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Performance indicators: benchmarking between six cities in Scandinavia

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ABSTRACT: The Scandinavian cities of Copenhagen, Oslo, Helsinki, Stockholm, Gothenburg and Malmo have a long tradition of co-operation in development projects. In 1995 the group started a project with the aim of developing performance indicators (PIs), in order to facilitate comparisons between the cities. The group has developed PIs within the following areas: Customer Satisfaction, Quality, Availability, Environment, Organisation/Personnel and Economy. These PIs, compiled for the six cities, provide a basis for a performance comparison between the cities and for in-depth discussion as to why some cities have exceptionally high or low PI values. The conclusions from these discussions have inspired new approaches in the ongoing internal change processes in the participating utility companies—reinforcing driving forces for quality and efficiency—and constitute a step in the development of a benchmarking process.

INTRODUCTION

Water services in Scandinavia

Water supply and wastewater services in Scandinavia are normally provided by local authorities, who also operate and own the assets. In small communities in Denmark, Finland and Norway the water supply is often managed by consumer co-operatives, while the municipality provides sewerage. There is a growing interest in increasing the co-operation between neighbouring municipalities (Table 1).

From design and construction to operation and maintenance

From the middle of the 1980s, focus has been gradually changing from the design and construction of water purification plants, wastewater treatment plants and regional water distribution and wastewater mains, to the operation and maintenance of existing systems.

A debate on 'collapsing underground systems' emphasized the lack of information and the need for a collection and evaluation of knowledge on network maintenance and necessary rehabilitation, with both a short and long term perspective.

METHODS

In order to offer tools for the effective operation and maintenance of water distribution and sewerage networks, in the mid-1980s the Swedish Water & Wastewater Association (VAV), developed a computer based information system for network register (VABAS), for handling basic network data and for registration of functional disturbances, service interruptions and maintenance and rehabilitation measures.

A planning model called DUF was later added to VABAS. This model covers all network activities, from operations, 'blue-light actions' and planned maintenance measures to long-term rehabilitation planning.

Table 1 Summary of water supply services by country

	Number of water and wastewater utilities								
Country	Managed by the municipality	Inter-municipal companies	Consumer-managed cooperatives. Private companies. Management contracts.	Population supplied (million inhabitants)	Drinking water production (Mm^3)	Surface/ ground water (%)	Length of water mains (km)	Length of sewers and storm water pipes (km)	Number of wastewater treatment plants
Denmark	178	0	2768	5.3	472	1/99	34 000	48 000	1630
Finland	486	176	147	4.4	420	46/54	71 000	38 000	570
Norway	966	15	485	3.8	1100	94/6	39 000	30 000	2000
Sweden	244	40	7	7.7	937	51/25/24*	66 120	87 450	2078

*Surface water/ground water/artificial groundwater.

Table 2 Summary of water supply services in the six cities

City	Population supplied* (million inhabitants)	Drinking water sales† (Mm^3)	Surface/ Ground water (%)	Length‡ of: water mains (km)	sewers (km)	storm water pipes (km)
Copenhagen	0.48	34/32	2/98	897	910	50
Helsinki	0.53	45/20	94/6	1086	1012	721
Oslo	0.49	55/3	100/0	1569	1464	727
Stockholm	0.72	77/31	100/0	1744	1569	1025
Gothenburg	0.44	44/3	100/0	1714	1560	853
Malmö	0.24	26/0	79/21	851	899	515

*Population within the city boundaries.
†Sales within the city/supply to other municipalities.
‡Exclusive service connections.

Are the water and wastewater utilities efficient?

During the intense debate about privatisation in the beginning of the 1990s it was obvious that the utility companies had to establish systems for a more systematic evaluation of their activities and for making it possible to compare with other utilities.

In 1995 the Scandinavian cities of Copenhagen, Oslo, Helsinki, Stockholm, Gothenburg and Malmo (the 6-Cities group) started a co-operation project with the aim of developing performance indicators, which should facilitate comparisons between the cities. Some of the city data from 1996 are compiled in Table 2.

Set of performance indicators

The Swedish model for evaluating the operation and maintenance (O&M) costs in water and wastewater utilities, DRIVA (developed by VAV), was used as a basis for the selection of suitable performance indicators. The model structures gave a clear overview of the total operational and maintenance costs in the utility by allocating them to the activities where they belonged down to the lowest possible level in the organisation. The DRIVA-PIs used by the 6-Cities group are for O&M, expressed per unit for water treatment, distribution, collection of wastewater and sewage treatment. In addition, a number of PIs were selected to describe the serviceability of the companies, e.g. interruptions in distribution, and blockages and flooding in the wastewater collection system.

The selected PIs in DRIVA are used to describe the technical system and its performance. The use of PIs will be particularly interesting when the focus is on the long-term development of quality and costs and when the PIs are used as tools in the management system. The 6-Cities PI-group[a] has defined a structure of performance indicators which is suitable for comparisons between different utility companies.

The group tested the following set of PIs:

- Customer satisfaction: PIs and measuring methods reflecting the customer expectations and appraisal of the water services;
- Quality: Quality-related PIs complementing economic PIs and customer satisfaction PIs;
- Availability: PIs describing the reliability of operation of the entire system;
- Environment: PIs illustrating the utilities' environmental achievements;
- Organisation/personnel: PIs describing, for example, the relation between 'In-house work' and external services and efficiency;
- Economy: PIs comparing costs at an overall level.

The selected set of PIs were chosen from the compilation of a number of key figures used in the six cities, and in addition new performance indicators were added which were considered to be of interest for an overall assessment of the long-term development of water and wastewater services.

The economic indicators use the volume of water sold as a basis for the calculation of unit costs. In order to be able to compare cities that 'import and export' drinking water or treatment of wastewater, 'net costs' are calculated. Charges from regional companies that deliver drinking water to a city or treat the wastewater from it are allocated to costs for O&M and Interest & Depreciation in the same proportions as does the regional company. These external costs are added to the corresponding internal costs.

The income that a city obtains from the sale of drinking water, or from the treatment of wastewater for other municipalities reduce the corresponding costs. Other income from activities that have created O&M costs for the utility are deducted from the total cost. By this method, the 'net cost' for serving the inhabitants of the city can be calculated. The economic PIs are expressed in ECUs.

The group has developed a manual which describes the

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definition of the data and PIs and also lays out the established routines for data collection and calculation of PIs.

RESULTS

Benchmarking 1996

The selected PI-set has been tested on the six cities' activities for the year 1996. The test showed that, despite country boundaries and different languages, it was still possible to compare results.

Examples of PIs for quality, availability and environment are illustrated in Figs 1–4.

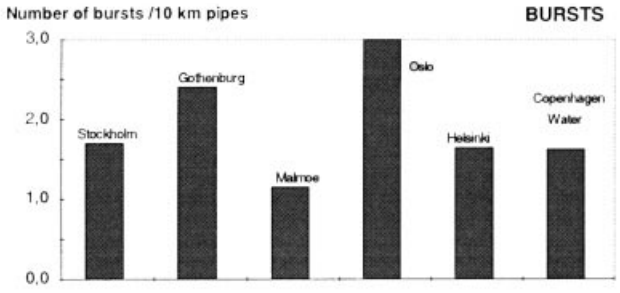

Fig. 1 Number of bursts in the water distribution network (exclusive service connections) per 10 km of pipes.

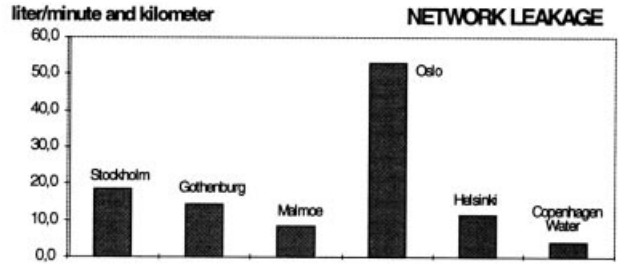

Fig. 2 Network leakage (difference between produced water from own waterworks plus water delivered from regional waterworks—and the sum of sold water and own consumption for the network maintenance) per minute and per km of the network length (exclusive service connections).

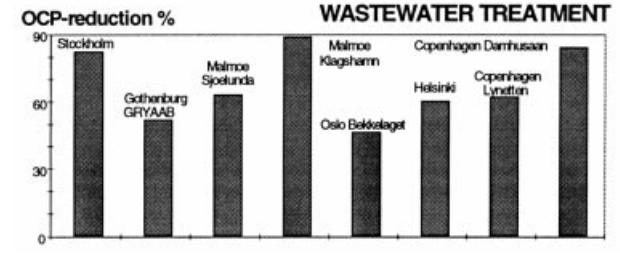

Fig. 3 Reduction of oxygen consumption by treatment at wastewater treatment plants in percentage of the incoming load. The OCP-value is calculated as the weighted sum of the BOD_7 -load multiplied by factor 1, the N_{total}-load multiplied by factor 18 and the P_{total}-load multiplied by factor 100.

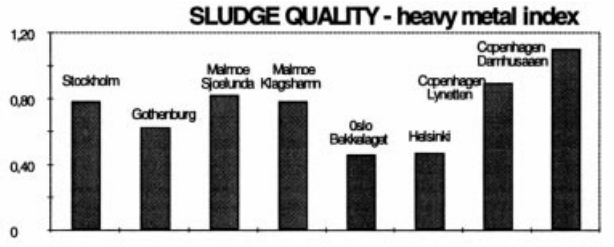

Fig. 4 The metal content in sludge in relation to limits set by the Swedish Environmental Agency. The index is calculated as the sum of the quotient between mean value from analysis and the limit value for the heavy metals Pb, Cd, Cu, Cr, Hg, Ni and Zn.

The test of the selected PIs has given the following feedback:

- Definitions of data and PIs are critical;
- Many of the PIs should include a description of the trend over a 5–10-year period;
- Local conditions and accounting principles have a large effect on PI-values;
- During the process of testing, the existing PIs were improved and new PIs were developed;
- Interest in working with PIs increased;
- The PIs can be used as a supplement to the annual accounts.

The PIs that were compiled for the six cities provided a basis for a performance comparison between the cities and an in-depth discussion into why some cities have exceptionally high or low PI values. The conclusions from these discussions inspired new approaches into the ongoing internal change processes in the participating utility companies—reinforcing the driving forces behind quality and efficiency—and constituting a step in the development of a benchmarking process.

Proposals for a continuation to the work

The set of performance indicators for the six-city group is illustrated in Fig. 5 and the proposals for continued work are commented below.

Definition of the performance indicators

One experience from group's test is that the quality and reliability of the PI key figures is dependent on how well they are defined. The same problems have occured in the compilation of the statistics by national branch organisations. A lot of effort has been expended on establishing a uniform cost structure and in defining the unit-costs. However, there are still concepts within the water and wastewater utilities that are not clearly defined. One example of these is the definition of rehabilitation and the question as to whether the costs of reconstruction and renovation should be entered into the calculations as operational costs or as investments.

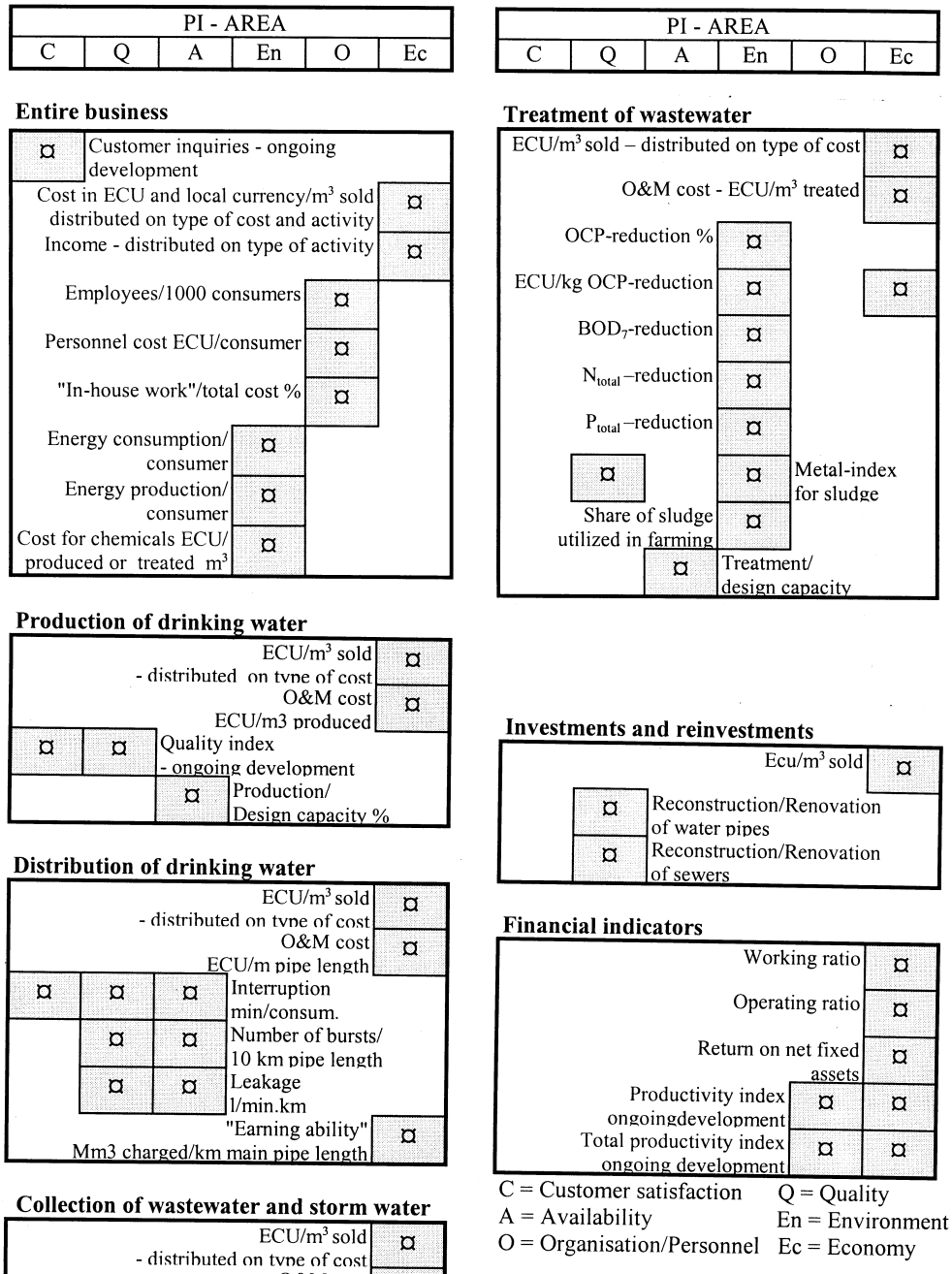

Fig. 5 Definitions of performance indicators.

Customer focus

The customer focus can, within several activities include the development of customer questionnaires in order to survey the customers' expectations and satisfaction with the water services. In order to increase customer satisfaction, information campaigns, etc. must be carried out. Within the group of six cities these matters will be dealt with in co-operation with an ongoing project carried out by VAV.

Quality development and environmental matters

A further development of performance indicators within the quality and environmental field are needed. For example, a

'Quality index' for drinking water quality will need to be developed. In order to describe the overall status of the condition of the pipe network, a 'Fingerprint' will be tested. Practical experiences from the implementation of quality and environmental management systems will be exchanged among the participants in the group of six cities.

Cost-effectiveness
In the present situation, with ever-increasing demands for cost-effectiveness, it is important to develop performance indicators within the areas of organisational development and efficiency drives. In the group of six cities a 'productivity-index' will be tested.

A new budget procedure
With a set of well established PIs it would be possible to develop a budget model that would be based on clear objectives, with corresponding PIs, covering availability, serviceability, environment, economy and quality.

Benchmarking projects
One area where the comparison of PIs has led to further studies is in pipe network leakage and methods for reducing the leakage.

'Standardised performance indicators'
In order to clarify how PIs ought to be interpreted when comparing the situation in different cities' water and wastewater works, the group will analyse the significance of different local factors such as number of connections, specific water consumption, central vs. local wastewater solutions, accounting principles, etc.

Benchmarking is a never-ending process
The six cities have decided that the benchmarking process shall continue. The compilation of data for 1997 was completed in spring 1998. An evaluation of these data has taken place, which will result in new improvements and ideas for changes.