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Benchmarking and Performance Indicators for Water Supply and Wastewater Services

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Benchmarking and Performance Indicators for Water Supply and Wastewater Services

The thesis reviews and analyses throughout methods of:

- Benchmarking,
- Performance Assessment (Metric Benchmarking), and
- Performance Indicators system (especially ISO standardization of PIs and IWA PIs).

About Thesis
Special Attention – IWA Methods

Special attention was given to IWA methods of:

- benchmarking,
- performance assessment and performance indicators system,
- structure and components,
- performance indicators,
- data confidence-grading scheme and
- implementation of those processes and methods.

About Thesis
Specific Objective and Overall Goal

Specific objective was, to make a deeper reflection on IWA Performance Indicators for wastewater services.

The overall goal of this thesis research was to theoretically explore tools for comparison and improvement of efficiency and effectiveness in water utilities (water supply and wastewater sector).

Introduction 1
Water and Wastewater Industry

Water and wastewater industry are a matter of public interest.

Water companies ARE different in nature:

- They are doing a business as a public services,
- They are natural monopolies,
- They have no direct competition.

Introduction 2
Water and Wastewater Industry

Water and wastewater industry are pressurized by both, societies and governments for more transparency, effectiveness and efficiency.

To improve the desired efficiency and effectiveness to a certain level, each utility, first, has to know, what the best practice is.

For such a purpose, a method of benchmarking was developed.

BENCHMARKING

Introduction – Explanation 1

Natural need in human psychology, behavior and activity is assessing performance.

We, as a persons, social groups, or regions and states, always want to know if we can be better, or how we are, compared to the others.

BENCHMARKING

Introduction – Explanation 2

Often we want to know if we have made an improvement to ourselves over time.

It is difficult to determine whether we are good at something, if there are no previous references.

Through the process of benchmarking, those references can be established.

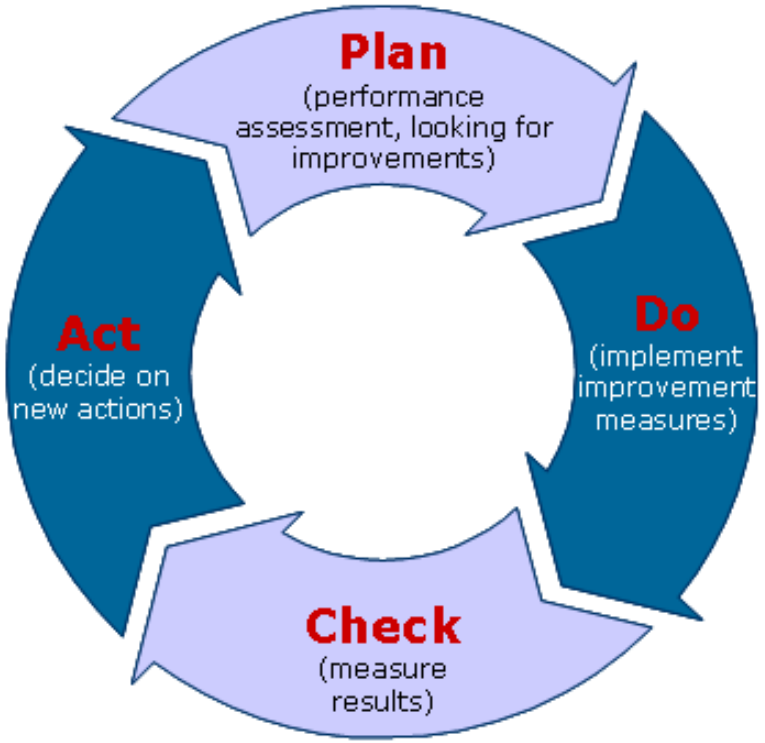
BENCHMARKING

Definition – Concept

Benchmarking is a tool for performance improvement through systematic search and adaption of leading practices

Benchmarking should follow the **Plan-Do-Check-Act** principle.

It should be done on annual basis.



BENCHMARKING

Concept – purpose

Performance comparisons and benchmarking projects can be organized on a voluntary basis but can also be obligatory.

Depending on the purpose, these projects are initiated by different organizations, e.g. associations, consultants or government agencies.

BENCHMARKING

Metric or Performance?

There are two different approaches to benchmarking:

- **Performance Assessment** or "***Metric Benchmarking***" with answer on "Where am I, What am I doing?" and
- **Performance Improvement** or "***Process Benchmarking***" with answer on "Where and what are the opportunities for improvement?"

Performance Assessment and **Performance Improvement**

(or Metric Benchmarking and Process Benchmarking)

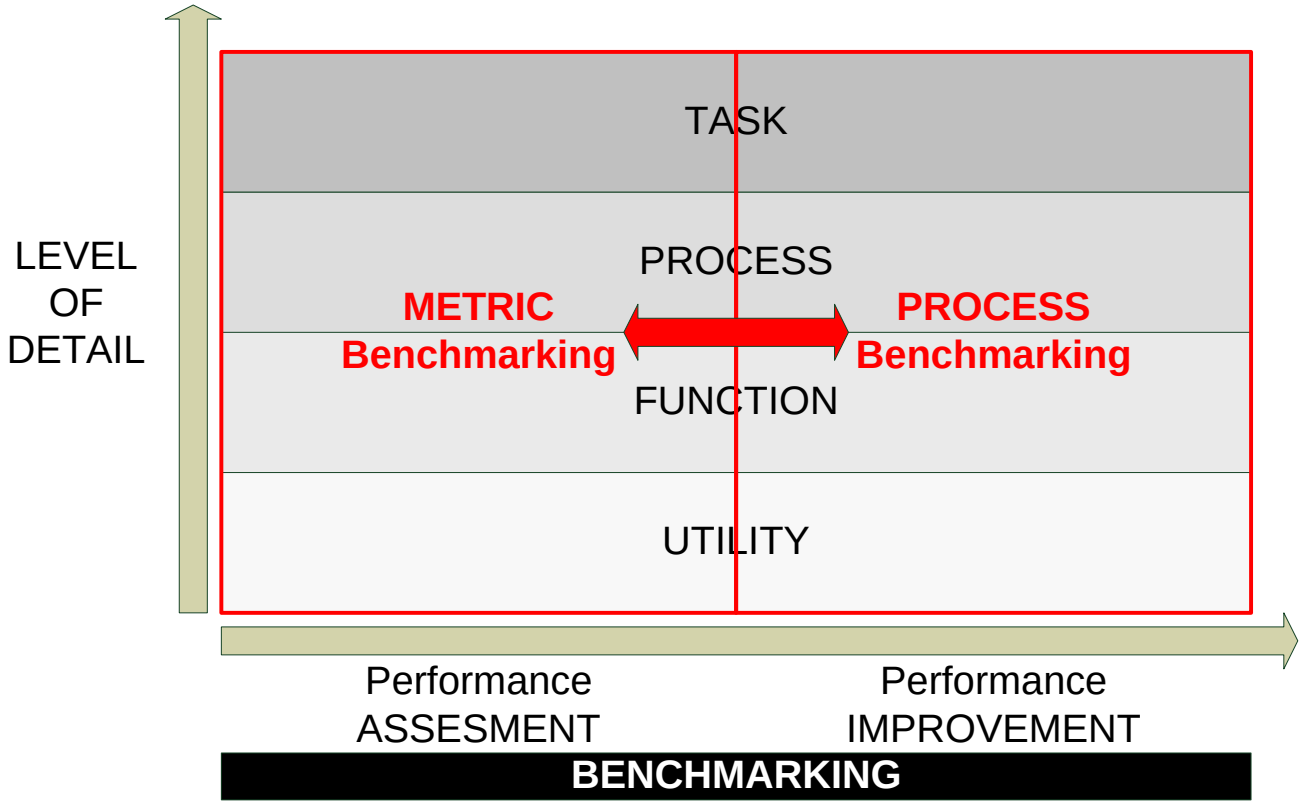


Illustration of “performance assessment” (metric benchmarking) and “performance improvement” (process benchmarking) as described by Kingdom and Knapp (1996) (adopted from Cabrera 2006)

Performance Assessment (Metric Benchmarking)

Performance assessment (metric benchmarking) is a natural and intuitive way of comparison.

Water industry as a business is one of the last natural monopolies. It needs regulation and performance assessment gained a great importance, as a tool for comparison.

However, comparing performance indicators has become the natural tool for regulators of the water industry worldwide.

Performance Assessment (Metric Benchmarking) – Stakeholders 1

Potential users (entities or “stakeholders”) of performance assessment in water and wastewater services can be (Alegre et al. 2006 and Matos et al. 2003):

- The *water and wastewater undertakings* (no matter of ownership status);
- The *consumers or direct users*;
- The *indirect stakeholders* (affected by impact on surrounding environment);
- The *pro-active stakeholders* (environmental organisations, consumer protection agencies and other pressure groups);

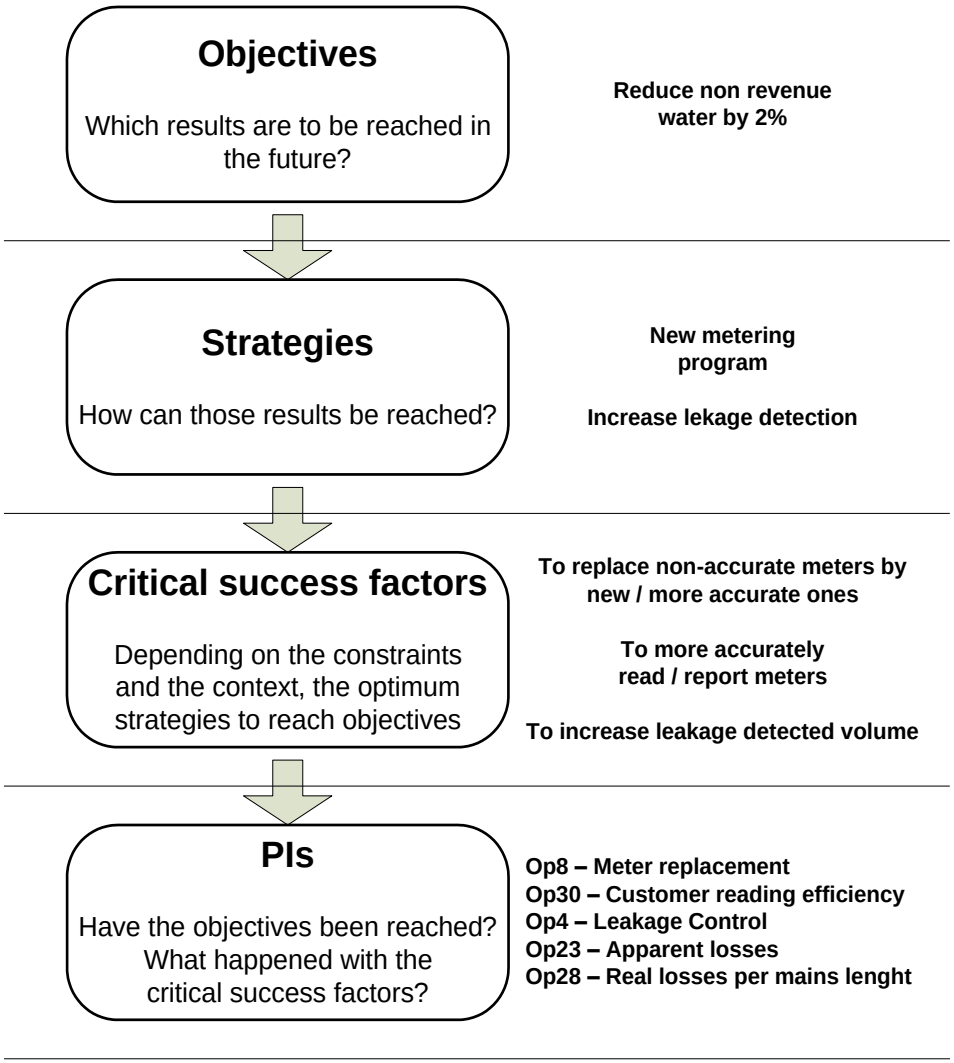
Performance Assessment (Metric Benchmarking) – Stakeholders 2

Potential users (entities or “stakeholders”) of performance assessment in water and wastewater services can be (Alegre et al. 2006 and Matos et al. 2003):

- The *policy-making bodies* (at local, regional or national level);
- The *regulatory agencies* (responsible for economical and quality of service regulation);
- The *auditors, financing bodies and agencies*;
- The *quality certifying organisations*;
- The *multi-lateral organisations*.

Performance Assessment

Phases – Steps



Performance Assessment
(Metric Benchmarking)

Performance assessment could be, described as the art of simplification:

- the more concise the data, the better;
- but an oversimplification of the whole picture can provide insufficient information for making good decisions.

ISO Standards series 24500:2007 (24510, 24511 and 24512) and standardization of Performance Indicators 1

In 2007, the ISO TC 224 published the international standard series ISO 24500:2007 –
"Activities relating to drinking water and wastewater services":

- ISO 24510 (2007): Guidelines for the assessment and for the improvement of the service to users,
- ISO 24511 (2007): Guidelines for the management of wastewater utilities and for the assessment of wastewater services,
- ISO 24512 (2007): Guidelines for the management of drinking water utilities and for the assessment of drinking water services.

ISO Standards series 24500:2007 (24510, 24511 and 24512) and standardization of Performance Indicators 2

Those standards are not normative, just informative guidelines, they are applicable on a voluntary basis.

All three standards share common parts, including terminology, annexes and structure of PIs.

ISO Standards series 24500:2007 (24510, 24511 and 24512) and standardization of Performance Indicators 3

The standards recommend building PI Systems according to IWA recommendations (IWA Manual of Best Practice Handbooks).

ISO **24511:2007** and ISO **24512:2007** are twin standards, but ISO **24510:2007** is slightly different.

Structure of ISO Standards series 24500:2007 – comparison review 4

ISOWD 24510	ISOWD 24511	ISOWD 24512
Scope	Scope	Scope
Normative References	Normative References	Normative References
Terms and Definitions	Terms and Definitions	Terms and Definitions
Components of Services	Components of Wastewater Systems	Components of Water Supply Systems
User's Needs and Expectations	Management Components of a Wastewater Service	Management Components of a Drinking Water Supply Service
Performance Indicators	Wastewater Service Objectives	Drinking Water Supply Service Objectives
	Guidance on the Management of Wastewater Service	Guidance on the Management of Drinking Water Supply Service
	Service Assessment	Service Assessment
	Performance Indicators	Performance Indicators

ISO Standards series 24500:2007 (24510, 24511 and 24512) and standardization of Performance Indicators 5

According to those two standards, management of water/wastewater utility needs:

- **Formulation of objectives** and service assessment criteria,
- **Targeting the service assessment criteria** by the use of a set of performance indicators,
- **Evaluation of the performance** by measuring and assessment.

The ISO 24500:2007 series of standards are giving definitions (same as IWA) concerning Performance Indicators (PI).

Performance Indicators System
Introduction

Performance indicators are efficiency or effectiveness measures of the activity of a utility.

The traditional ratio combines at least two relevant variables measured in the real world and provides significant information.

By combining the adequate indicators, a general picture of reality can be achieved.

Performance Indicators Systems
ISO for PI, IBNET and IWA

There are many Performance Indicators systems (PIs) worldwide:

- **ISO standards for PI**
- **IBNET** (The International Benchmarking Network for Water and Sanitation Utilities)
- **IWA** (International Water Association) Performance Indicators systems for water supply and wastewater sector

Performance Indicators System

IWA PIs

IWA manuals on performance indicators provide a structure that may prove to be a valuable guide when building up such a system.

ELEMENTS of IWA PIs for Water Supply and Wastewater Services

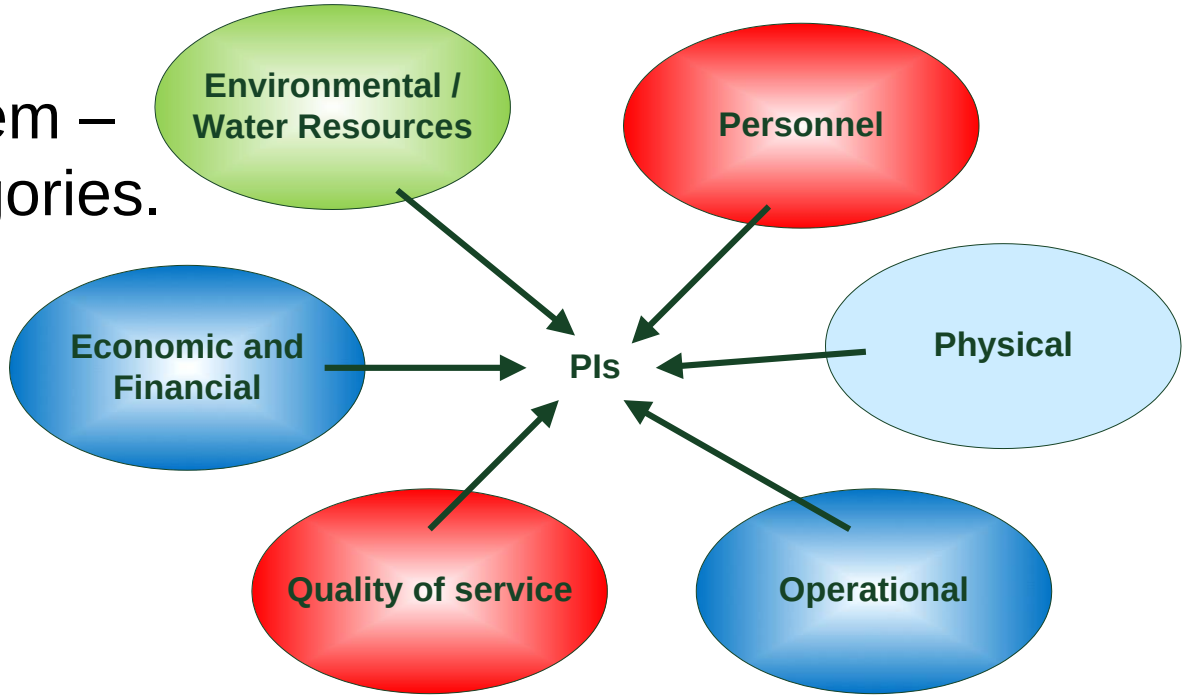
The PI system consists of four types of data elements, each of them with different rules within the system:

- variables;
- performance indicators (PI);
- context information (CI);
- explanatory factors.

STRUCTURE of IWA PIs for Water Supply and Wastewater Services

The methodology of data elements of PI system is almost the same for water supply and wastewater services.

Structure of PI system –
– six separate categories.



Performance Indicators

Usage – Purpose

The usage of indicators can be of a different purpose:

- Assessing the fulfillment of objectives/targets.
- Trend analysis.
- Peer comparison.

Performance indicator systems (PIs) and benchmarking are instruments for internal corporate management but also for comparisons of utilities on a regional, national and international scale.

Performance Indicators System
Objective-oriented

The implementation of any Performance Indicators system has to be **objective-oriented**.

Performance Indicators **are the last step of a larger management** strategy:

- that should link the undertaking's **Objectives** to;
- **Strategies**;
- define **Critical success factors**; and
- only then bring **Performance Indicators**.

Performance Indicators
Recommendations 1

The goals and targets to achieve should be established as the first step and according to those objectives, the PI should be chosen.

The adverse process is a terrible mistake.

If the PI are chosen first, without the objectives, than the result will be tracking PI without straight and clear idea what the improvement is.

Objectives need to be precise and clear.

Performance Indicators
Recommendations 2

The number of performance indicators should be well balanced.

- Too many indicators – increase costs and difficulties.
- Too few –lead to poor assessment.

Performance Indicators
Implementation Phases

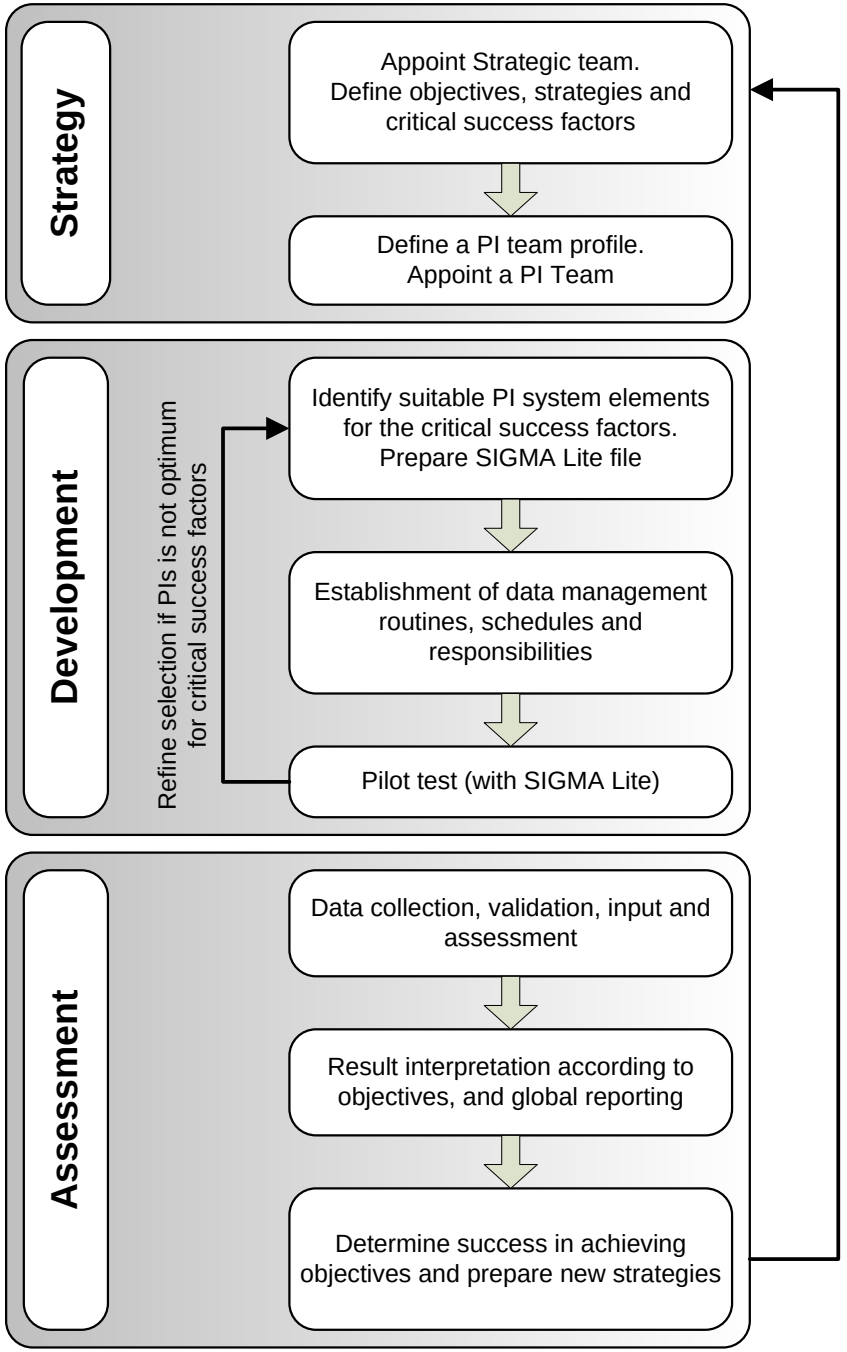
Implementation process is the same (unique) for both, water supply services and wastewater services. Both consist of three phases:

- **Strategy**,
- **Development** and
- **Assessment**.

All three phases are intended to be a continuous improvement process with in utility.

IMPLEMENTATION of IWA Performance Indicators System PHASES

Phases of the PI system implementation process for water supply services (Alegre et al. 2006)



Structure of IWA Performance Indicators System for **Wastewater** Services 1

The IWA **Performance Indicators** system for wastewater is structured into six separate categories of performance:

	Code	
Performance indicators for wastewater	wEn	Environmental indicators
	wPe	Personnel indicators
	wPh	Physical indicators
	wOp	Operational indicators
	wQS	Quality of service indicators
	wFi	Economic and financial indicators

Structure of the PI framework (Matos et al. 2003)

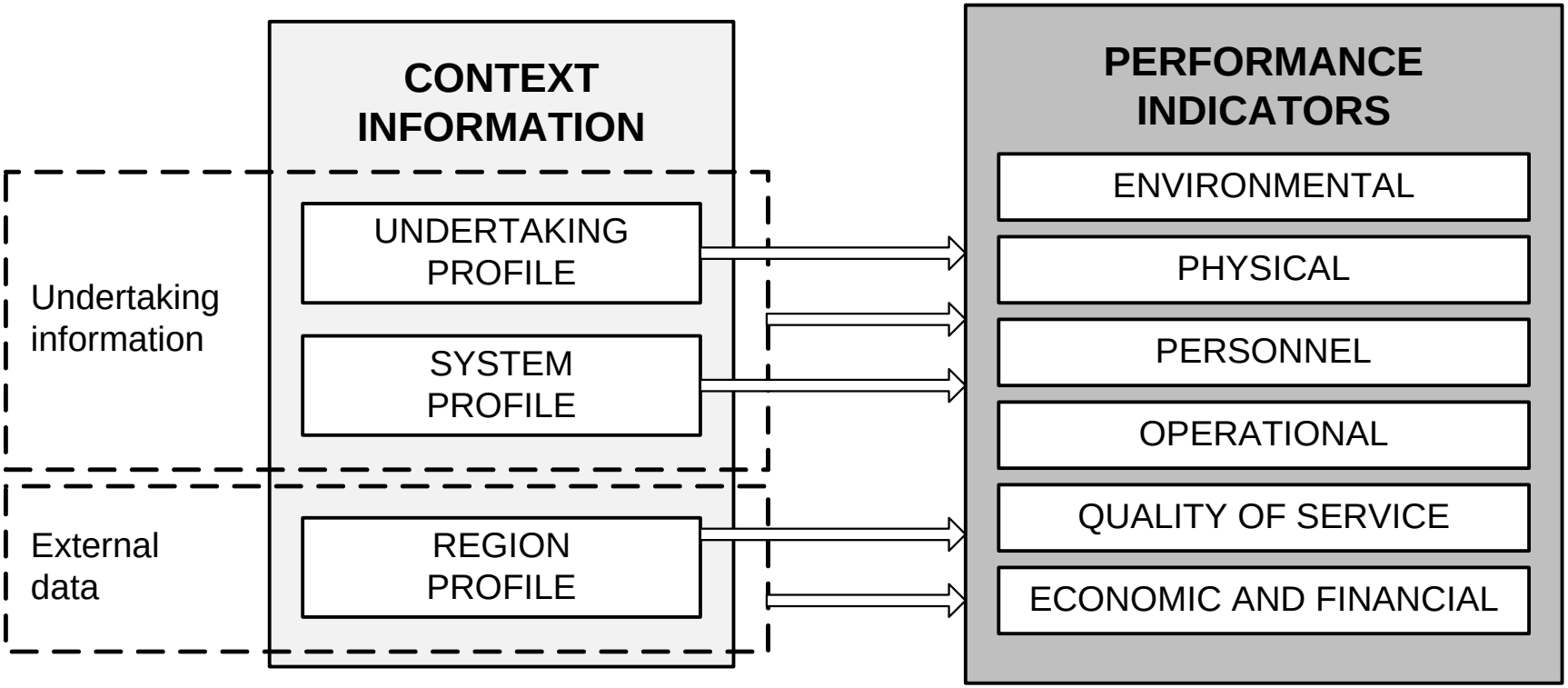
Structure of IWA Performance Indicators System for **Wastewater** Services 2

The interpretation of performance of an undertaking cannot be carried out without taking into account the context in which it operates.

Having this in mind, the structure of the PI system also includes context information about profiles for undertaking, system and region.

Structure of IWA Performance Indicators System for **Wastewater** Services 3

Structure of wastewater **CI and PI**
(Matos et al. 2002a and Matos et al. 2003)



Structure of IWA Performance Indicators System for **Wastewater** Services 4

IWA **PI system structure** for wastewater services:

(Complete **list of Performance Indicators for Wastewater** is listed in APPENDIX, according to Matos et al. 2003, Cabrera et al. 2006. and Matos et al. 2002b.)

Group Code	Main PI group	Subgroup	Number of PIs subgroup (+ sub-indicators)	Number of PIs main group (+ sub-indicators)
wEn	Environmental indicators	Wastewater	5	12 (+3)
		Solid residues	7 (+3)	
wPe	Personnel indicators	Total personnel	2	20 (+5)
		Personnel per main function	5 (+2)	
		Technical personnel per activity	5	
		Personnel qualification	2	
		Personnel training	1	
		Personnel vaccination and safety	3 (+1)	
		Absenteeism	1 (+2)	
		Overtime work	1	
wPh	Physical indicators	Wastewater treatment	4	12
		Sewers	3	
		Pumping headroom	3	
		Automation and control	2	
wOp	Operational indicators	Sewer inspection and maintenance	5	45 (+11)
		Tanks and CSOs inspection and maintenance	4	
		Pumps and pumping stations inspection	2	
		Equipment calibration	3	
		Electrical and signal transmission equipment inspection	3	
		Energy consumption	3	
		Sewer system rehabilitation	4 (+3)	
		Pump rehabilitation	2	
		Inflow/infiltration/exfiltration (I/I/E)	4	
		Failures	8 (+1)	
		CSO control	1	
		Wastewater and sludge quality monitoring	3 (+7)	
		Vehicle availability	1	
		Safety equipment	2	
wQS	Quality of service indicators	Population served	4	18 (+11)
		Treated wastewater	1 (+4)	
		Flooding	5	
		Interruptions	1	
		Reply to customer requests	3	
		Complaints	2 (+7)	
		Third party damages	1	
		Impact on traffic	1	
wFi	Economic and financial indicators	Revenues	2 (+2)	37 (+8)
		Costs	2 (+4)	
		Composition of running costs per type of costs	5	
		Composition of running costs per main function (internal and outsourced)	5	
		Composition of running costs per technical function activity	4	
		Composition of capital costs	2	
		Investment	1 (+2)	
		Efficiency indicators	9	
		Leverage indicators	2	
		Liquidity indicators	1	
		Profitability indicators	4	
		Total number of PIs (+ sub-indicators):		**144 (+38)**

APPENDIX

List of Performance Indicators for Wastewater services, adopted from Matos et al. 2003, Cabrera et al. 2006 and Matos et al. 2002b

Group, Subgroup, Code	Indicator	Unit
Environmental indicators (wEn)		
Wastewater		
wEn1	WWTP compliance with discharge consents	[%/year]
wEn2	Wastewater reuse	[%]
wEn3	Intermittent overflow discharge frequency	[No./overflow device/year]
wEn4	Intermittent overflow discharge volume	[m3/overflow device/year]
wEn5	Intermittent overflow discharge related to rainfall	[%/year]
Solid residues		
wEn6	Sludge production in WWTP	[kg DS/p.e./year]
wEn7	Sludge utilisation	[%]
wEn8	Sludge disposed	[%]
wEn9	- sludge going to landfield	[%]
wEn10	- sludge thermally processed	[%]
wEn11	- other sludge disposal	[%]
wEn12	Sediments from sewer	[ton/km sewer/year]
wEn13	Sediments from ancillaries	[ton/km sewer/year]
wEn14	Solid waste from screens and grit	[ton/km sewer/year]
wEn15	Sediments from on-site systems	[ton/p.e./year]

Structure of IWA PIs
Confidence-Grading Scheme 1

Accuracy bands of data for PI system - the approximation between the result of a given measurement and the correct value for the variable to be measured.

DATA ACCURACY	Definition
1 - Error (%): [0;1]	Better than or equal to +/- 1%
2 - Error (%):] 1;5]	Not band 1, but better than or equal to +/- 5%
3 - Error (%):] 5;10]	Not bands 1 or 2, but better than or equal to +/- 10%
4 - Error (%):] 10;25]	Not bands 1, 2 or 3, but better than or equal to +/- 25%
5 - Error (%):] 25;50]	Not bands 1, 2, 3 or 4 but better than or equal to +/- 50%
6 - Error (%):] 50;100]	Not bands 1, 2, 3, 4 or 5 but better than or equal to +/- 100%
Error (%): > 100	Values which fall outside the valid range, such as > 100%, or small numbers

Structure of IWA PIs
Confidence-Grading Scheme 2

Overall confidence grades

The reliability and accuracy bands would form the matrix of confidence grades, according to ISO standard series 24511:2007 (Matos et al. 2003)

Accuracy Bands (%)	Reliability bands			
	A	B	C	D
[0; 1]	A1	++	++	++
]1; 5]	A2	B2	C2	++
]5; 10]	A3	B3	C3	D3
]10; 25]	A4	B4	C4	D4
]25; 50]	++	++	C5	D5
]50; 100]	++	++	++	D6

NOTE: '++' indicates confidence grades that are considered to be incompatible

Structure of IWA PIs
Confidence-Grading Scheme – CONCLUSION

To make it possible for comparisons to be carried out between services, confidence grades should be chosen appropriately and applied consistently.

BENCHMARKING

Examples of Benchmarking Initiatives and Projects in Water and Wastewater Industry 1

Overview of some benchmarking in the water industry (Cabrera et al. 2006) and as found in literature:

Program Name	Country	Program type	Level of detail	Type of activity	Geographical scope	IWA manuals based
6 – Cities Group	Scandinavia	BM	U, F & P	WS & WW	R	No
DANVA	Denmark	BM	U & F	WS	N	No
European Benchmarking Co-operation (EBC)	Europe	BM	U, F & P	WS & WW	R & I	Yes
Germany (several)	Germany	BM	U, F & P	WS & WW	N	Yes
NWWBI	Canada	BM	U, F & P	WS & WW	N	No
OEWAV	Austria	BM	U & F	WW	N	No
OVGW	Austria	BM	U & F	WS	N	Yes
QualServe	USA	BM	U	WS & WW	N	No
SEAWUN	South – East Asia	BM	U	WS	R	No
VEWIN	The Netherlands	BM	U, F & P	WS	N	No
WSAA	Australia	BM	F & P	WS	R & I	No
ADERASA	Latin America	PA	U	WS & WW	R	No
FIWA	Finland	PA	U	WS & WW	N	No
IBNET	World Bank	PA	U	WS & WW	I	No
Norsk Vann	Norway	PA	U	WS & WW	N	No
OFWAT	England & Wales	PA	U & F	WS & WW	N	No
Svensk Vatten	Sweden	PA	U	WS & WW	N	No
PAS	India	BM	U & F	WS & WW	N & R & L	No
FEDERGASAQUA	Italia	BM	U, F & P	WS & WW	R	No
IRAR & ERSAR	Portugal	BM	U	WS & WW	N	Yes
CARE-W	Europe	BM	U & F	WS	I	Yes
ALUSEAU	Luxemburg	PA	U & F	WS & WW	N	No
France (several)	France	BM	U, F & P	WS & WW	N	No
WaBe	Czech Republic	PA	U & F	WS	N	Yes
WSOP	Slovenia	BM	U & F	WS	N	Yes
AWSR	Slovak Republic	BM	U	WS	N	Yes
IPM	Republic of Serbia	PA	U	WS	N & I	No

BENCHMARKING

Examples of Benchmarking Initiatives and Projects in Water and Wastewater Industry 2

The Benchmarking Program of
European Benchmarking Co-operation **(EBC)**

The approach is fully supported by International Water Association (IWA).

BENCHMARKING

Examples of Benchmarking Initiatives and Projects in Water and Wastewater Industry 3

The International Benchmarking Network for Water and Sanitation Utilities **(IBNET)**

Three key aspects:

- Participation is voluntary,
- IBNET does not itself collect data,
- Its focus is on developing time-series data.

Benchmarking Initiatives in the Republic of Serbia 1

During the 2012 the Pilot project - Benchmarking of water and sewerage utility companies in Serbia was implemented.

This Project named “Benchmarking I” involved 15 utilities in Serbia:

Leskovac, Raška, Sjenica, Novi Sad, Vrbas, Bečej, Negotin, Svilajnac, Subotica, Sremska Mitrovica, Horgoš-Kanjiža, Bač, Novi Pazar, Kladovo and Novi Bečej.

Benchmarking Initiatives in the Republic of Serbia 2

The project was financed by the World Bank, according to the methodology of IBNET.

The focus of the Project was data reliability.

Benchmarking Initiatives in the Republic of Serbia 3

Data were collected on annual basis, for period 2007 – 2011.

For 2011, data were evaluated for reliability under the methodology of IBNET, while for data 2007 – 2011 it was not the case.

Benchmarking Initiatives in the Republic of Serbia 4

Data reliability have been classified into five separate categories:

- from 1 – reliable and documented,
- to 4 – based on an estimate of employee (undocumented)
- and 0 – no available data.

One of the preconditions for accreditation of utility is that the gained indicators have reliability of 70%,
for each individual category (institutional, technical and financial data) (Krstić and Arvaji 2013).

Benchmarking Initiatives in the Republic of Serbia 5

The collected data were classified in four sections:

- Institutional data (1-11; 38-43);
- Technical data (12-37),
- Income data (44-57) and
- Expenditure data (58-70).

In total 70 data about each utility (Nastić et al. 2013).

Benchmarking Initiatives in the Republic of Serbia 6a

The analysis of collected data, for monitored period in 15 participated utilities, showed some general conclusions:

- There is no participation of private capital;
- Continuous water supply of the population is provided (24/365);
- Water supplying network increases 1% annually;
- Wastewater collection network increases 2% annually;
- The number of customers is decreasing;

Benchmarking Initiatives in the Republic of Serbia 6b (continuing)

The analysis of collected data, for monitored period in 15 participated utilities, showed some general conclusions:

- The quantity of distributed water is decreasing;
- The rates and tariffs for water and wastewater are increasing;
- There is no preferential tariff for socially vulnerable customers;
- Only 3 of the 15 participating companies have a secondary wastewater treatment.

Benchmarking Initiatives in the Republic of Serbia 7

After the collection and evaluation processes for 15 utilities, database has been established, which enables all participating utilities to compare their data and indicators with each other.

The most characteristic indicators of participants were published on the Internet site of IBNET.

Benchmarking Initiatives in the Republic of Serbia 8

The success of the Pilot project “Benchmarking I” has enabled in Project “Benchmarking II” with the expansion of activities in 2013 and more interested utilities (25).

CONCLUSION 1
General conclusions for PI

- Achieving efficiency requires INFORMATION.
- Performance indicators are a tool delivering such information.
- Indicators only work when compared, but the tool needs to be well designed for such purpose.
- PIs may be a trend, but must be used as part of a strategic approach.

CONCLUSION 2
General conclusions for PI (continuing)

- A standard structure (IWA/ISO) allows expandability, compatibility and exportability.
- Confidence grading is crucial in order to make well informed decisions.
- A living set of Performance Indicator needs to be based on practical experience.
- Beware of the strengths and limits.

About Thesis
“Quick Guidelines”

This thesis is supposed to be a sort of direction, “instruction”, or references for colleagues wanted to work on benchmarking and performance indicators systems in water utility companies (especially wastewater services).

Thesis should be understood as literature review or “quick guidelines” for benchmarking, performance assessment and performance indicators.

Thank you for your attention.

Hvala na pažnji.

Ευχαριστω πολυ για την προσοχη σας.

The End
of
Thesis and

EDUCATE!