Vitcu“ to the editors of the magazine The Water Loss Detectives, taking into account their work and the popularity enjoyed by the publication among the specialists.

The Water Loss Detectives is issued since 2011 and is addressed to specialists in detecting water losses, presenting information about events and opportunities for professional development, equipment used, the strategies applied and numerous case studies. The editorial team brings together employees of several water companies and higher education institutions in the country and is coordinated by Alin Anchidin, hydrotechnical construction engineer who leads the team of water losses detection in the company Aquatim.

Currently, the publication has been transferred into the online media, and the archive containing old numbers can be accessed on the website www.aquatim.ro, AquaŞtiri section, on the Romanian Water Association website, www.ara.ro, and from the portal dedicated to water loss, www.pierderideapa.wordpress.com. The Editorial Team consist of: Alin Anchidin, Loredana Leordean, Alexandru Aldea, Iulia Mihai, Florin Vasilache, Alexandru Manescu, Jurica Kovacs, Gh Constantin Ionescu, Ioana Alina Costescu, Mihai Badila, Lucian Laslo and others contributors....

The AIIR Conference for building installation is at the XXIV edition, addressing at issues in modern life namely environmental comfort, environmental protection and unconventional energies, providing a framework for the installation engineering specialists for exchanging opinions and information. The installation Engineers had also the opportunity to inform themselves about EU policies and regulations for energy efficiency in buildings, HVAC systems and energy efficiency of buildings in Romania.
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