Do we need NRW software for operators?

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Introduction

IWA best practices are very well developed, are used in many projects and many case studies have proved great success. Especially dividing network in DMAs and even simple work with measurement results have caused fast increase of NRW and leakage reduction efficiency in many companies. The operators usually have developed their own methodology for data evaluation in order to prioritize the leakage detection in DMAs with non-acceptable leakage level.

The approach, the usual used indicators and their target values are very varied in the Czech Republic and usually we can meet certain insufficiency in the process of permanent evaluation of leakage level in the DMAs compared to the IWA methodology. A large majority of Waterworks in the Czech Republic evaluate primarily NRW distribution in the DMAs based on the balance of inflow and invoiced water in time step of 1 or 3 months. Systematic evaluation of leakage level based on night inflow evaluation is quite exceptional. A check of flow diurnal patterns in SCADA is sometimes used, however it is usually not supported by an automatic process and it has become more demanding on the gradual increase of the DMA number.

The approach to the control of leakage detection actions based on such data differs a lot as well. Very easy performance indicators or principles are usually used for prioritization of DMAs. We can meet with evaluation and limit values of % of NRW, unit leak [$m^3km^{-1}year^{-1}$], % of night flow from day demand, etc. The operators usually can keep such targets quite easily in some DMAs and almost always have some DMAs where they cannot meet the targets even if they invest enormous effort. So, quite often is used strategy of “keeping of existing leakage level”, i.e. leakage detection is done in a zone with “significant” increase of NRW % compared to the previous time period. The operators usually miss answers to questions such as:

- What is the best performance indicator (or combination of PI) for control of leakage detection actions in our daily practice?
- Is the leakage level which we keep in a DMA low or high?
- We have quite different conditions in DMAs (size, density of customers, pipe materials, difficulty of leakage detection and preliminary survey, repairs cost, etc.). Are we able to have equal target indicators valid for such different conditions?
- Is it possible to link up the leakage reduction control to operational costs?
- Do we need special software for operators in NRW reduction process? Which functions should it have? What is the neighbourhood of such SW and what is the necessary level of linking?
- Are there needed different types of SW applications for different types of users and different regions?

The case studies

Knowing all the limits of existing methods and tools for leakage evaluation in real operational conditions, we have initiated the development of methodology and tool for

efficient operational evaluation of NRW. The development started in 2008 in close collaboration with North Bohemian Waterworks as a continuation of very successful NRW reduction projects. The resulting SW application Leakage Monitor serves for automate evaluation of leakage with stress on its economic aspects and daily evaluation of economic level of leakage in each DMA is used as main principle for control of leakage detection actions in the company. The application is implemented and used in daily practice of operators in cities Teplice, Chomutov and Usti nad Labem. The operational benefits can be evaluated from almost 2 years history of daily use by operators.
The practical example is used for demonstration of the operational benefits of the SW application, such as:

- Simplification of data collection and evaluation
- Automate data collection from many data sources related to NRW
- Sound methodology for control of leakage detection actions based on financial analysis and identification of economic leakage level for individual DMAs
- Combination of results of water balance and night inflow analysis
- Prove the operational cost savings
- Easy outputs in form of tables, graphs, maps, alarm messages etc.
- Flexibility in output modifications
- Linking to pressure optimization, planning of new DMAs and network rehabilitation planning
- Etc.

Principles and main benefits of the application

Leakage Monitor is a software and implementation for complex data collection and tasks solution connected with leakage evaluation, technical and economical optimization working as utility information system.

Leakage monitor runs all analysis and prepares all outputs automatically at chosen time (i.e. 5 AM). Evaluation of leakage in DMAs is based on analyses of measurement data by the SCADA system as well as from GSM and GPRS devices. Data are processed and stored in a central database. The results of the evaluation can be checked by the Leakage Monitor user interface from any place in the utility intranet. The Leakage monitor also generates daily reports and provides the water supply operator with the actual data analyses via intranet.

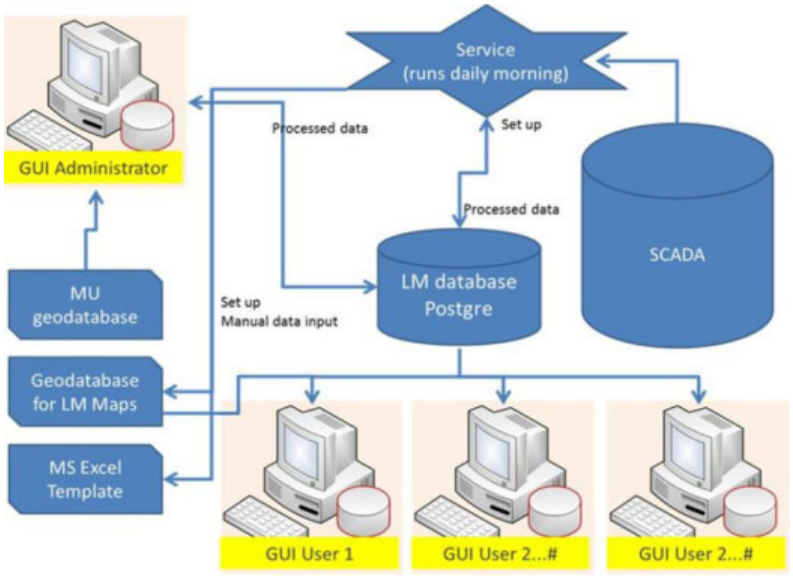
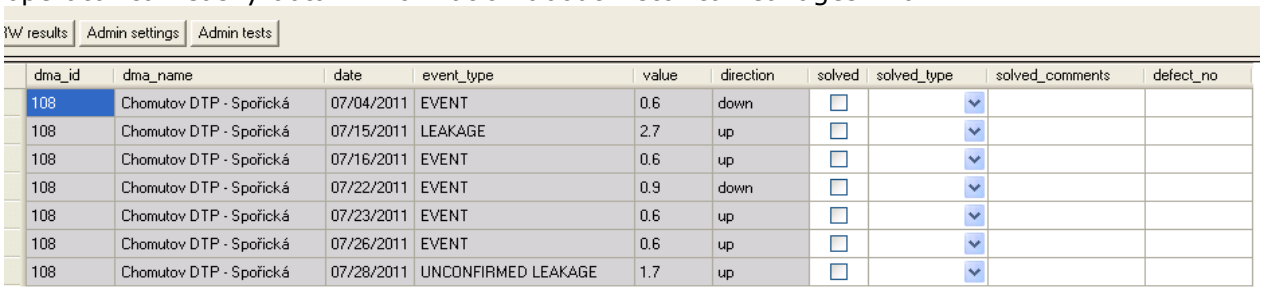


Figure 1 Data collection and result distribution working scheme of Leakage Monitor

The night inflow is summarized from all inflow/outflow sensors and used for evaluation of leakage. The consumption of big night customers as well as night consumption of other customersare considered.
The method of NRW volume evaluation based on a comparison of inflow in a DMA with the sum of volume of invoiced water and self-consumption is used as well.
All analysis are done automatically early morning when the operator has all results prepared for use.

Figure 2 Automate evaluation of leakage (black line) from night inflow in a supply zone

Leakage Monitor evaluates and stores all important changes of leakage in a DMA. The operator can easily obtain information about historical leakages in a DMA.



dma_id	dma_name	date	event_type	value	direction	solved	solved_type	solved_comments	defect_no
108	Chomutov DTP - Spořická	07/04/2011	EVENT	0.6	down				
108	Chomutov DTP - Spořická	07/15/2011	LEAKAGE	2.7	up				
108	Chomutov DTP - Spořická	07/16/2011	EVENT	0.6	up				
108	Chomutov DTP - Spořická	07/22/2011	EVENT	0.9	down				
108	Chomutov DTP - Spořická	07/23/2011	EVENT	0.6	up				
108	Chomutov DTP - Spořická	07/26/2011	EVENT	0.6	up				
108	Chomutov DTP - Spořická	07/28/2011	UNCONFIRMED LEAKAGE	1.7	up				

Figure 3 Report of events and leakages in one DMA in selected period

The Economical level of leakage in a supply zone is calculated based on the balance between possible cost savings on leaking water and costs of leakage reduction works.
The evaluation of the possible cost savings on leaking water considers:

- actual level of leakage in a supply zone
- level of leakage which is possible to achieve after leakage reduction actions
- price of leaking water
- dynamics of the leakage growth

The costs of leakage reduction works is calculated based on evaluation of unit price of the typical leakage detection actions and the extent of such actions needed in a supply zone.
Some of the inputs must be estimated based on operator's experience at the beginning. However the system can be adapted very soon to the real and representative data.
The main economic indicators evaluated for each supply zone are:

- Return period of the costs of leakage reduction works in months
  It indicates supply zones, where leakage detection works will be most efficient
- Economical leakage level for selected return period in l/s
  It indicates difference of the actual leakage from the level that is worth to solve from an economical point of view.
- Time to reach the economical leakage level

All economic indicators are presented in complex but simple outputs and serve for effective planning of leakage detection works.

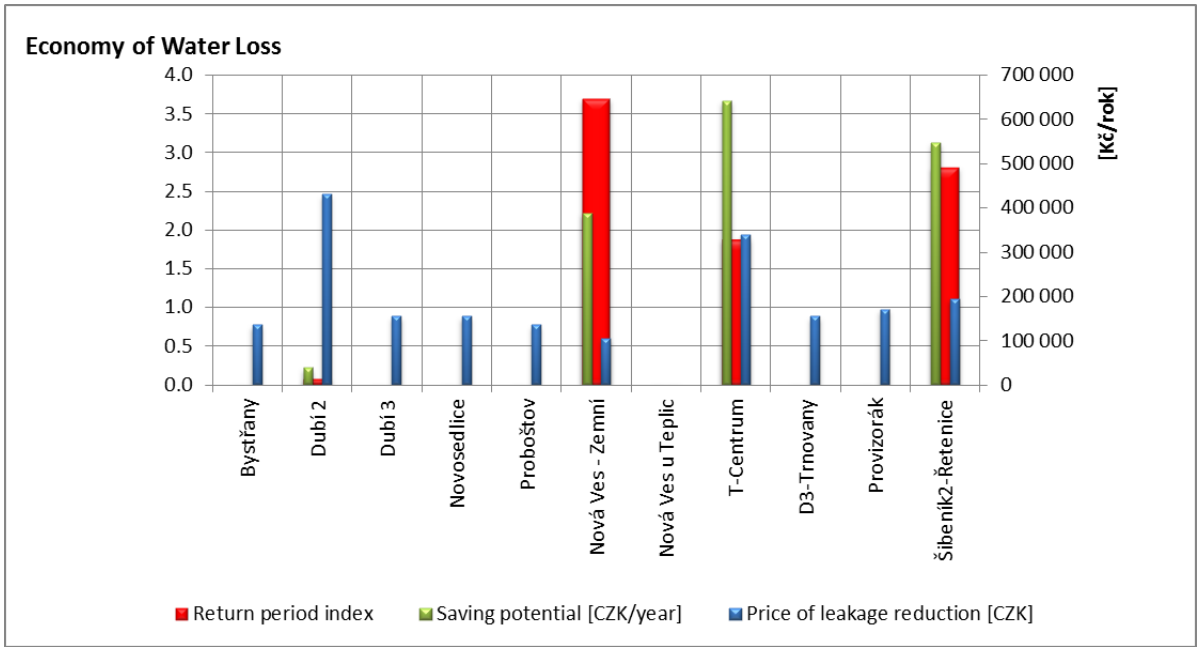


Figure 4 Comparison of leakage reduction works costs (blue columns) with possible cost savings on leaking water (green columns) and return period index (1 USD = 18 Kč)

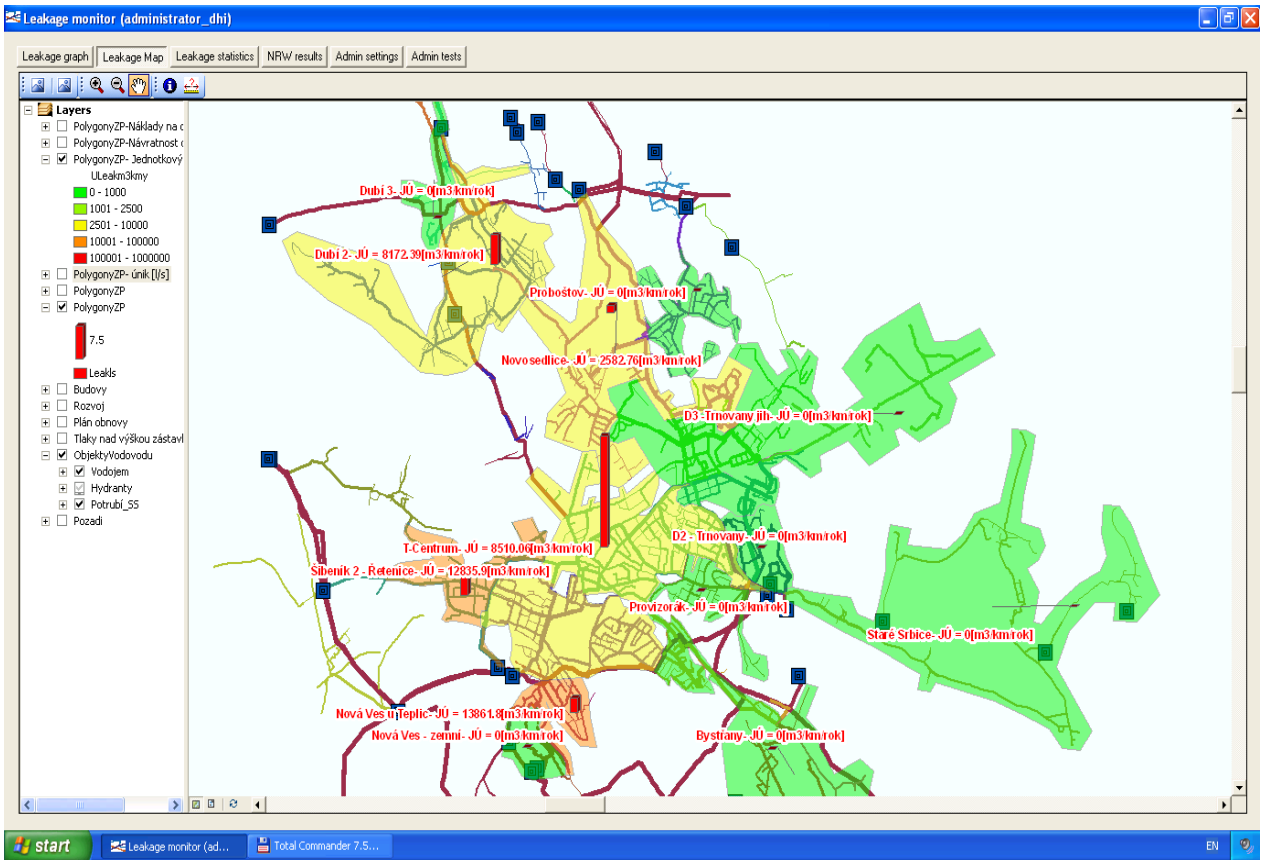


Figure 5 Evaluation of leakage results in a map

Conclusion

The water supply operator practice of daily leakage evaluation in DMAs and the use of the results usually havea lot of limits. The methodology developed and implemented in presented case studies reflects economic aspects of leaking water and leakage reduction costs as main driver for management of leakage detection control. The principle guarantees that the utility effort will conclude in highest efficiency in leakage reduction and optimized cost of leakage detection.
The collection of the data needed for the economic evaluation as well as the economic calculations is practically impossible to do manually in daily practice due to it being demanding and complex. So, a tool for automatic evaluation linked to necessary data sources and working in “on-line” regime is a mustfor such comprehensive approach.

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