How to achieve and prove performance improvement – 15 years of experience in German wastewater benchmarking

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ABSTRACT

This paper shows the results of performance improvement, which have been achieved in benchmarking projects in the wastewater industry in Germany over the last 15 years. A huge number of changes in operational practice and also in achieved annual savings can be shown, induced in particular by benchmarking at process level. Investigation of this question produces some general findings for the inclusion of performance improvement in a benchmarking project and for the communication of its results. Thus, we elaborate on the concept of benchmarking at both utility and process level, which is still a necessary distinction for the integration of performance improvement into our benchmarking approach. To achieve performance improvement via benchmarking it should be made quite clear that this outcome depends, on one hand, on a well conducted benchmarking programme and, on the other, on the individual situation within each participating utility.

Key words | benchmarking, communication, efficiency, performance improvement

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INTRODUCTION

Benchmarking at different levels is a well-established method within the German water industry. In 15 years of practice a wide range of experience has been established by utilities using the instrument on a voluntary basis. The company aquabench, founded in 2003 by leading German and Swiss utilities, has developed around 25 different benchmarking projects, which apply the method to the corporate level as well as to different processes of the industry. The projects cover the whole water cycle and are used by more than 800 utilities.

Nonetheless, it seems to be an open question in some public discussions as to how to prove the success of benchmarking projects in terms of performance improvement. For instance, one regulator in Germany is of the opinion, that benchmarking '… is non-transparent, is voluntary, its success is not measurable or is not taken on by the customer and it does nothing for the protection of clients' (Daiber 2008).

Contrary to this opinion, performance improvement in benchmarking projects can be demonstrated. The aim of this paper is to prove this statement based on a comprehensive review of seven projects from the wastewater industry. For this purpose our understanding of benchmarking will be presented by our definitions, its practice and its history in the German water industry together with our review methods in the first section (on definitions, methods and data).

The highlighted results of our review in the main section will show the huge savings and improvements that took place in the participating wastewater utilities. Several lessons learned from those 15 years can be drawn and thus, recommendations both in methodological and practical terms can be made to maximize the success with benchmarking.

DEFINITIONS, METHODS AND DATA

Benchmarking is closely related to performance improvement as stated by the German Association for Water, Wastewater and Waste: 'The objective of benchmarking consists of determining the improvement potential and to elaborate and implement realizable measures to improve performance' (DWA 2008, p. 9). This understanding is supported by the definition given by the IWA Specialist Group on Benchmarking (Cabrera *et al.* 2011, 2010).

Figure 1 expresses this idea that, in the long run, performance improvement should lead to a change of actual position of a utility in the direction of best practice value.

doi: 10.2166/wst.2012.914

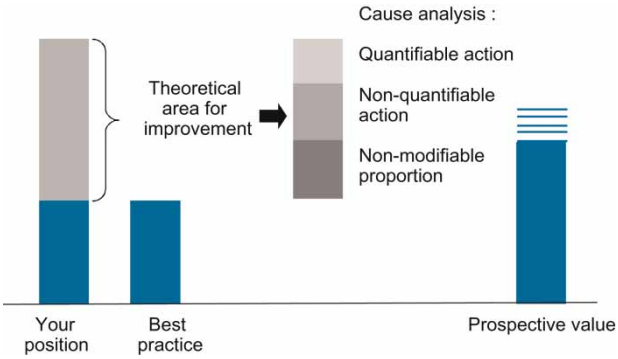

Figure 1 | The theoretical idea of benchmarking (DVGW & DWA 2005).

In 1996, utilities from Germany and Switzerland developed their own approach to adapt voluntarily this management instrument to the water industry. Against the background of cost pressure and political demands to modernize the water industry, the instrument should achieve for the participants:

- Transparency by positioning.
- Considerations for improvement.
- Access to a wide range of industry knowledge via networking.

First, projects applied the methodology to processes of the wastewater industry such as sewer operation, sewer construction and wastewater treatment. Such projects at the process level have, within the whole water sector, until today been run by the utilities, either with the support of consultant agencies or by aquabench.

Benchmarking is today a well-established method in the German water sector, which is not only adopted as part of the modernization strategy of the German federal government (Bundestag 2002; Bundesregierung 2006) but is also completed by projects at corporate level and public reports. Later projects are strongly supported by regional associations and ministries (see for more ATT *et al.* 2008, 2011).

In order to characterize the German approach very briefly, we list the following features (see for more DVGW & DWA 2005; ATT *et al.* 2008, 2011):

- Clear structure and definitions of benchmarking systems (especially national manuals).
- Methods developed from the industry for the industry.
- Voluntary participation.
- Multidimensional performance assessment framework (efficiency, sustainability, quality, safety (of operation) and customer satisfaction).
- Performance assessment tools, e.g. aquabench online software, reporting and workshops.
- Derivation of action plans and proposals.
- Continuous benchmarking (almost all projects are conducted on an annual, biannual or triennial basis).
- Distinction into benchmarking at utility level and at process level.

It is safe to say that this benchmarking approach fits well with the main features given by the IWA Specialist Group on Benchmarking (Cabrera *et al.* 2011; for other national approaches and histories see Cabrera & Pardo 2008; Water Utility Management International 2008; Alegre *et al.* 2009; IWA, VEWIN, WATERNETWERK 2009).

To investigate the success of benchmarking projects and of this approach we chose seven projects from wastewater services, which were conducted for a meaningful period of time, i.e. longer than 4 years in a row (see Table 1). Here, we incorporate only operators with consistent time series – or in the case of the participants in federal state projects, those with data comparable with that of national surveys.

We examined the change of performance indicators and, through interviews with participants, verified whether a change in indicators could be linked to change of

Table 1 | Chosen projects for survey out of 25 aquabench projects

Project	First year	Chosen database	Number of participants	Number of participants in our survey
Corporate benchmarking (national rounds)	2002	2004–2009	30	10
Corporate benchmarking (federal states)	2005	2006–2008	>600	61
Laboratory	2005	2006–2008	13	6
Industrial discharger surveillance	2005	2006–2008	15	6
Supply management	1998	2002–2008	23	8
Sewer operation & maintenance	1999	1999–2008	62	12
Sewer construction	1998	2003–2008	24	6
Wastewater treatment plant operation & maintenance	1996	2002–2008	>200	13

operational practice, induced by benchmarking activities. After establishing such a connection, financial improvement was assessed by calculating the actual savings through comparison of actual value with the value of the basic year (taking inflation into account).

RESULTS: FIVE ASSUMPTIONS FOR PERFORMANCE IMPROVEMENT IN BENCHMARKING PROJECTS

Benchmarking leads to action proposals

The last common step of benchmarking projects conducted by a group of utilities is the derivation of action proposals to change operational practice. These action proposals have a quite diverse level, ranging from detailed calculation of potential saving effects and detailed time planning to general identification of potential areas of improvement.

Our survey in the wastewater industry shows that more than 350 different action proposals, derived from the investigated benchmarking projects, were documented for the utilities (Table 2).

The next step for a participant in a benchmarking project is now to bring these proposals into reality inside their own company. Few utilities and projects actually follow up the success and results of the action proposals in a systematic way.

We tried to measure the success by looking at the change of concrete figures of our performance indicators.

Key performance indicators are different for each utility

The integration of the benchmarking results into the reality of each utility depends on the given culture of change and the given priorities inside the organization towards the benchmarking results. Furthermore, external factors such as price development, a change of regulatory framework, new technologies and others influence strongly the economic activity of operators (e.g. Freymuth *et al.* 2011) and their options for improvement. For example, strong restructuring programmes were conducted by the corporate management inside three of the utilities examined (marked time series in Figure 2). To reduce the number of staff was one clear goal of corporate strategy. Generally, these utilities were more open to derived financial action proposals than others.

But even without a different commitment towards possible strategies and solutions for improvement it became clear that, for each utility, the relevant key performance indicators differ, as priorities and performance and therefore the need to improve, in general, differs.

Direct links between performance improvement and key performance indicators can be found at process level

Real change induced by benchmarking results (proving the idea of benchmarking as drawn in Figure 1) can be

Table 2 | Number and areas of action proposals derived from seven benchmarking projects

Project	Optimization areas	Action proposals
Laboratory	Scope of investigation, sampling efficiency, automation, laboratory capacity, procedures, quality assurance	37
Industrial dischargers surveillance	Strategy (activities and frequencies), efficiency sampling and laboratories, employee qualification, price and charges models	36
Sewer O&M	Camera and flushing technology, work time models, crew strengths, cleaning intervals, management of vehicles and outside services, work preparation and management systems	60
Sewer O&M – pumping stations	Modification cleaning technique, modification of cleaning and inspection intervals, differentiation of inspection activities, optimization of remote action and power consumption	63
WWTP O&M	Each sub-process: investments plant technology, scheduled maintenance intervals, control of facilities, use of materials, controlling, insourcing	160
Sewer construction	Time recording software, reduction of through times, improvement of cost determination, coordination with other pipeline agencies, raw material standards, manholes, shoring, award of contract practice	8
Materials management	Contract specifications, change to building cleaning, introduction of e-procurement, centralization, condition analysis toner, storage capital tie-up	24

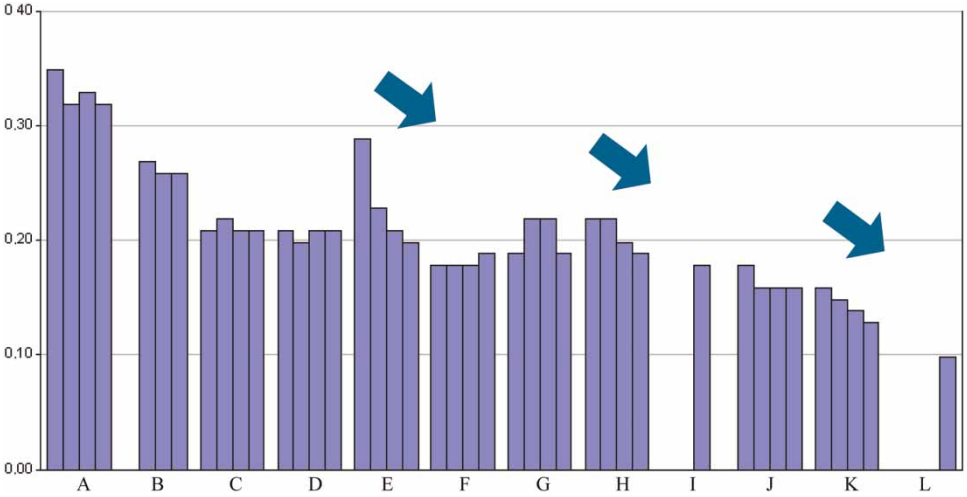

Figure 2 | Development of staff [FTE/km] in the years 2003, 2005, 2007, 2009 for 12 metropolitan utilities differs strongly between participants.

shown by examining the development of key performance indicators (KPIs) in benchmarking at process level. KPIs represent the levers which can actually be influenced by the 'process owner' (responsible person) and which can be changed directly without interaction with other factors.

To prove that benchmarking induces measurable operational change, we examined more than 100 such performance indicators and followed up the consequences of derived action proposals as listed in Table 2. Each discerned change was verified by interviews with the process owner as to whether benchmarking results induced or at least supported the operational change. Here, we listed 29 examples of operational change for 12 utilities, which cannot be considered as a final listing. The operational changes include change of maintenance strategy, of staffing, of technique, of process management, of investment strategy, of construction and materials management, of in- and outsourcing, and of conditions of external services. Their success can be measured by indicators of efficiency as well as change of indicators for quality, sustainability, safety and customer satisfaction. The examples of efficiency improvement examined add up to savings of €20 million for the participants in each coming year, which means savings of between 0.5 and 3.0% of operating costs of the whole wastewater services of each utility per year or up to 70% of the examined costs (inflation adjusted). For each euro paid for the external costs of running a benchmarking project the participants are repaid between €3 and €60 of savings.

Three examples are used to illustrate how KPIs in benchmarking work at process level.

Example 1: Change of the cleaning strategy for sewers (KPI: Annual rate of cleaning) – Efficiency improvement.

Within the benchmarking 'Sewer operation and maintenance', cleaning strategies for sewers, especially cleaning frequencies, were made transparent to operators of major German cities. Based on a comparison of the percentage of cleaned sewers per year, five operators changed their cleaning strategy towards demand-driven cleaning intervals and route planning.

Comparing the situation of the years 2008 and 1999, at least 6,000 km of sewers (equal to 28% of the total network length of 21,000 km) were spared annual cleaning without any loss of quality regarding odour problems, blockages or damage. This reduction results in estimated savings of approx. €6.6 million per year compared with the basis year 1999 (inflation-adjusted) and is equal to around 40% of the costs.

Example 2: Change of standards of manhole construction (KPI: Specific costs of manhole construction) – Efficiency improvement.

One participant of the benchmarking 'Sewer construction' originally set out specific requirements for manhole construction (DIN plus internal standards) regarding the reinforcement of shafts and step irons. By reducing these requirements to the standards of DIN only, more suppliers were able to participate in tender actions. At a constant quality the average cost per manhole was reduced by 20% from 2005 to 2007. This cost corresponds to savings of €180,000 per year compared with the basis year 2005 (inflation-adjusted) meaning around 22% of the costs of the manhole construction. The decision to change construction standards has been substantially supported by the benchmarking process.

Furthermore, an increase of distance between manholes during sewer renewal has been encouraged by means of an exchange of experience about a new technology.

Example 3: Change of monitoring strategy (KPI: Number of samplings and analyses) – Quality and safety improvement.

One participant of the benchmarking projects 'Laboratory' and 'Industrial dischargers surveillance' changed their strategy of monitoring wastewater loads and concentrations regarding the frequency of sampling and type of analysis.

By reducing the monitoring at the wastewater treatment plant (all process steps) sampling and analysis capacity was created, which was further used in the sewer network for monitoring industrial dischargers. The measure is cost-neutral, as the specific cost reduction at the WWTP was 31% in the time span of 2005 to 2008, and the specific cost for monitoring industrial dischargers increased by 115%.

The more intensive monitoring of the sewer network has led to new findings, e.g. new dischargers were identified. Eventually, the measure led to lower pollutant loads at constant costs.

Table 3 | Benchmarking participants do perform better

	Non-participants in corporate benchmarking projects	Participants in corporate benchmarking projects
Number	41	61
Average change of total costs (taking inflation into account)	0.9%	−2.1%
Number and proportion of operators with cost increase < inflation rate	22 = 54%	42 = 69%

Operators who use benchmarking perform better

To gain a general view about the overall financial performance improvement, we additionally compared the change of total costs for wastewater services between the years 2006 and 2008 for two peer groups: participants in so-called corporate benchmarking projects and wastewater operators who have not participated in benchmarking projects but who have delivered data for national surveys of economic data (see Table 3). It can be shown that, on average, operators using benchmarking do perform better. Their total costs on average are decreasing (inflation adjusted) and the proportion of operators with a cost increase lower than the inflation rate is higher in this group.

In addition, we investigated the development of operational costs on single process level for 12 operators. In Figure 3 the mean increase of main process costs is compared to the inflation rate. Within the time span, 2003 to 2008, the increases of nominal operational expenditure are equal to or lower than the inflation rate for the two main processes and for the corporate level. One has to keep in

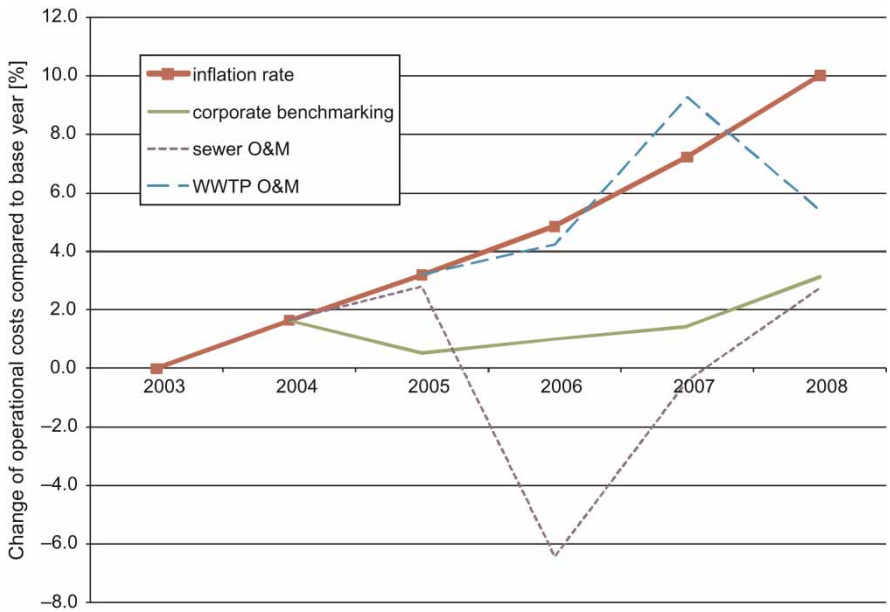

Figure 3 | Average cost increase in different analysed benchmarking objects (12 utilities).

mind, that the inflation rate underestimates cost increases relevant for wastewater services (e.g. higher proportion of energy costs for wastewater treatment). Within the period under review we did not observe a decrease of the non-financial performance (quality, security, sustainability).

Even without being able to link this development directly to change of KPIs, it is safe to state that operators who use benchmarking show clear indications of cost stability (Figure 3).

Performance improvement needs more attention in our benchmarking concept

The IWA task group on benchmarking has presented a new framework on how to understand benchmarking at the different levels of a utility in 2009: 'Benchmarking is a tool for performance improvement through systematic search and adaptation of leading practices' (see Figure 4, Cabrera 2009). This definition is strongly supported by our findings. It seems to be correct, that benchmarking will lead to performance improvement no matter at what level of detail it is conducted: participants in benchmarking at utility level, as in benchmarking at process level, certainly show clear indications of cost stability.

The manual of the IWA task group elaborates further on this concept of benchmarking and lists a great number of success factors for performance improvement (Cabrera *et al.* 2011; for success factors for performance assessment see also Alegre *et al.* 2009). We would like to use the concept to comment on the state of German benchmarking with the following:

First comment: Benchmarking at process level and at utility level are different concepts for performance improvement.

Our examination verified performance improvement by change of concrete key performance indicators. Change of performance indicator is closely related to our core idea of benchmarking (see Figure 1). Here it has to be stated, that few financial key performance indicators, in which change can be directly demonstrated, can be found at a utility level in German benchmarking. Such financial performance indicators in German benchmarking can, however, be found in benchmarking at process level. Here the so-called 'process owner', the manager of the object, is directly involved. As the manager is best suited to assess the effects of improvement actions, it is safe to say that benchmarking at process level generates more detailed action plans, closely related to the change of concrete key performance indicators (Figure 4). Benchmarking at process level is therefore often seen as an option for activity after running benchmarking at the utility level.

This situation does not mean that benchmarking at utility level does not help improvement. Based on customer

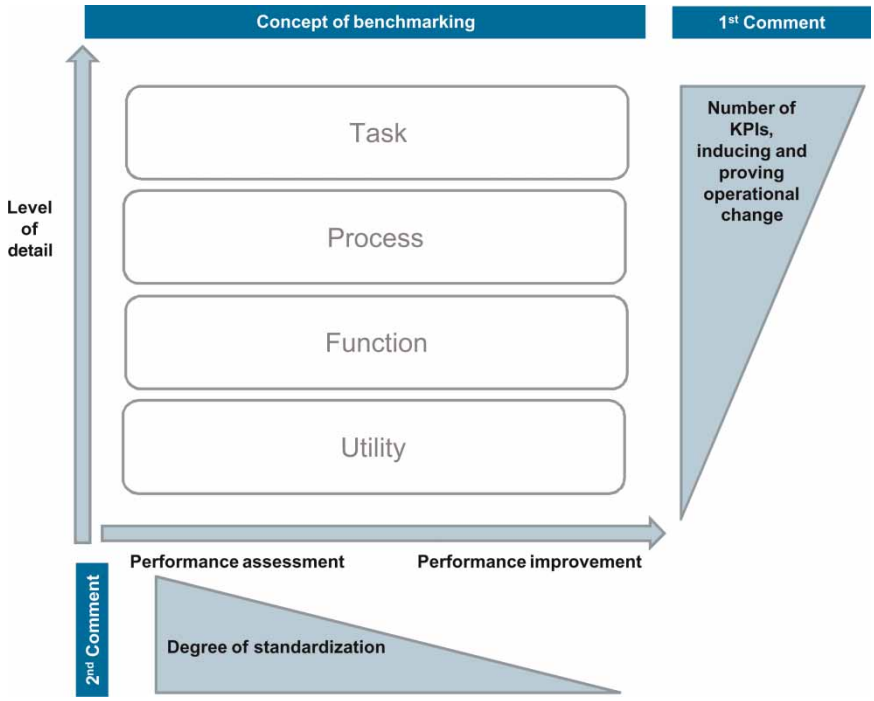

Figure 4 | Comments on the concept of benchmarking (based on Cabrera *et al.* 2011).

satisfaction surveys we know that, on the one hand, three-quarters of participating utilities certainly obtain meaningful new findings by performance assessment and nearly 80% of participants want to use the results for improvements in operating practice. Utilities improve by performance assessment, network opportunities, tools for communication of performance, support of decision making, internal transparency, motivation and insights for employees.

Second comment: More focus on goals, internal communication and controlling of action proposals is needed to support performance improvement.

The steps in a benchmarking project leading to performance assessment are much better defined and elaborated than the steps leading to performance improvement. The degree of standardization decreases, as is shown in Figure 4. Based on this assumption we in addition examined the internal process of benchmarking inside six utilities. First, we defined 'ideal steps' for the conduct of a benchmarking programme, and second, we compared this 'ideal project flow' to the reality inside six participating utilities.

It can be shown that, inside the utilities examined, the steps of data collection, data control and analysis are quite similar and well-adjusted to the 'ideal steps' of a benchmarking project. However, major differences can be found by comparing the steps 'planning and preparation' and 'integration of results'. In summary, some results:

- A better systematic connection between the concrete goals of the utility and benchmarking results should be established.
- A mechanism for the controlling of action proposals as well as for integration of benchmarking results into other management tools, such as balanced score cards or management systems, should be established.
- Individual help by individual workshops, presentations and on-site visits remain a major aid for utilities following a benchmarking project, especially for participants in benchmarking at utility level.

CONCLUSIONS

Improvement by benchmarking can be proven. For efficiency improvements we can summarize, that in comparison with inflation rate and in comparison with other utilities, benchmarking participants definitely perform better on average. This situation seems to be true for participants in both benchmarking at corporate level and at process level.

Benchmarking pays off. Our examples show that, compared with the first year of each benchmarking cycle, €20 million can be saved each coming year, which means savings between 0.5 and 3.0% of operating costs of a utility or up to 70% of the examined costs. For each euro paid for the external costs of running a benchmarking project the participants are repaid between €3 and €60 of savings.

Additionally, a huge number of action proposals also effect performance of sustainability, quality, safety and customer satisfaction of the participants. We will prove these findings by even longer time series with special focus on examples in the latter performance areas.

Different concepts of benchmarking still exist in the framework given by the IWA specialist group and it is necessary to be aware of the different levels to which benchmarking is applied, as well as to sharpen our methods and terminology. Operational change associated with change of concrete key performance indicators can be found mainly for benchmarking at process level and depends strongly on the individual situation of each utility. But there are various ways leading to improvement; change of KPIs is not the only reason for participation in benchmarking. Benchmarking is a networking, learning and communication opportunity as well.

Furthermore, benchmarking is a tool to support improvement in individual utilities. Therefore standardization of the benchmarking steps for improvement is consequently less extensive than standardization of the steps of performance assessment. Nonetheless, the tools for improvement inside a benchmarking project can themselves be improved.

REFERENCES

Alegre, H., Cabrera, E. & Merkel, W. 2009 Performance assessment of urban utilities: the case of water supply, wastewater and solid waste. *Journal of Water Supply: Research and Technology – Aqua* **58** (5), 305–315.

ATT Association of Drinking Water from Reservoirs, BGW Federal Association of the German Gas and Water Industries, DBVW German Alliance of Water Management Associations, DVGW The German Technical and Scientific Association for Gas and Water, DWA German Association for Water, Wastewater and Waste, VKU Association of Local Utilities (publ.) 2008 *Profile of the German Water Industry*. wvgw Wirtschafts- und Verlagsgesellschaft Gas und Wasser mbH, Bonn.

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Bundesregierung 2006 *Bericht der Bundesregierung zur Modernisierungsstrategie für die deutsche Wasserwirtschaft und für ein stärkeres internationales Engagement der deutschen Wasserwirtschaft*. Report of the Federal Government concerning the modernization strategy for German Water Services and for an stronger international engagement of the German Water Sector, Berlin.

Bundestag 2002 *Bundestagsbeschluss 'Nachhaltige Wasserwirtschaft in Deutschland'*. Decision of the Federal parliament 'Sustainable Water Services in Germany', Berlin.

Cabrera Jr, E. 2009 Introduction to benchmarking. In: *Proc. 'PI09 Benchmarking Water Services – the way forward'*, Amsterdam, 12–13 March 2009.

Cabrera Jr, E. & Pardo, M. A. (ed.) 2008 COST C18 – performance assessment of urban infrastructure services. Drinking water, wastewater and solid waste. In: *Proceedings of COST C 18 Final Conference & IWA Conference PI08, Valencia*, IWA Publishing, London, UK.

Cabrera Jr, E., Dane, P., Haskins, S. & Theuretzbacher-Fritz, H. 2010 *Forget 'Metric' and 'Process', Benchmarking is Reborn: The New IWA Benchmarking Framework*. Water 21 – magazine of the International Water Association, December 2010, IWA-Publishing, London, p. 54.

Cabrera Jr, E., Dane, P., Haskins, S. & Theuretzbacher-Fritz, H. 2011 *Benchmarking Water Services – Guiding Water Utilities to Excellence*. IWA-Publishing, London.

Daiber, H. 2008 *Die Untersagung überhöhter Wasserpreise durch die hess. Landeskartellbehörde*, Vortrag am Institut für Dt. und Europ. Wirtschafts-, Wettbewerbs und Regulierungsrecht der Freien Universität. (Prohibition of excessive water tariffs by the regulation authority of Hesse, Lecture at the Institute for German and European Economic, Competition and Regulatory Law at the Free University). Berlin, 12 December 2008.

DVGW Deutsche Vereinigung des Gas- und Wasserfaches, DWA Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall 2005 *Leitfaden Benchmarking für Wasserversorgungs- und Abwasserbeseitigungsunternehmen* (Benchmarking Manual for Water and Wastewater Operators). WVGW Wirtschafts- und Verlagsgesellschaft Gas und Wasser mbH, Bonn.

DWA 2008 Advisory Leaflet DWA-M1100 *Benchmarking in Water Supply and Wastewater Disposal*. Hennef.

Freymuth, J., Franz, T., Frehmann, T., Jathe, R., Obermayer, A., Tränckner, J. & Winkler, U. 2011 Wirtschaftliche Auswirkungen struktureller Veränderungen – ein Blick von oben (Economic Impact of Structural Changes – A Look from Above). *KA Korrespondenz Abwasser, Abfall* **58** (2), 159–164.

IWA, VEWIN, WATERNETWERK 2009 PI09 Benchmarking Water Services – the way forward. In: *Proceedings of the IWA PI09 Conference*, Amsterdam, The Netherlands, CD ROM.

Water Utility Management International 2008 Special issue Benchmarking. *Water Utility Management International* **3** (2).

First received 16 June 2011; accepted in revised form 14 October 2011