Austrian Case Study on Process Benchmarking of Water Loss Management

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Introduction

From 2002 to 2006 OVGW (Austrian Association for Gas and Water) undertook two project runs of metric (company) benchmarking. In 2007 an initiative on process benchmarking in the Austrian water supply sector was started. Different to the approach of the International Water Association (IWA) within the Manual of Best Practice on Process Benchmarking (Larsson et al., 2002), the Austrian system is not holistic but analyses various selected processes out of the whole field of activities of a water supply utility.

Water loss management is one of the analysed processes, in which a very vast range of tasks has to be considered when benchmarking this process.

Kölbl (2008b) describes the OVGW process benchmarking system on water loss management in detail. This paper gives a short overview about this approach and describes first experiences of benchmarking the process of water loss management.

OVGW Benchmarking Project

With around 5,500 water supply companies, supplying about 7.2 million inhabitants in rural, urban and metropolitan areas, the Austrian water supply sector is small structured. Based upon the international and national debates on requirements concerning the improvement of efficiency and the assurance of quality of drinking water services, the Austrian Association for Gas and Water (OVGW) developed a mid-term strategy for setting up and carrying out benchmarking activities (Figure 1), (Theuretzbacher-Fritz et al., 2007a).

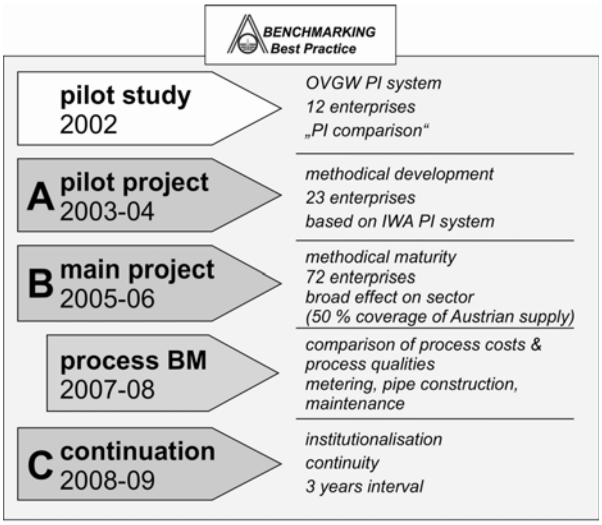

Figure 1: OVGW benchmarking strategy (Theuretzbacher-Fritz & Kölbl 2003, amended)

The OVGW benchmarking activities are generally based upon the principles of voluntary and anonymous participation.

The pilot study in 2002 was followed by the pilot project on metric (company) benchmarking (stage A) was completed in summer 2004 (Neunteufel et al., 2004). The following stage B (2004 project) with 72 participants was finished in June 2006 (Theuretzbacher-Fritz et al., 2007b). All metric activities are based on the IWA PI system (Alegre et al, 2000 and 2006). Future projects on metric benchmarking will be organised in time intervals of three years. In the time between two metric benchmarking projects, projects on process benchmarking are carried out.

Process benchmarking is the logical continuation and complement of the accomplished metric benchmarking. Also international experiences show that the instrument of process benchmarking is well applicable for detecting optimisation potentials and defining measures for improvements (e.g. Piccinin, 2006, Ottilinger, 2004). Therefore OVGW started its process benchmarking initiative in 2007. The aim of the OVGW process benchmarking is a comparative analysis and the optimisation of different working processes of water undertakings.

The OVGW process benchmarking is focused on 3 subject areas (Table 1). In the first attempt 8 processes were offered to the companies and 6 of them were realised. Depending on company needs others can follow.

Table 1: Processes of OVGW process benchmarking 2007

Sales Process	Customer meter reading
	Customer meter replacement
Construction of pipes	Construction of new mains
	Construction of new service connections (not realised)
	Rehabilitation of mains
	Rehabilitation of service connections
Mains network operation and maintenance	Water loss management
	Network inspection (not realised)

OVGW Process Benchmarking System for Water Loss Management

Larsson et al. (2002) describe a holistic approach of process benchmarking like it is practised e.g. in the Netherlands. The idea of that system is to carry out comparisons for the whole scope of duties of a water supply utility with all processes, beginning with the water abstraction and ending at the sales to customers.

For the requirements of benchmarking the process of water loss management this holistic approach is not practicable because water loss management is an integrative process that reverts to various tasks of the whole scope of duties of a water supply utility. Therefore a selective strategy like it is practised e.g. in Australia (Piccinin, 2006), Canada (Main et al., 2008) or Bavaria in Germany (Kiesl & Schielein, 2005) was chosen.

The basis for the process structure has been the IWA methodology in water loss management. This methodology was worked out almost over the last two decades by members of the IWA Water Loss Task Force and is based on international best practises. In the following a very short overview about this methodology is given.

IWA methodology of water loss management

Beside other publications to this topic, Farley & Trow (2003) describe the IWA methodology in water loss management very clearly. Figure 2 gives an overview of the basic correlations.

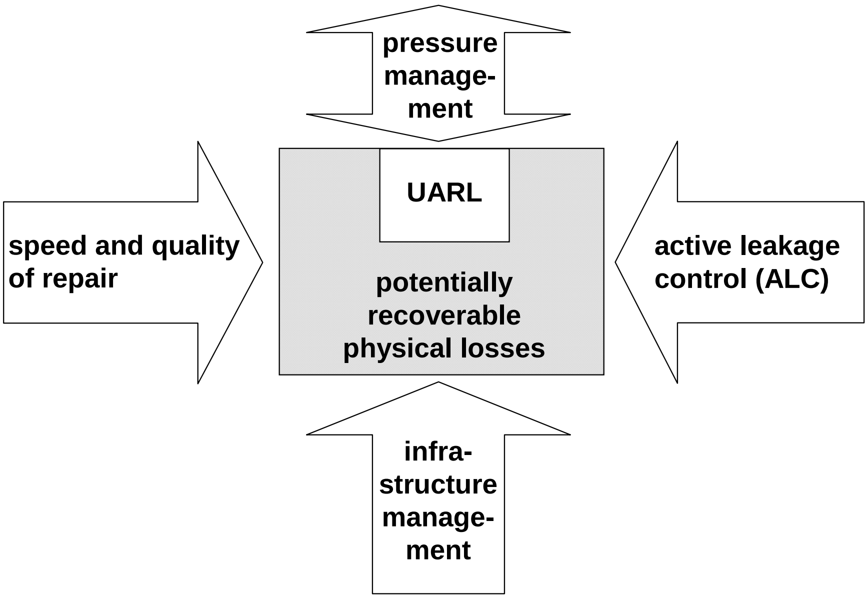

Figure 2: The four basic methods for managing physical water losses (Farley & Trow, 2003, amended)

The white rectangle in Figure 2 represents the unavoidable real (physical) water losses (UARL). These are losses which usually cannot be under-run even with an optimal water loss management. The surrounding larger dotted rectangle represents potentially recoverable physical water losses. These potential savings change with the strenghtness of the arrows acting on this square.

The double arrow above the square indicates that the water losses are decreasing by reducing the service pressure and also the other way round. With pressure reduction also the burst frequency can be decreased significantly. There are also many international examples (e.g. McKenzie et al. 2007) for high savings of water in fact of temporary pressure reduction over the night hours.

Very important for the amount of water losses are type and extent of leakage control.

According to Pilcher (2007) Active Leakage Control (ALC) can be described as a proactive strategy to reduce physical water losses by detecting and pinpointing of non-visible leaks using highly trained engineers and technicians with specialised equipment followed by a prompt and good quality repair of these leaks. Best practice also includes the prompt repair of visible leaks.

Therefore the term Active Leakage Control (ALC) includes not only measures of leakage detection (e.g. step testing, common sounding surveys, noise logging or gas checks) but also measures of leakage monitoring. This means monitoring the system input and also single zones or DMAs (District Metered Areas) and managing all the technical equipment for these measurements and flow control activities. Depending on the existing technical equipment of a water supply utility two different strategies in leakage detection are possible (Kölbl, 2008b):

- leak detection as routine survey on a rotational basis (e.g. annual leak detection campaigns for selected network areas) and without educated guesses (e.g. increased night-minimum flow in a DMA)
- cause related leak detection e.g. on basis of leakage monitoring and DMAs

Infrastructure management covers various tasks which influence the amount of water losses directly or indirectly. Beside the technical equipment of a water supply utility the rehabilitation management (including analyses of failure statistics based on pipe groups), the management of maintenance (fittings, pumps, flow meters, valves etc.) but also the customer meter management (average age of customer meters, methodology of meter reading etc.) and hydraulic modelling of the supply system are part of this topic. In general infrastructure management covers long-term measures and many of them cannot be influenced over short time periods.

Also essential for the amount of water losses is the speed and quality of repair. The repair time is the time from locating a leak to the recovery of the functionality of the pipe.

OVGW Process Structure

A diligent process structure is a precondition for a high-quality process benchmarking. Thus the process structure of water loss management has to consider the basic methods of water loss management suggested by the IWA Water Loss Task Force (Figure 2). Therefore various sub processes and supporting processes were defined. Figure 3 shows the OVGW process structure with a division into four sub processes:

- Leakage Monitoring
- Leak Detection
- Repair
- Analyses & Planning

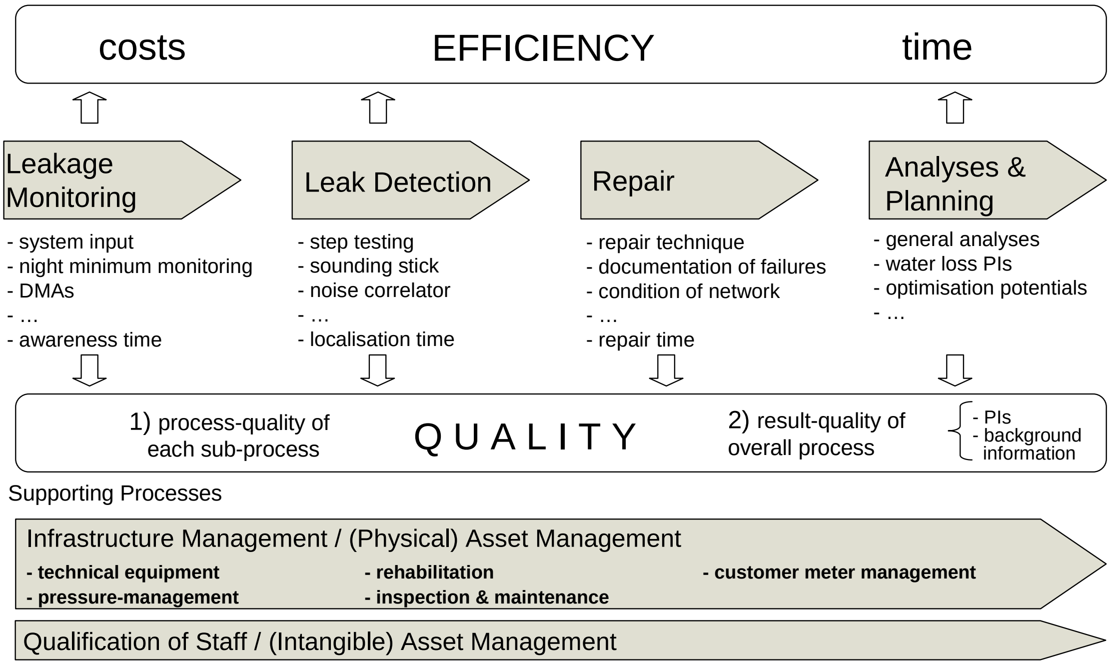

Figure 3: OVGW process structure for water loss management (Kölbl, 2008b)

Additional to these four sub processes also supporting processes play an important role for the process of water loss management. Supporting processes are activities which are not only done for the purpose of water loss management but which have a great influence on the performance in water loss management. The supporting processes can be divided into qualification of staff (intangible asset management) and the infrastructure management (physical asset management). The infrastructure management covers the construction or installation and the operation (including inspection and maintenance) of all physical assets with an influence on water loss management that are not taken into account in the sub processes (e.g. pressure management, customer meter management, rehabilitation planning etc.), (Kölbl, 2008b).

In order to benchmark both technical and economical aspects, quality criteria for each process step have to be determined. A lot of background information about the individual conditions (e.g. structure of the water supply system) and about the differences in the operations are necessary.

Process benchmarking procedure

Once the assessment system is set up, the procedure of process benchmarking consists of four main parts (Figure 4): calculation of process performance indicators (PIs), internal analyses of results, exchange of experience e.g. in form of workshops and realisation of measures.

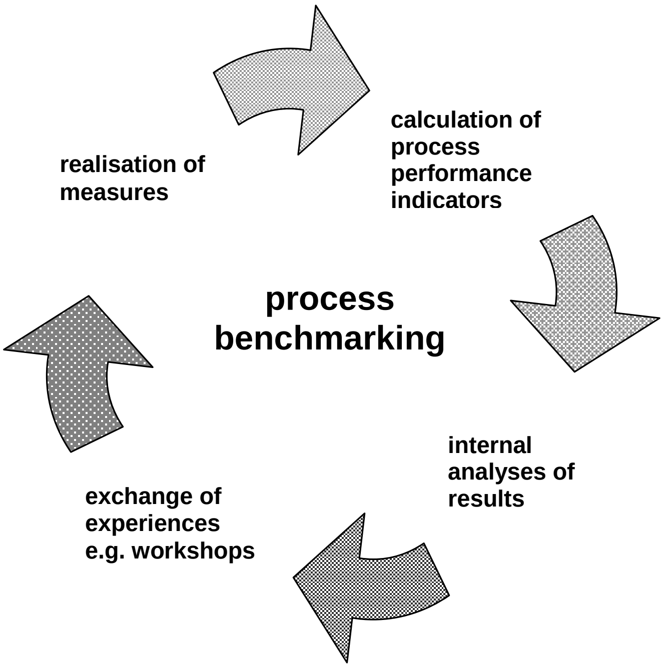

Figure 4: Procedure of process benchmarking (Kölbl et al., 2008a)

One of the most important parts within a process benchmarking project is the exchange of experiences between the participants. Therefore a one-day workshop on cause analysis and deriving of measures was held.

Performance indicators

The whole system of performance indicators for the process of water loss management consists of 72 PIs. On the first view this seems to be quite much but in fact of a structured style of representation it is easy to orientate.

Table 2: Number of performance indicators

	Number of PIs
Water loss PIs	6
Overall process	11
Sub process leakage monitoring	11
Sub process leak detection	22
Sub process repair	9
Sub process analyses and planning	11
Supporting processes	2

Following water loss performance indicators are calculated:

- Water loss ratio (%)
- Real losses per mains length (m^3/km·h)
- Real losses per connection and day (l/conn·d)
- Real losses per connection and day per metre service pressure (l/conn·d·m)
- Infrastructure Leakage Index ILI (--)
- Non-Revenue-Water (%)

For both the overall process and the sub processes, the costs and also the working time are calculated. Outsourcing (in-house and external) of tasks is also considered and separately visualised. For all water flow data the accuracy was evaluated.

Quality matrix

A quality matrix was developed to evaluate the process quality. Same as the PI-structure also the structure of the quality matrix is based on the process structure. To each sub processes and supporting processes various single questions are evaluated. All in all about 100 single criteria are considered in the quality matrix and different quality indices are calculated underlain with a weighting system.

Results

Within this paper it is not possible to give a complemented description of all the project results. Therefore only some examples are part of this paper.

Water loss PIs

The performance within the water loss PIs shows how successful a water utility operates the water loss management. It also has to be mentioned that it is very important to watch the trend of water loss PIs and not only data of a single year to check the success in water loss management.

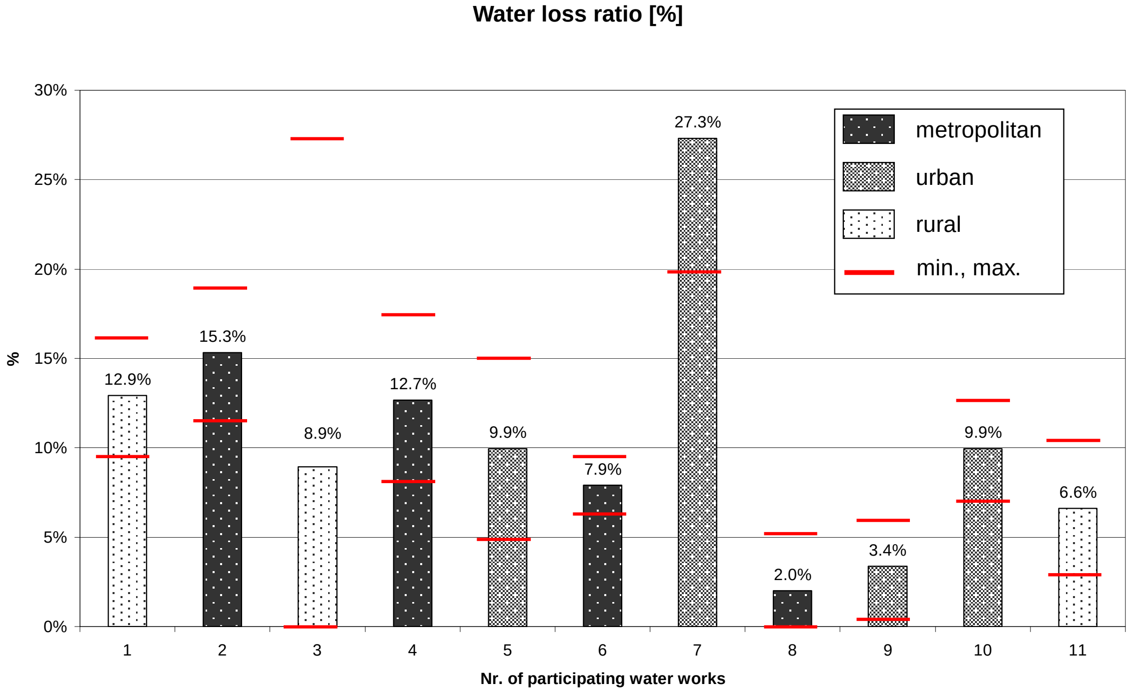

Figure 5: Results: Water loss ratio

The water loss ratio (Figure 5) represents the percentages of the real losses of the system input. This PI is still very common although it is definitely not qualified for the assessment of water losses (compare Lambert & Hirner, 2000 or DVGW W 392, 2003). Therefore this PI is calculated within the project to show the inexpediency in comparison with other PIs.

For technical assessment of water losses it is necessary to use PIs which consider structural parameters like the mains length, the number of service connections or the average service pressure.

In DVGW W 392 (2003) real losses per mains length are the decisive PI whereby assessments in subject to the structure of the distribution network (rural, urban or metropolitan) can be done (Figure 6 and Table 3).

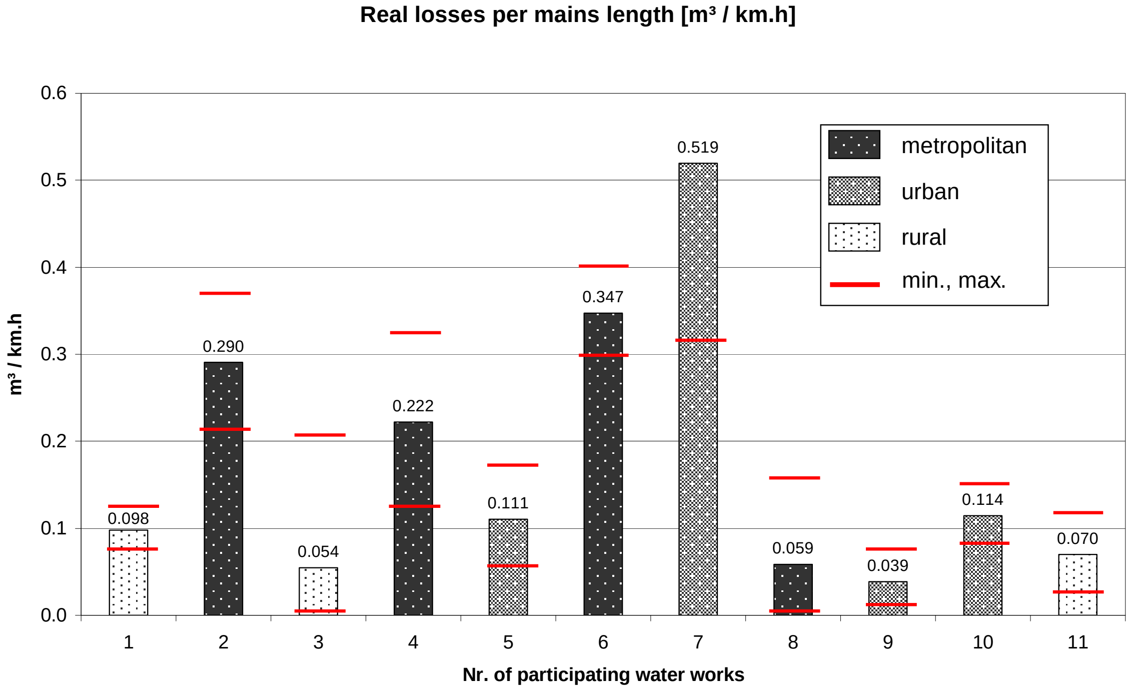

Figure 6: Results: Real losses per mains length

Table 3: Standard values for real water losses per mains length in water distribution networks in m³/km·h according to DVGW W 392 (2003)

assessment of water losses	*structure of distribution network*		
	area 1 (metropolitan)	*area 2 (urban)*	*area 3 (rural)*
low water losses	< 0.10	< 0.07	< 0.05
medium water losses	0.10 - 0.20	0.07 - 0.15	0.05 - 0.10
high water losses	> 0.20	> 0.15	> 0.10

Figure 7 shows results for the ILI, which is only calculated for water utilities with more than 3000 service connections.

Comparing the performance of water utility number 6 on basis of these three PIs it becomes clear that water loss ratio leads to a completely wrong interpretation of the situation. ILI as well as real losses per mains length consider the structure of the supply system and give results which can be used as technical assessment. By that point the importance of considering data accuracy of water balance data should be mentioned as well (note: min., max. values in Figure 5, Figure 6 and Figure 7 represent confidence intervals).

Figure 7: Results: Infrastructure Leakage Index

Overall performance

Beside evaluations of each sub process also the overall performance is analysed. Therefore the costs per kilometre distribution mains as well as the effort in working time per kilometre distribution mains are calculated. These values are compared with an overall quality index which is calculated out of single quality indices of all sub processes and supporting processes.

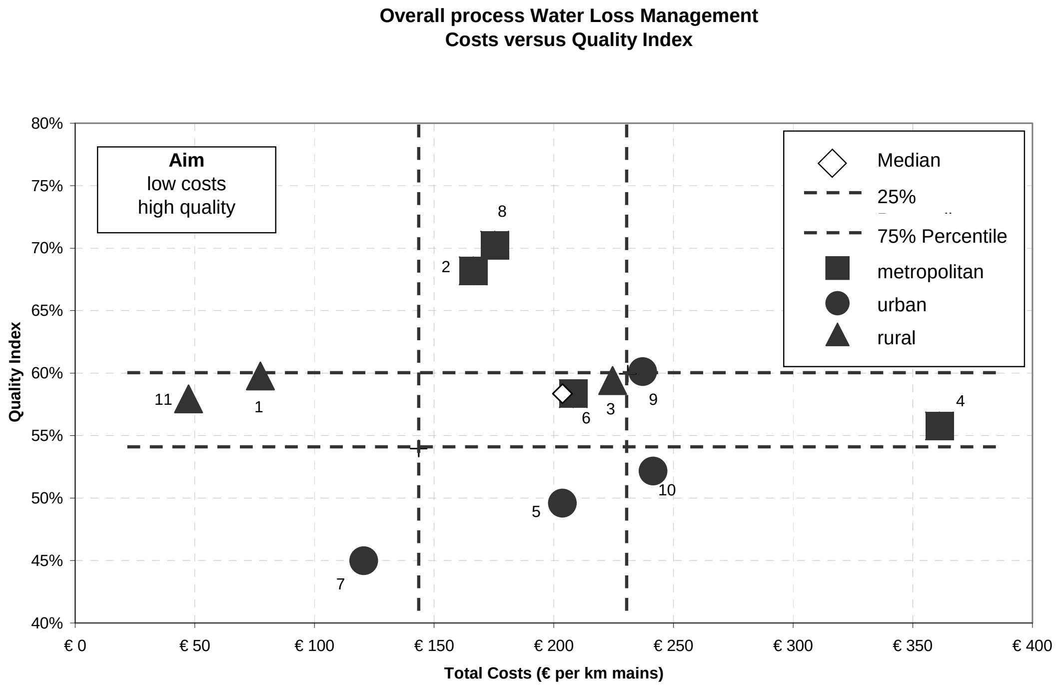

Figure 8: Overall performance of whole process (the numbers represent the participating water works)

Figure 8 shows the overall performance of the whole process of water loss management. The range of costs per kilometre mains is very broad and reaches from about 50 € per km up to about 360 € per km. This broad range shows that there is large potential to increase the efficiency at some companies and it also shows how important it is to find out the right strategy for leakage monitoring and leak detection. For example water work number 4 does a lot of leak detection on rotational basis (compare Figure 9) but the ILI is about 3 (compare Figure 7) what is not that bad in comparison with international examples but for the Austrian situation there is room for improvement.

On the left side of Figure 8 there are the water utilities 1 and 11, which use DMAs for leakage monitoring (note: The costs for installing the monitoring system are not included. E.g. for utility 1 the annual depreciation costs for the monitoring system are about € 65). Figure 9 shows that the effort for leak detection in systems using DMAs is significant lower than in systems with leak detection on rotational basis.

Sub Process Leak Detection

In substitution for all other sub processes some results of leak detection are described briefly. The water utilities with the number 1, 3 and 11 use DMAs, whereas number 7 does not have a real strategy in water loss management. The other utilities do leak detection almost on rotational basis (some of them have mixed strategies with some DMAs and some larger zones).

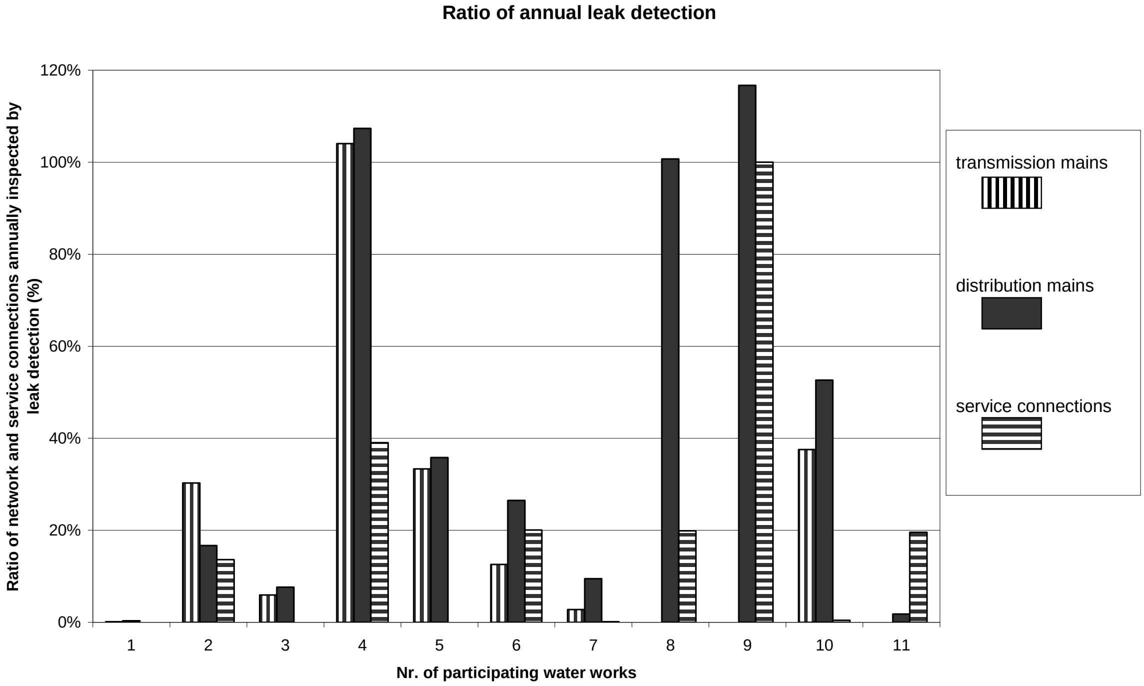

Figure 9: Results: Ratio of network and service connections annually inspected by leak detection

Figure 9 shows how much leak detection is done by the water utilities. The costs related with the amount of leak detection also vary with the used leak detection technology. For example the water utility number 4 has high costs using mainly common sounding methodology (listening stick, leak noise correlator). On the other hand the utilities number 8 and 9 use noise loggers and have much lower costs for leak detection. Comparing with the water loss PIs (Figure 6) the utilities number 8 and 9 have a much better performance than utility number 4.

Conclusions and Outlook on Future Benchmarking Activities

Following the feedbacks of the participating companies, the first Austrian experiences in benchmarking the process of water loss management are mainly positive. Except some necessary improvements the process benchmarking system is working well. On basis of the calculated PIs and the well structured quality matrix a performance assessment is possible and measures for improvement can be derived. Another aspect is the use of the performance comparison as a decision support to find the optimal strategy in water loss management for each water supply utility.

With the aim of a standardised process structure for future international benchmarking activities the IWA Water Loss Task Force started an initiative under the leadership of Roland Liemberger on mapping the process of water loss management.

With the focus on company (metric) benchmarking the Austrian project team started CEEBI, the Central and Eastern European Benchmarking Initiative. The aim of CEEBI is to implement compatible benchmarking systems on a high-quality level together with local partners. The first inception project in Hungary (Laky et al., 2008) is nearly completed and it is planned to implement data from Slovenia soon. Within that CEEBI project framework, future cross-border comparisons should be enabled.

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