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ISO/TC 224 / SC

Title

Service activities relating to drinking water supply systems and wastewater systems - Quality criteria and performance indicators

Secretariat **AFNOR**

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 24512 was prepared by Technical Committee ISO/TC 224, *Service activities relating to drinking water supply systems and wastewater systems - Quality criteria of the service and performance indicators*.

Introduction

0.1 General

Water constitutes a worldwide challenge for the 21st century, both in terms of the management of available water resources and the provision of access to drinking water and sanitation for the world's population. The United Nations (UN) in 2002 recognized that access to water is an essential human right, and in conjunction with national governments, it set ambitious goals "Millennium Development Goals" to increase access to drinking water and wastewater services particularly in developing countries. International conferences on sustainable development and water (e.g. the World Summit on Sustainable Development in Johannesburg in September 2002 and the third World Water Forum in Kyoto in March 2003) stressed this issue and the UN agencies (i.e. WHO, UNESCO, etc.) have developed recommendations and programs to advance this framework.

In addition to public health protection, the sound management of the drinking water and wastewater utilities (hereinafter referred to as "water utilities") is an essential element of the integrated management of water resources. Sound management practices of these utilities will contribute, both quantitatively and qualitatively, to sustainable development.

Water utilities contribute to social cohesion and economic development within a community and the quality and efficiency of service have implications for virtually all activities of the society. They also enhance environmental protection through integrated management of water resources and the principles of sustainable development.

Because water is considered both an "economic" and "social" good, the management of water utilities should be transparent to and inclusive of stakeholders, identified according to the local context. The stakeholders should be involved in both setting service objectives and assessing the adequacy and efficiency of service delivery. The stakeholders involved in water services include among others: users, national and/or regional and/or local public authorities charged with the regulation and oversight of the water services, public or private operators of the water utilities, non governmental organisations (NGOs), research organisations, laboratories and special interest groups. The relationship among stakeholders vis-à-vis water services varies around the world. In many countries, there are bodies that have responsibility (in whole or in part) for overseeing water service activities, whether or not the utilities are publicly or privately owned or operated and whether or not they are strongly regulated or self regulated.

Examples of these bodies include:

— Governments (national or local) or public agencies acting with legal or legislative authority,

— Associations of the services themselves (i.e., national or regional drinking water or wastewater associations),

— Autonomous bodies seeking to play a public and/or oversight role (e.g., organizations of concern such as non-governmental organizations), and

— Water users and customers.

This standard does not prescribe the respective roles of various bodies/stakeholders nor define required processes for local, regional, or national bodies that may be involved in the provision of water services. In particular, the standard does not interfere with the free choice of the responsible bodies regarding the general organisation and the management of their utilities. The standard is applicable to publicly and privately owned and operated utilities alike, and does not favour any particular ownership or operational model.

The organisation of water utilities falls within a legal and institutional framework specific to each country. The Ministerial declaration from the Third World Water Forum recommends, in this respect, that governments endeavour to reinforce the role of local public authorities, particularly as regards the ensuring of adequate water services.

The aim of the water utilities is to cover everybody in their area, and to provide users the continuous supply of drinking water and the collection and treatment of wastewaters, under economic and social conditions that are acceptable both for users and responsible bodies. Water utilities should comply with the requirements of relevant authorities and meet specified expectations, while ensuring the long-term sustainability of the service. In a context of scarcity of resources, including financial resources, it has to be ensured that the investments made in installations are appropriate and that necessary attention is given to proper maintenance and effective use of the installations. This will contribute to the efficient operation of the water utilities and to the optimisation of available resources.

The aim of this standard is to provide the relevant stakeholders with guidelines for improving the service and the management of water utilities, consistent with the overarching objectives fixed by the international intergovernmental organizations noted above and by the national competent authorities. The standard is intended to facilitate dialogue between the stakeholders, enabling them to develop a mutual understanding of the functions and tasks that fall within the scope of water utilities.

The following standards provide guidelines for defining and assessing service to users, and for managing drinking water and wastewater utilities.

The following ISO standards address:

ISO 24510 – Service activities relating to drinking water and wastewater – Guidelines for the service to users (service oriented standard)

ISO 24512 - Service activities relating to drinking water and wastewater – Guidelines for the assessment of drinking water services and the management of utilities (management oriented standard)

ISO 24511- Service activities relating to drinking water and wastewater – Guidelines for the assessment of wastewater services and the management of utilities (management oriented standard)

The ISO 24511 and ISO 24512 standards set out in sequence a description of water services and briefly describe the physical (infrastructural) and managerial (institutional) components of utilities. Core **objectives** for water services considered to be globally relevant at the broadest level are set out followed by guidelines for the management of the utilities. These are then related to examples of possible actions that may be taken to achieve the objectives. Each action can also be characterized by related **service assessment criteria**. Finally, for each service assessment criterion there is a range of possible **related performance indicators** that might be used to assess the performance of the service.

The object of the ISO 24510, ISO 24511 and ISO 24512 standards is not to lay down systems of specifications supporting direct certification of conformity, but to give guidelines for continuous quality improvement of the management of the water utilities.

Implementation of these ISO standards does not depend on adoption of the ISO 9000 and/or ISO 14000 series standards. Nevertheless, these guidelines are consistent with and supportive of those management systems standards. These guidelines are also consistent with the principle of the "plan-do-check-act" (PDCA) approach: they link, through a dynamic and interactive process, general methods and tools for developing locally-adapted specifications and objectives, together with the management components and activities, necessary for assessing performance. Implementation of an overall ISO 9001 and/or ISO 14001 management system may facilitate the implementation of these guidelines, and conversely, these guidelines may help to achieve the technical provisions of the ISO 9001 and ISO 14001 standards for organizations choosing to implement them.

Use of these standards is voluntary in accordance with ISO rules. The standards are sufficiently flexible and allow adaptation according to local, regional or national needs.

The recommendations given in the standards are focused on functions, on results and on general organization without insisting on the means, in order to permit the broadest possible use of the standards, while respecting the cultural, socio-economic, climatic and legal variations of the different countries and regions of the world. As a consequence, it should be understood that the expectations of local users may be impossible to meet due to factors such as climate conditions, resources availability, and the difficulties relating to the economic sustainability of the water services, particularly regarding financing and the users' ability to pay for improvements. These conditions may restrict the implementation of some provisions of the standards in developing countries. Efforts should therefore be focused on the identification of priorities and the provisions of the standards that assist with implementing the priorities.

Following these principles, defining service coverage is a political choice, and resulting performance can only be assessed regarding the targeted value.

These standards, and more specifically the performance indicators (PI's) given as examples, should not in any case be considered as a prerequisite or condition for the implementation of a water policy or for the financing of projects or programs.

In order to assess and improve the services and to ensure proper monitoring of implementation, the stakeholders may establish an appropriate number of performance indicators (PI's), selecting them from the examples given or developing other relevant performance indicators taking in account the methodology described in the standards. The PI's should relate to the objectives for which they are defined and be used to set required or targeted values. In order to meet the principle of adaptability to local contexts, the standards also indicate procedures and tools facilitating local implementation, but do not impose any specific indicator or any minimum value or performance range. The use of PI's is only one of the possible support tools for continuous improvement.

Finally, the standard is not aimed at defining specifications concerning the quality of the drinking water supplied or the wastewaters discharged: this falls within the responsibility of the national or international public authorities; nor does address specifications for the design and construction of the installations and equipment, or with the methods for analysing the quality of the waters.

0.2 Drinking water supply services

The reader of this International Standard should note that most utilities have constructed infrastructure and facilities that are operated primarily to supply drinking water for the use of those who are users of the service. Many utilities may supply the users by direct pipe connection or equally, by other means (e.g. trucks, bottles, etc). Broadly the social objectives of the service are to promote public health and social and economic development, while protecting the environment.

Operationally, the broad objectives of a utility are to supply drinking water on a continuous or at least on an intermittent basis (depending on the final delivery mechanism) in sufficient quantities to meet users' reasonable demands.

The drinking water should be suitable for direct human consumption in accordance with local requirements, regardless of the other uses made of the drinking water delivered. Efforts are made to achieve that quality at all times and where that is the general expectation, when potability standards are not maintained or achieved, a specific warning to users should be provided.

The function of utilities is to provide drinking water for civil life, urban activities and industrial or other uses. Drinking water is considered a core activity on which society depends and therefore has a social as well as public welfare role. The fact that supplying drinking water involves the abstraction of water from the environment and the construction of infrastructure having lifetimes typically stretching over several human generations suggests that inter-generational equity and regard should also be a feature of the assessment. Therefore, a water utility, regardless of ownership, is public in nature and will be subject to public scrutiny and policy.

Some utilities cannot provide drinking water on a continuous, 24 hours a day, 7 days a week basis, nor is there an expectation that this will be achieved. Often these utilities are those who cannot deliver safe drinking

water. The objectives in this case may also have to be specifically tailored to the local or regional conditions and expectations.

Other service criteria such as cost/affordability and service sustainability are also generally appropriate and discussed in the appropriate clause of the standard.

Service activities relating to drinking water and wastewater — Guidelines for the assessment of drinking water services and the management of utilities

1 Scope

This standard provides guidelines for the management of drinking water utilities and the assessment of the services provided.

This standard includes

— the definition of a language common to different stakeholders,

— definitions of the characteristics of the elements of the service according to the customer expectations,

— a list of requirements to be fulfilled for the operation and maintenance (management) of a drinking water utility,

— drinking water utility objectives, and

— a list of service quality criteria and related examples of performance indicators, all without setting any target values or thresholds.

This standard addresses utilities in their entirety but it is also applicable to drinking water facilities at any level of their development (e.g. on-site facilities, networks, treatment facilities).

This standard specifically excludes:

— methods of design and construction of drinking water facilities,

— regulating the management structure,

— regulating drinking water service activities of operation and management including contracting, and

— topics relating to the system inside buildings between the point of delivery and the points of use.

Basic principles of this standard are given in Annex A.

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

NOTE The list of terms given below is common to ISO/CD 24510, 24511 and 24512.

2.1
accuracy
the closeness of agreement between a test result and the accepted reference value

NOTE The term accuracy, when applied to a set of test results, involves a combination of random components and a common systematic error or bias component.

[ISO 5725-1: 1994]

2.2
affordability
ability to be economically bearable by the **users** (2.41)

NOTE The affordability may be estimated through the level of prevailing charges for water services in relation to the available income of targeted social groups of consumers.

2.3
assessment
process (2.27), or result of this process, comparing a specified subject matter to relevant references

2.4
asset
capital good used for the provision of the **service** (2.38)

EXAMPLES Tangibles assets: buildings, pipes, wells, tanks, treatment plants, equipments, hardware; intangible assets: software, databases.

NOTE 1 Assets may be tangible or intangible.

NOTE 2 Contrary to consumables, assets may be depreciated in accounting systems.

2.5
asset management
the processes that enable a **water utility** (2.44) to optimise the cost of providing, maintaining and disposing of infrastructure assets for specified **performances** (2.24)

2.6
availability
extent to which a **water utility**'s (2.44) infrastructure asset, resources and employees enable effective provision of **services** (2.38) to **user** (2.41) as specified

2.7
community
one or more natural or legal persons and, in accordance with national legislation or practice, their associations, organisations or groups, having interests in the area where the **service** (2.38) is provided

2.8
confidence grade
assessment (2.3) of the **quality** (2.28) in terms of **accuracy** (2.1) and reliability

2.9
connection
service connection
set of physical components ensuring the link between a **point of delivery** (2.25) and the water main or the point of collection and the sewer

NOTE In wastewater systems, connection is synonymous with drain.

2.10
coverage
extent to which a **water utility**'s (2.44) assets allow **services** (2.38) to **users**

2.11
customer
user (2.41) who has a direct or indirect relation by means of a **service agreement** (2.39) with the **water utility** (2.44)

2.12
drinking water
water intended for human consumption

2.13
drinking water system
infrastructures
infrastructures necessary for supplying **drinking water** (2.12)

2.14
effectiveness
extent to which planned activities are realised and planned results achieved

[ISO 9000: 2000]

2.15
efficiency
relationship between the result achieved and the resources used

[ISO 9000: 2000]

2.16
environment
surroundings in which an organisation operates, including air, water, land, natural resources, flora, fauna, humans, and their interrelation

NOTE 1 Surroundings in this context extend from within an organisation to the global system.

[ISO 14001:2004]

NOTE 2 For the application of the standard, environment is considered as a specific stakeholder.

2.17
infrastructure
system of tangible fixed assets needed for the operation of a **water utility** (2.44)

NOTE Adapted from ISO 9000: 2000.

2.18
interruption
situation where the **service** (2.38) is not available

NOTE Interruptions may be planned or unplanned.

2.19
maintenance
set of activities aimed at keeping or restoring an asset in order to perform required functions in specified conditions

NOTE Maintenance is a combination of technical, administrative and managerial activities.

2.20
management
coordinated activities to direct and control an organisation

NOTE In English, the term “management” sometimes refers to people, i.e. a person or group of people with authority and responsibility for the conduct and control of an organization. When “management” is used in this sense, it should always be used with some form of qualifier to avoid confusion with the concept “management” defined above. For example, “management shall…” is depreciated whereas “top management shall…” is acceptable.

[ISO 9000: 2000]

2.21
management system
system to establish policy and objectives and to achieve those objectives

[ISO 9000: 2000]

NOTE A management system of a drinking water and/or wastewater utilities can include different management systems, such as a quality management system, a financial management system or an environmental management system.

2.22
on-site facility
set of physical assets necessary for supplying **drinking water** (2.12) or collecting and treating **wastewater** (2.42) without connection to a utility

2.23
operator
person or organisation, which performs day-to-day activities necessary for the provision of the **service** (2.38)

NOTE 1 There may be one or several operators for a given service. For example, distinct operators for installations operation, billing and recovering service.

NOTE 2 The operator may be legally distinct or not from the responsible body.

2.24
performance
achievements of an activity, a **process** (2.27) or an organization

2.25
point of delivery
point of entry
physical fixed interface beyond which the utility is not legally responsible

EXAMPLES A connection box, a meter, the limit between public and private property.

NOTE The point of delivery is generally defined in the service agreement.

2.26
point of use
physical fixed interface where the **user** (2.41) normally takes the water for the intended use

EXAMPLES A tap, a public drinking fountain.

NOTE 1 The point of use may be in private or public property.

NOTE 2 The point of use may be the same as the point of delivery, for example in the case of a public drinking fountain.

2.27
process
set of interrelated or interacting activities which transforms inputs into outputs

[ISO 9000:2000]

2.28
quality
degree to which a set of inherent characteristics fulfils **requirements** (2.34)

[ISO 9000: 2000]

NOTE Clearly distinguish between quality of the product (drinking water or treated wastewater) and quality of the service; this standard does not define the product quality.

2.29
quality management system
management system (2.21) to direct and control a **water utility** (2.44) with regard to **quality** (2.28)

NOTE Adapted from ISO 9000:2000.

2.30
registered customer
customer (2.11) for whom relevant information is recorded by the **responsible body** (2.36) or **operator** (2.23)

2.31
rehabilitation
operation on an infrastructure restoring its initial level of **performance** (2.24)

NOTE Adapted from EN 752-5: 1997.

2.32
relevant authority
competent authority
body entitled to lay down policies and legal framework and/or to check the compliance with these rules, concerning activities of **water utilities** (2.44)

EXAMPLES National, regional or local governments, public agencies, regulators.

NOTE The relevant authorities fix the general legal framework for the organization of the drinking water and wastewater utility, with which the water utilities (i.e. the responsible bodies and their operators) have to comply.

2.33
repair
action on a non-conforming product, equipment or facility to make it acceptable for the intended use

NOTE 1 Adapted from ISO 9000: 2000.

NOTE 2 Repair includes remedial action taken on a previously conforming product to restore it for use, for example as part of maintenance.

NOTE 3 Repair can affect or change parts of the non-conforming product.

NOTE 4 Repair may be planned (preventive maintenance) or due to emergency.

2.34
requirement
need or expectation that is stated, generally implied or obligatory

[ISO 9000: 2000]

NOTE "generally implied" means that it is custom or common practise for the drinking water and/or wastewater utilities, the users of the service and other interested parties, that the need or expectation under consideration is implied.

2.35
residues
sub-products resulting from the different processes applied to **drinking water** (2.12) or **wastewater** (2.42)

EXAMPLES Sludge, septage, sand or grit, grease, debris.

NOTE Residues may be liquid, solid or mixed.

2.36
responsible body
body which has the overall legal responsibility for providing drinking water and/or wastewater services and for establishing the policy and the general organization of the relevant **water utility (2.44)**, for a given geographic area

EXAMPLES A regional or local government, a city, a public agency, a private company.

NOTE 1 The responsible body can be public or private.

NOTE 2 The responsible body may operate directly the system with its own means or entrust a contractor for the operation.

2.37
restriction
situation where the service does not meet the availability conditions specified in the **service agreement** (2.39)

NOTE Restrictions may be planned or unplanned.

2.38
service
result of a **process** (2.27)

NOTE 1 Adapted from the definition of "product" given in ISO 9000: 2000

NOTE 2 Services are one of the four generic categories of products with software hardware and process materials. Many products comprise elements belonging to different generic products categories. Whether the product is then called service depends on the dominant element.

NOTE 3 Service is the result of at least one activity necessarily performed at the interface between the supplier and user and is generally intangible. Provision of a service can involve for example the following:

- activity performed on a customer supply tangible product (e.g. wastewater),
- activity performed on a customer supply intangible product (e.g. processing new connections demands),
- delivery of an intangible product (e.g. delivery of information), and
- creation of ambience for the user (e.g. customer reception offices).

2.39
service agreement
establishment of an accord between the **registered customer** (2.30) and the **water utility** (2.44) on the conditions of service provisions

EXAMPLE A contract.

NOTE It may be implicit or explicit.

2.40
stakeholder
person or group or organization having an interest in the performance or success of an organization

EXAMPLES Users and building owners, responsible body, operator, employees of the operator, external product suppliers and providers of other services, contractors, communities, consumers and environmentalist associations, relevant authorities, financial institutions.

NOTE 1 Adapted from the definition of "interested party" given in ISO 9000: 2000

NOTE 2 For the application of the standard, environment is considered as a specific stakeholder.

2.41
user
end user
person, group or organization, that benefits from drinking water delivery or from service of collecting and/or treating its effluents

NOTE 1 Users are a category of stakeholder.

NOTE Users may belong to various economic sectors: domestic users, commerce, industry, tertiary activities, agriculture.

2.42
wastewater
water affected by human activities and storm waters, discharged to the **environment** (2.16) or sewer

NOTE This includes sanitary and industrial wastewater allowed to be discharged into a sewer system outside buildings, as well as sanitary waste in undiluted form, sanitary wastewater combined with storm water, and storm water that does not include sanitary wastewater.

2.43
wastewater system
infrastructures
infrastructures necessary for collecting and treating **wastewater** (2.42)

2.44
water utilities
the overall processes, activities and means necessary for supplying **drinking water** (2.12) or collecting and treating **wastewater** (2.42) and providing the associated **services** (2.38)

3 Components of drinking water systems

3.1 General

A drinking water system generally comprises **four** components: a **water resource** (aquifer, lake, river or the ocean); a means of abstracting the water from the source and transporting it to a community - **intake facilities and raw water transmission mains** (often comprising pumping stations and pipelines); a **treatment facility** or facilities; and a **storage, transmission and distribution system** for the drinking water. In some simple systems, the treatment facility component may not be present depending on the quality of the source water and the intended uses of the water, or the facility may include only a disinfection component. In more complex drinking water systems there may be multiple sources, multiple pumping stations and reservoirs in the transport system; multiple stages to the treatment facility and processes; and pumping and re-treatment stations in the distribution system including at treated water reservoirs.

3.2 Types of systems

The systems can be centralised, decentralised for small communities or on-site.

Schematic presentations showing the elements or components of drinking water systems and the relations between the various components are shown in Annex B.

The supply can be continuous or intermittent; the water may be delivered by pipe to the customer's property or by some other means (e.g. truck, bottle, etc.). In addition, the utility may be linked to other utilities allowing the exchange (import or export) of raw or treated water.

3.3 Water resource

Any source of water, either groundwater or surface water is a water resource. Surface water sources could include streams, rivers, lakes or reservoirs. Seawater and reclaimed wastewater have become sources of water in arid or water short areas. Groundwater sources are waters contained within the geological formations accessed by springs, wells or bore holes.

Drinking water utilities generally have to use the water that is available to them, although aquifer or groundwater sources are less exposed than surface water to microbial and other hazards. Large utilities may have a number of independent water sources.

3.4 Intake and transport

The water intake system normally requires pumping stations to remove water from the aquifer or from a surface source to transport the water to the treatment facility. Some utilities may have the advantage of a water source that allows the use of gravity fed transport systems. In any case, the transmission mains may have in-system storage reservoirs and even disinfection systems if it is necessary to protect the transport lines from bacterial growth.

3.5 Treatment

Drinking water treatment facilities can vary from basic, providing some degree of disinfection, to multiple processes, providing clarification (e.g. coagulation, flocculation and filtration steps) with pH adjustment as necessary for optimal treatment processes. A final disinfection stage is usually necessary to ensure disinfection residuals in the distribution system. More advanced technologies can be employed as necessary and appropriate.

3.6 Storage, bulk transport and distribution

Drinking water entering the distribution system passes through a series of pipes whose diameter frequently diminishes as the distance from the treatment facility increases from water mains or trunk mains to the smaller water pipes connected to customers. In some cases, the final distribution of drinking water may be by truck or some other means. The distribution system may have storage reservoirs located at key points to take advantage of natural physical topography, or for reasons of balancing supply over peak and non-peak periods of demand.

It may be necessary to install disinfection facilities to ensure the quality of the drinking water to be delivered.

Valving and metering equipment may be installed throughout the distribution system for control purposes.

Metering equipment is frequently installed at various points in the drinking water systems for operational control purposes, and may be installed at the point of delivery.

3.7 Disposal of residues

Residues are produced at a number of stages in the water treatment process. Residues normally contain a large amount of water and are generally dewatered to reduce the volume.

The options for disposal, depending on quality, are:

— landfill sites when residues are sufficiently dewatered, and

— a wastewater treatment facility if approved by local authority.

4 Objectives for the drinking water utility

4.1 General

The responsible body should establish the objectives, associated service criteria and performance indicators for a drinking water utility, taking into account the legal requirements of the relevant authorities as a basis and the expectations of the users and other stakeholders in conjunction with its operators.

Figure 1 below, illustrates relevant relationships between stakeholders for establishing objectives.

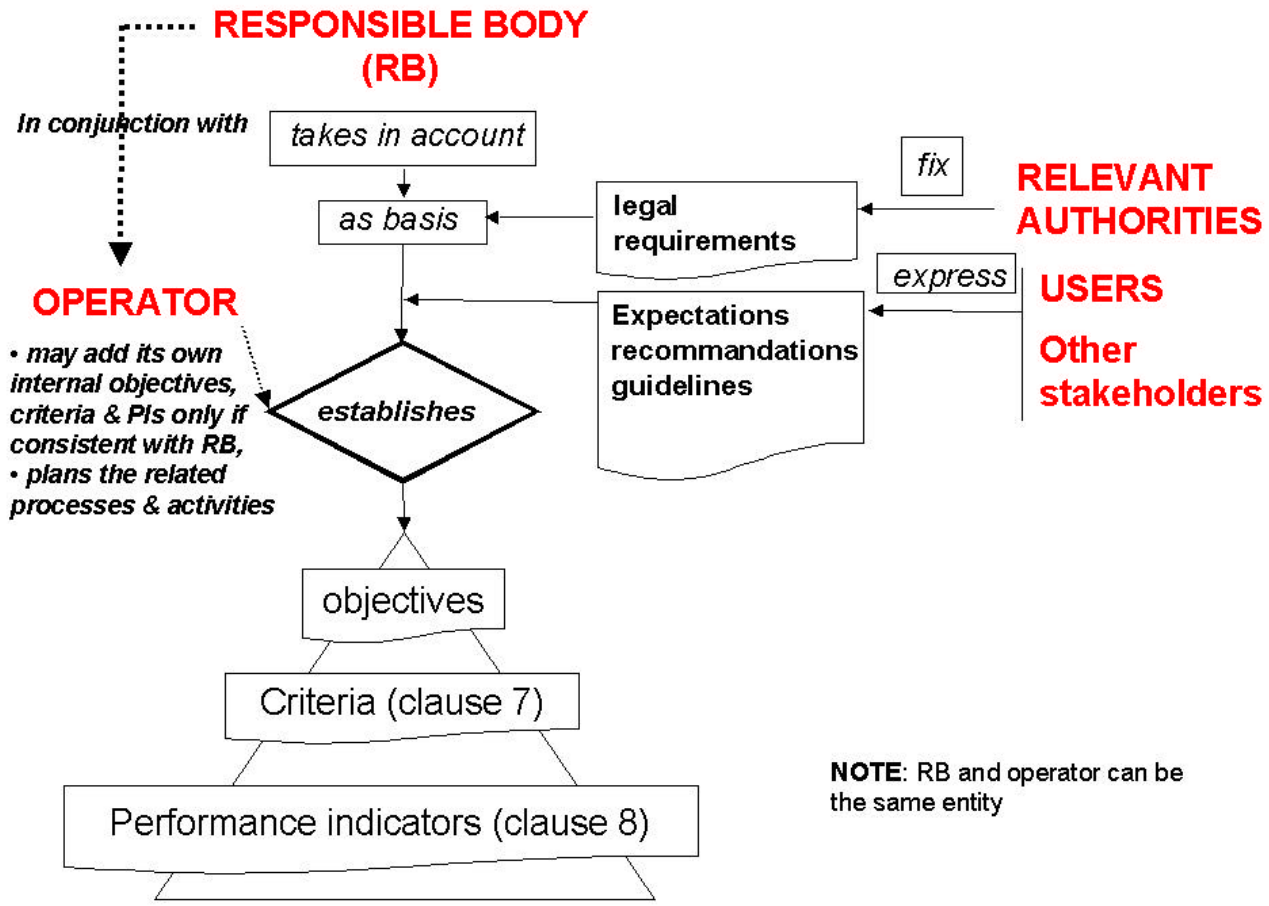


Figure 1 — Relevant relationships between stakeholders for establishing objectives

The following objectives (see 4.2 to 4.6) are considered to be the principal objectives for drinking water utilities. Possible actions that a drinking water utility can undertake to achieve these objectives are shown in Annex C.

4.2 Protection of public health

The primary objective of a drinking water utility is to ensure a ***sufficient supply*** *of* ***safe*** *and* ***agreeable*** *drinking water.*

Sufficient supply means a quantity of drinking water available to the consumer in accordance with applicable national public health standards, regulations or guidelines taking into account the WHO Sanitation Guidelines (see bibliography [8]).

Safe drinking water means drinking water that has a quality in accordance with the applicable national health regulations taking into account the WHO Guidelines for Drinking Water Quality (see bibliography [9]). Safe drinking water may also be expressed in terms of microbiological, chemical or radiological qualities.

Agreeable drinking water means drinking water that is aesthetically acceptable (e.g., in terms of taste, odour, or colour).

It is important that the drinking water is of **sufficient supply** and **agreeable** to the consumer (i.e., aesthetically acceptable), as the consumer might otherwise be inclined to go to unsafe water sources.

4.3 Provision of services (under normal and emergency situations)

An objective of a drinking water utility is to ensure that under normal conditions drinking water is available on a continuous basis.

Drinking water is essential for public health and societal development and sustainability. Continuity of supply is equally essential. From time to time, the water supply may be interrupted. Risk management activities should be undertaken to minimize this possibility. However, where an emergency condition applies, emergency plans and response actions should be initiated.

The objective should also be to provide drinking water to critical customers or critical service areas during emergency situations and to restore service as quickly as possible when interruptions have occurred.

Critical customers (e.g., hospitals, schools) includes those who may not be able to be evacuated to areas where water supply is still available; critical service areas may include areas of governance or transportation corridors. Provision of drinking water in emergency conditions may involve alternative distribution mechanisms or obtaining water from adjacent unaffected supply services.

4.4 Sustainability of the water utility

An objective for a drinking water utility is to ensure that the assets provide capacity to meet the current needs and future demands.

The water utility should maintain and when necessary replace assets in order to keep the drinking water service reliable for a long period of time.

The water utility should react to changes in the natural and social environments, such as water resource availability and drinking water demand, taking into consideration the most current research and technology.

4.5 Promotion of sustainable development of the community

An objective for a drinking water utility is to promote sustainable development of the community.

Sustainable development means the ability for the community to grow and prosper within the environmental resources available to it, without limiting the use of those resources by future generations and includes:

— contributing to and implementing sustainable water resources management policies and practices,

— contributing to development planning and resource allocation through consultation, provision of information and analysis in conjunction with appropriate institutions, and

— contributing to public safety (e.g., fire-fighting) and related services.

4.6 Protection of the environment

*An objective for a drinking water utility is to minimize **environmental impacts** remediate tangible past adverse effects to the environment.*

Environmental impacts are generally caused by the following:

— consuming energy,

— generating environmental pollutants, the emission of gases, noise and odours and the improper management of residues and other wastes,

— contaminating water resources, impairing freshwater quality and quantity in rivers, lakes and aquifers, aquatic ecosystems, and

— depleting water resources, which affect quality or quantity of streams or aquifers and their ecosystems.

5 Management components of a drinking water utility

5.1 General

It is recommended that the drinking water utility establish an integrated management system that would encompass all the management components for providing the water service.

Management of a utility requires the integrated management of various fields:

— activities and processes,

— resources,

— customer relations,

— information,

— assets,

— environment,

— risks.

5.2 Activities management

There are many individual activities and processes within a drinking water utility. These may be undertaken at many different levels within the hierarchy of the organisation. Activity and process management includes: policy-making, strategy formulation, regulatory compliance, internal and external coordination, and operations and controls.

5.3 Resources management

Drinking water utilities normally have the following resources that should be managed:

— personnel (human resources),

— material and equipment (non-fixed assets, e.g. spare parts, vehicles, and chemicals. Assets are also considered in 5.4 below),

— financial (costs and benefits),

— natural resources (e.g. land).

5.4 Asset management

Water services have tangible and intangible assets. Management of the assets includes: maintenance of the up-to-date system inventory, monitoring and registration of data on the condition of the system, planning, maintaining or rehabilitating the system, optimising depreciation and reinvestment, and performing risk management.

5.5 Customer relations management

A drinking water utility is essentially present to serve its customers. Customer relation's management is equally critical to the success of the service and includes: identification of customer needs and expectations, customer service (registration and handling of complaints, customer accounting/billing, and communication, education and information).

Special consideration should be given to achieving customer satisfaction and reference should be made to ISO 24510.

5.6 Information management

In all drinking water utilities, information management is becoming increasingly important and a feature of regulatory control programs.

Information management includes: data management (acquisition, evaluation, registration and updating of data). Increasingly, information is required to be communicated transparently to users and other stakeholders.

5.7 Environmental management

The planning of the development of the water supply system can be based on a long-term strategy for environmental protection, by improving step by step the water supply system taking into account the population and urbanisation development, the safeguard of public health and the protection of the water source.

5.8 Risk management

Risk management comprises proactive approaches taken to assure the continuity of the service in emergency situations, e.g. natural disaster (earthquake, extreme weather events, etc.) and technological and other accidents. Further, proactive measures include the prevention or response to criminal acts of vandalism or terrorism.

6 Guidelines for the management of drinking water utilities

6.1 General

The organisation's management structure should be designed to ensure the correct, effective and efficient planning, implementation, monitoring and checking of all tasks, processes and activities. It should encompass the full range of services or functions provided.

The mission of the drinking water utility is to abstract, treat and distribute potable water and to treat, reuse or dispose of its residues in an acceptable fashion, addressing all the components of the management of the drinking water utility as described in clause 5 in order to fulfil the objectives as stated in clause 4.

Process management of and within drinking water utilities should be carried out using the four point "plan-do-check-act" scheme, which involves planning of activities (plan), implementation of the plan, (do), data collection and monitoring (check), and assessment and decision-making on possible changes needed to improve the performance (act).

Centralised, decentralised and on-site water services should be improved and monitored to ensure the protection of water resources and of the receiving environment from pollution and to ensure maximum recovery and reuse of process water and residuals.

6.2 Organisation

6.2.1 General

The drinking water utility should provide a well-structured documentation of its hierarchy and organisation of workflow.

Periodic reviews of the management system should be carried out to ensure its continual improvement.

Managers and supervisors should check all mandatory or legal requirements for their proper application. If they detect non-conformity or deviation in the hierarchical and workflow organisation and/or the documented regulations, they should initiate immediate remedial action.

Management capability is required.

Financial capability and funding should be adequate to provide for operational and capital requirements.

Consideration should be given to developing and making the best use of staff expertise.

6.2.2 Hierarchical organisation and responsibilities

The operator should define all tasks, competences and the ensuing responsibilities relating to the activities pursued by the drinking water utility. The management structure and organisation should be clearly defined to establish responsibilities to ensure that all activities are completed correctly.

6.2.3 Organisation of work flow

The drinking water utility should define the sequence of all essential operations required for the proper performance of its tasks, processes and activities on the basis of its hierarchical organisation (see clause 5), ensuring that both internal cooperation and the interfaces resulting from the integration of third-party organisations are organised in a harmonious manner. More detailed working instructions should be given whenever required to ensure the proper and expert handling of individual activities, adhering to applicable national generally accepted requirements or practices.

There should be a clear definition of the type, scope and level of detail of the organisation of workflow, including the qualification level and in-service proficiency of the employees in charge of handling all tasks and activities.

6.2.4 Business documents and records

Suitable documentation for all tasks and activities as set out in clause 5 should be prepared to furnish proof that they have been carried out properly and expertly.

Managers and supervisors should check these records at regular intervals.

All supervision and checking activities should be documented.

If not stated otherwise in national legal provisions, license permits and official directions or the nationally generally accepted requirements or practices, every document should be kept on record for a defined period.

The documents concern for example:

— plans and system documentation,

— operating instructions, diaries and records,

— financial records,

— test records, proof of maintenance,

— water analysis, effluents and sludge quality,

— contractual and legal affairs,

— measures respecting employees.

6.3 Planning and construction

The planning of the adaptation, the development and the construction of the water system should be based on a long-term strategy for environmental protection, by improving step by step the water system taking into account the population and urbanisation development, the evolution of the expectations, changes in the mandatory and legal requirements, the safeguard of public health the protection of the water source.

6.4 Operations and Maintenance

6.4.1 General requirements

Operations and maintenance concern the assets of the water system and include:

— abstraction,

— treatment of raw water,

— distribution of water to point of delivery (including assessment of water mains, reservoirs and tanks),

— reduction in process water and the treatment and reuse of such process water, and

— the safe transportation and disposal of residues.

The water operator should develop a plan for an operations and maintenance strategy covering both proactive and reactive activities.

The activities and responsibilities of the water operator should cover the aspects listed below:

— operations (actuating, switching, controlling open and closed-control loops),

— operational efficiency controls,

— maintenance (servicing, inspection, rehabilitation, repair),

— monitoring of source and finished water and residue quality and quantity,

— commissioning (stopping, re-commissioning, decommissioning) may be in conjunction with the responsible body,

— troubleshooting (during and outside normal hours of work),

— documentation.

6.4.2 Technical activities

6.4.2.1 Water treatment facilities

The management of treatment and other processes with the drinking water utilities should be undertaken in a manner that optimises the use of equipment and resources involved.

Each unit of the water treatment facilities should be operated according to its specifications. The proper operation of the treatment facilities may require in particular:

— adjusting the treatment and the type and volume of reagents used, to the characteristics of the water or residues,

— ensuring the regular supply of treatment products, their correct storage and maintenance of recipients and dosing device,

— controlling the elimination of waste and of by-products, and

— controlling the efficiencies of the processes and establishing and monitoring critical control points.

6.4.2.2 Water transportation system

Water can be transported by different means (pipelines, road tankers, etc.).

6.4.2.3 Emergency provisions

The continuity of the drinking water utility to users is a priority for protecting public health and the environment therefore the operator should be prepared to take the necessary steps to deal with emergency situations. When service is interrupted, the service should be restored as soon as possible and special attention should be given to the needs of critical customers or critical service areas.

For emergency situations, in order to minimise the negative impacts on the water service the operator should work out an emergency plan based on a risk assessment.

It is recommended that the emergency plan be tested and that simulation exercises be conducted in order to train the operating personnel in managing emergency situations. Experience of previous crises and simulation exercises should be documented.

On the basis of the risks previously analysed and classified, preventive actions should be worked out and economically evaluated.

6.4.3 Support activities

6.4.3.1 Purchasing equipment, materials and products

Processes should be established for both the procurement and stockpiling of all materials, equipment and products.

Clear and precise specifications should be produced and conformity assessed. For the execution of the tasks and activities, professional and appropriate equipment should be available to employees.

The maintenance of drinking water quality requires the use of chemically, microbiologically and sanitarily satisfactory additives and construction materials, paints and coatings for all surfaces coming into contact with drinking water.

This requirement should be fulfilled in both the procurement and stock-keeping processes for all such materials and components.

The choice of the pipeline components and tube materials should be taken into account on the physical demands placed on the pipeline.

6.4.3.2 Contractual and legal affairs

All rights, permits and contracts (supply contracts, customer contracts, etc.) should be managed properly. Specific attention should be paid to abstraction and discharge consents, rights to lay water mains, easements for treatment, storage and disposal facilities.

6.4.3.3 Accounting/billing

The accounting system should be comprehensive of all costs including environmental and resource costs. If charged for the provision of water, fees may reflect the full or partial costs of the water services according to applicable social policies. The calculation of the fee should be transparent.

6.4.3.4 Human resources

The drinking water utility should make sure that all employees are educated, trained and qualified for the tasks to be carried out.

6.4.3.5 Protection of labour

The operator should provide a safe environment, appropriate equipment (e.g. personal safety equipment) and work procedures. The personnel concerned should receive instruction on worker safety. Attention should be paid to the occupational health for all personnel with respect to specific risk in operating water systems.

6.4.3.6 Outsourcing

When outsourcing work, the overall responsibility should remain with the drinking water utility. Therefore, the utility should make sure that the third-party involved:

— meets all the necessary personnel and material requirements,

— is capable of ensuring the proper monitoring and checking of its own activities, and

— has at its disposal, staff of suitable reliability and efficiency as well as having the technical and expert knowledge required to perform the tasks in question.

7 Service assessment

7.1 General considerations

Generally, assessment is a process which, as every process, should be managed explicitly and clearly define the objectives of the process**,** the scope of the assessment, the responsible organisation, the parties involved, the model or method to be followed, the resources needed, the frequency and activating event, and the users of the results.

There are a great variety of possible assessments, depending on the features listed above. For example, there is performance assessment, within a reduced or wide scope (e.g. environmental performance assessment), conformity assessment, risk assessment, and audits, etc. If not precisely specified, the concept of assessment may induce risks of confusion or conflicts between the interested parties.

A distinction should be made between the results of an assessment and the use and interpretation of these results. It is recommended that when an assessment is launched, the parties interested and the relevant decision-makers share a common understanding of the nature and the criteria of the decisions, which are expected to flow from the results of the assessment.

Some types of assessment procedures may be already standardized. In such cases it is recommended that the relevant standards be used.

EXAMPLE Review [ISO 9000:2000 - 3.8.7] or an environmental performance evaluation [ISO 14031:1999 - 2.9].

As with every process, an assessment process should be periodically reviewed and improved, regarding its objectives, its efficiency and its effectiveness (i.e. concept of plan–do–check–act).

When the responsibilities of the control of the assessed system are shared between several stakeholders, the interpretation of the results of an assessment may be very sensitive if used for the analysis of the responsibilities. The more complex the system, the more difficult the interpretation. The greatest caution is therefore recommended.

An overall assessment policy for an organisation should encompass all of the various management systems and procedures. Self-assessment is, considered a procedure defined and controlled by the body responsible for the subject matter of the assessment and should be included in every management component, aiming at closing the cycle linking objectives to results.

The assessment policy should be attentive to the overall efficiency and effectiveness of the various assessments, avoiding duplications.

7.2 Considerations relating to drinking water services

This standard is only a guideline; it is not a specification, the compliance with which one of the stakeholders could want to check. It is not a tool for certification, but presents general guidelines aimed at encouraging the definition and the implementation of good practices for the management of drinking water services.

Due to the diversity of legal, institutional and managerial systems for the management of drinking water utilities, it is not possible to specify assessment procedures in this standard.

Whenever possible, the assessments should be focused on performance and on the satisfaction of users and meeting the objectives for the service, and not on the means and detailed organization implemented for meeting the objectives.

The recommendations relating to assessment differ between service to users and management of the utility.

For service to users, the objectives and criteria recommended in the relevant standard are strictly focused on the performances of the service at the interface between the utility and the user. It is recommended that assessment processes should focus only on performance and effectively involve the users in the processes.

For management issues, the general recommendation of focusing on performance criteria is also applicable; nevertheless, some activities do not fit well with direct measurement of their performance.

In such cases indirect assessment of the performance can be accomplished through the evaluation of some management systems such as risk management, and asset management.

If, at a geographically relevant level (country, region, city,), adapted specifications can be established for the management of the water utility, then these specifications should also include provisions concerning assessment processes.

When the responsible body and the operator(s) are not the same legal body, attention is drawn to the importance of some general recommendations made above, regarding the difficulties and the dangers of trying to determine responsibilities from inadequate assessments processes.

In such a case, concerning service to users, the responsible body and its operator should be considered as one unique entity.

Concerning management of the utility, self-assessment should be integrated in every process. When assessment processes are common to both the responsible body and the operator, the conditions of such assessments should be precisely defined by the relevant authorities or by contract between these two parties.

7.3 Service assessment criteria

Service assessment criteria can provide a basis for the assessment of the service provided to the user and/or the management activities of the utility. The necessary service assessment criteria should be selected according to the objectives and requirements as determined by stakeholders reflecting the local conditions.

Service assessment criteria are the link between objectives and performance indicators. The example below shows, for one of the objectives proposed in clause 4, possible service assessment criteria. More examples are given in Annex D.1.

It should be noted that a particular service assessment criteria may be related to more than one objective.

EXAMPLE Objective: Protection of public health

*The primary objective of a drinking water supply service is to ensure a **sufficient supply** of **safe** and **agreeable** drinking water.*

Possible Service Assessment Criteria:

— Meeting or exceeding the minimum quantity of drinking water necessary to meet service requirements,

— Meeting or exceeding drinking water quality requirements, and

— Meeting or exceeding the applicable minimum aesthetic standards.

8 Performance indicators

8.1 General

Performance indicators are used to measure the efficiency and effectiveness of a utility in achieving its objectives (particularly those identified in clause 4).

Performance indicators should be used within the context of a comprehensive service assessment system. This system should include, amongst other tools, a coherent set of indicators and the related components that allow for a clear definition of these performance indicators and assist in their interpretation.

8.2 Performance indicators systems

8.2.1 General

A performance indicator system comprises a set of performance indicators, context information and variables.

8.2.2 Performance indicators

Individual performance indicators should be unique and collectively appropriate for representing the relevant aspects of the service in a true and unbiased way.

Each performance indicator should:

— be clearly defined, with a concise and unequivocal meaning;

— be assessed from variables that can be easily measurable at a reasonable cost,

— contribute to the expression of the level of actual performance achieved

— in a certain area,

— allow for a clear comparison with targeted objectives and simplify an

— otherwise complex analysis,

— be verifiable,

— be simple and easy to understand,

— be objective and avoid any personal or subjective appraisal.

Performance indicators are typically expressed as ratios between variables. These ratios may be commensurate (e.g. %) or non-commensurate (e.g. $/m3). In the case of non-commensurate ratios, the denominator should represent one dimension of the system (e.g. number of service connections; total water main length; annual costs). This allows for comparisons through time, or between systems of different sizes.

Variables that may vary substantially in time (e.g. annual discharge volumes) particularly if not under the control of the utility should be avoided as denominators in the indicator ratios. An exception can be made when the numerator varies in the same proportion as the denominator.

A clear processing rule should be defined for calculating each indicator. The rule should specify all the variables required and their algebraic combination. The variables may be data generated and managed within the utility (utility data) or externally (external data). The use of internal utility data is generally preferred to external data because the quality of external data is out of the control of the utility. The interpretation of the performance indicators should not be carried out without taking into account the context, particularly if it is based on comparisons with other cases. Therefore, complementary to the performance indicators, the context information should consider also the characteristics of the system and the region in which the services are provided.

Examples of performance indicators and how to calculate them are provided in informative Annex D.2 Additional information on performance indicators and grading systems for performance indicators are provided in Annex E. Reference to existing relevant performance indicator systems is provided in the bibliography.

8.2.3 Variables

Each variable should:

— fit the definition of the performance indicator or context information it is used for,

— refer to the same geographical area and the same period of time or reference date as the performance indicator or context information it will be used for, and

— be as reliable and accurate as the decisions made based on it require.

Some of the variables are external data and mainly informative, and their availability, accuracy, reference dates and limits of the corresponding geographical area is generally out of the control of the utility. In this case, variables should also:

— whenever possible be collected from official sources, and

— be essential for the performance indicator assessment or interpretation.

8.2.4 Context Information

Context information defines inherent characteristics of a system that are relevant for the interpretation of the performance indicators. There are two possible types of context information:

— information describing pure context and external factors that are not under the control of the utility (e.g. demographics, topography, climate, etc.), and

— characteristics that can only be influenced by management decisions in the long term (e.g. age of the infrastructures).

8.3 Quality of the information

The quality of the data should reflect the importance of the assessment being conducted.

A scheme providing information on data quality is needed so that users of the performance indicators and context information are aware of the reliability of the information available. The value of the performance indicators is questionable without this scheme.

The recommended confidence grade of a performance indicator can be assessed in terms of its accuracy and reliability. The accuracy accounts for measurement errors in the acquisition of input data. The reliability accounts for uncertainties in how reliable the source of the data may be.

An example of a confidence-grading scheme is presented in Annex E.

8.4 Example of a performance indicator

Performance indicators are relevant to service assessment criteria which are the link to. The example below shows, for one of the objectives proposed in clause 4, possible performance indicators relevant to one of the service assessment criteria shown in 7.3. More examples are given in Annex D.2.

EXAMPLE Objective: Protection of public health

*The primary objective of a drinking water supply service is to ensure a **sufficient supply** of **safe** and **agreeable** drinking water.*

Possible Service Assessment Criteria: **Safe Drinking Water** - Meeting or exceeding drinking water quality requirements.

Safe Drinking Water

Performance Indicator: Potability

Total number of reportable treated water tests complying with legislation during the year X 100 / total number of reportable treated water tests – unit - %.

Comment: Each jurisdiction should establish legislated requirements or guidelines for safe drinking water and use acceptable methods of measurement. This performance indicator can also apply to individual parameters including microbiological, chemical, radioactivity, and aesthetic requirements or guidelines.

Annex A
(informative)

Basic principles of the standard

The figure A.1 below shows the linkage between the contents of the ISO Standard and the relationship of the standard to other guidance or related documents or requirements.

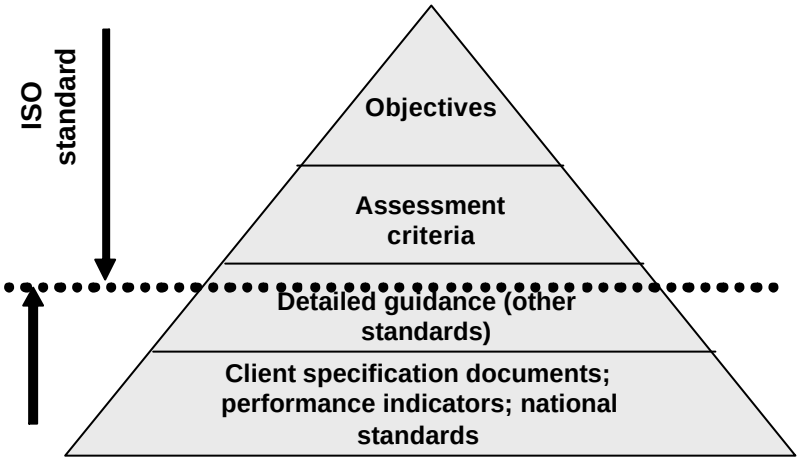


Figure A.1 — Level of detail of the standard

Figure A.2 below illustrates the relationship between activities of the relevant stakeholders and determination of the assessment elements of the standard.

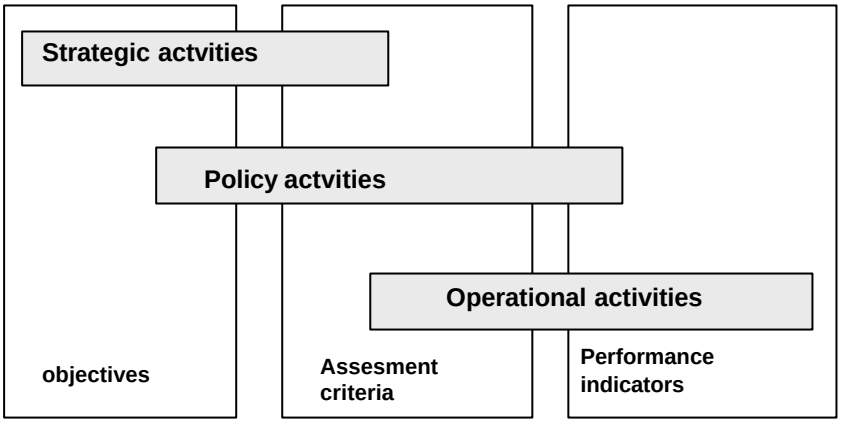


Figure A.2 — Relation between objectives, assessment criteria and performance indicators and related activities

The following figure A.3 integrates schematically figures A.1 and A.2 to show the relationship between activities and the level of details in the standard.

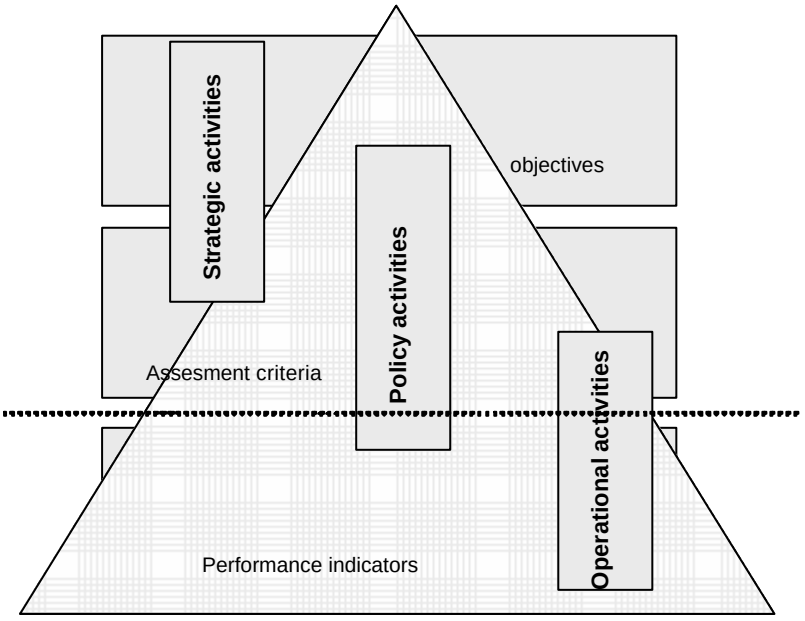
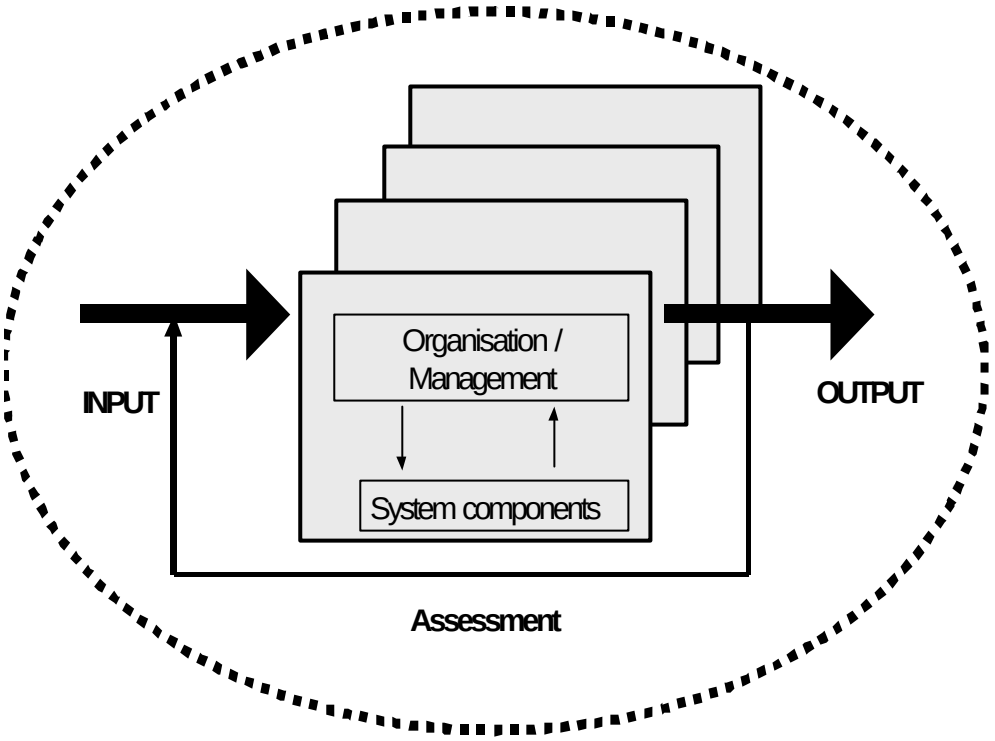


Figure A.3 — Relation between activities and level of details of the standard

The following figure A.4 indicates the relationship between inputs, outputs and the management of the service.

Figure A.4 — General model for water services



Annex B
(informative)

Schematics of drinking water supply systems

There are five essential elements or components of a drinking water supply system as shown in Figure B.1 below:

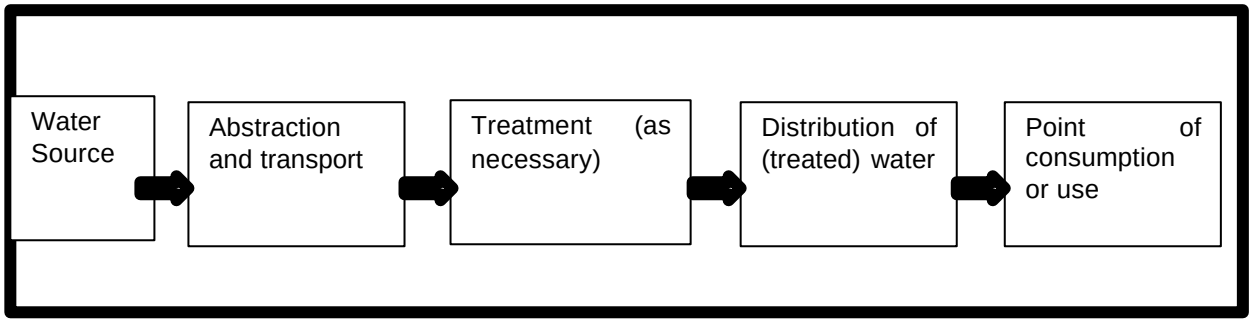


Figure B.1 — Basic schematic of a drinking water supply system

These components can be recognized in a typical on-site system such as may be found in private water supply systems of rural residences and buildings with a well, a pump, piping to connect the well to the building, possibly some sort of point-of-entry or point-of-use treatment system such as a water softener or filter, and a plumbing system connected to a series of taps located in the building or in some cases to a stand pipe for common use within a village.

They can equally be recognized as elements of a central water supply system as may be found in communities ranging from villages to cities and even regional water supply systems supplying several communities in a given geographic area. In this case the distribution system will include a broader distribution system of treated water mains connected to serviced buildings within the community. Figure B.2 below illustrates such a system, and notes that there may be connections between such a system and other systems which may be undertaken for a series of operational or security reasons.

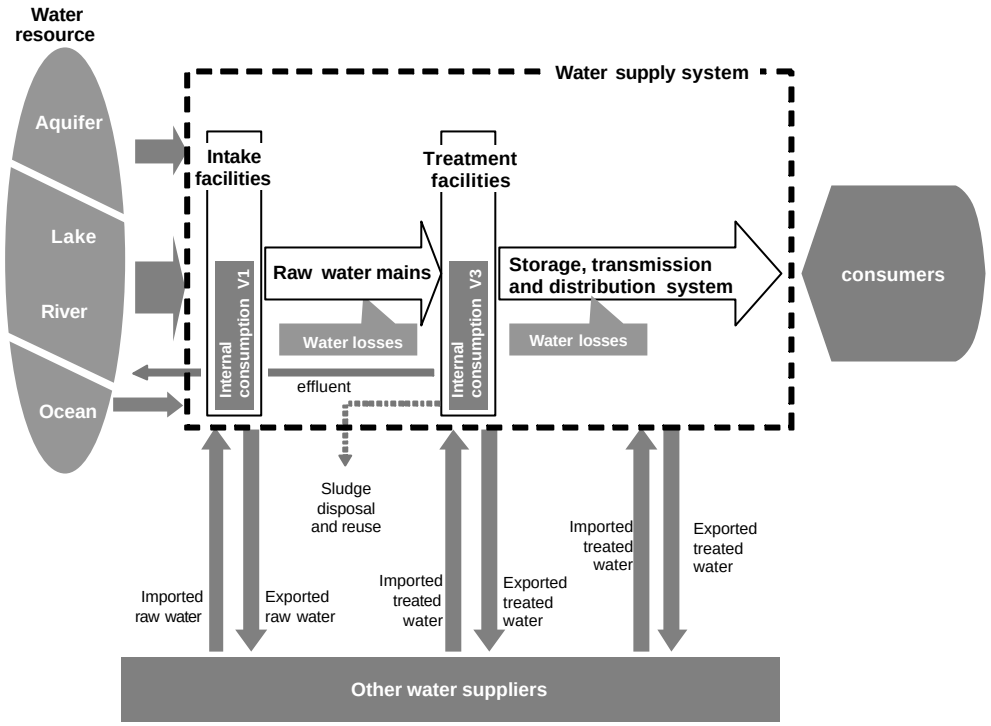


Figure B.2 — Schematic of a typical centralized service drinking water supply system

Annex C
(informative)

Possible actions to achieve drinking water service objectives

In developing objectives, care should be taken not to give the “means to achieve an objective” the status of being an “objective”. For example, "having a well-trained labour force" could be an objective but it could alternatively be a means to achieving an objective such as “producing safe drinking water” or "having a sustainable supply service".

For most objectives, a series of related action steps can be developed. This is illustrated in table C.1.

Table C.1 — Drinking water utility objectives and possible actions

Drinking Water Utility Objectives	Possible Actions
*The primary objective of a drinking water utility is to ensure a **sufficient supply** of **safe** and **agreeable** drinking water. (see 4.2)*	— provide drinking water that is potable at the point-of-delivery to the customer; — provide drinking water that is aesthetically acceptable at the point-of-delivery to the customer; — provide sufficient drinking water to meet the public health and sanitation needs of the customer.
An objective of a drinking water utility is to ensure that under normal conditions drinking water is available on a continuous basis. *The objective should also be to provide drinking water to critical customers or critical service areas during emergency situations and to restore service as quickly as possible when interruptions have occurred. (see 4.3)*	— provide a continuous supply of drinking water; — provide an adequate pressure of drinking water; — manage factors affecting the reliability of service.
An objective for a drinking water utility is to ensure that the assets provide capacity to meet the current needs and future demands. (see 4.4)	— ensure access to water resources; — provide an adequate system capacity; — operate and maintain or replace the service assets to maintain a good condition; — have an appropriate, safe and qualified labour force; — establish a pricing mechanism that will be fair to consumers and provide appropriate revenue flows; — establish tariff structures that provide for recovery of all drinking water supply costs.

Drinking Water Utility Objectives	Possible Actions
An objective for a drinking water utility is to promote sustainable development of the community. (see 4.5)	— contribute to sustainable integrated water resources management policies and practices including protection of water resources; — reduce environmental pollution through the reduction of gas, noise and odour emissions from drinking water supply service facilities and the discharge of filtration unit effluents; — select where possible materials of construction for assets or additives for treatment systems and infrastructure construction methods that are environmentally benign.
*An objective for a drinking water utility is to minimize **environmental impacts** remediate tangible past adverse effects to the environment. (see 4.6)*	— optimize various energy consumptions; — minimize the generation of environmental pollutants, the emissions of gases, noise and odours from drinking water facilities; — manage sludge and other wastes; — contribute to and implement sustainable integrated water resources management policies and practices; — protect water abstraction areas from contamination; — contribute to development planning and resource allocation through consultation, provision of information and analysis in conjunction with appropriate institutions; — protect water resources, freshwater quality and quantity in rivers, lakes and aquifers.

Annex D
(informative)

Examples of other drinking water objectives, related assessment criteria and performance indicators

D.1 Other drinking water objectives and possible service assessment criteria

The drinking water objective from clause 4 is stated, followed by possible service assessment criteria.

a) ***An objective*** *of a drinking water utility is to ensure that under normal conditions drinking water is available on a continuous basis. The objective should also be to provide drinking water to critical customers or critical service areas during emergency situations and to restore service as quickly as possible when interruptions have occurred (see 4.3).*

Possible assessment criteria:

— maintenance of a positive pressure in the distribution system;

— maintenance of a positive pressure that is greater than minimum requirements;

— maintenance of an adequate quantity of drinking water in the distribution system that is greater than minimum requirements;

— meeting targeted risk levels;

— having a critical customer plan.

b) ***An objective*** *for a drinking water utility is to ensure that the assets provide capacity to meet the current needs and future demands (see 4.4).*

Possible assessment criteria

— have legal access to water sources;

— design abstraction capacity, treatment capacity;

— distribution system capacity, etc.

c) ***An objective*** *for a drinking water utility is to promote sustainable development of the community (see 4.5).*

Possible assessment criteria

— manage drinking water demand;

— participate in development planning;

— provide education and awareness programs.

a) ***An objective*** *for a drinking water utility is to minimize* ***environmental impacts*** *remediate tangible past adverse effects to the environment (see 4.6)*.

Possible assessment criteria

— minimize energy consumed;

— minimize pollutants generated;

— remediate contaminated river or lake beds.

D.2 Examples of performance indicators

D.2.1 General

The management of drinking water systems can be assessed and improved in accordance with the objectives defined in clause 4 of this standard.

The fulfilment of these objectives can often be measured by means of performance indicators, however the performance indicator is often not the only method of measurement.

Performance indicators and guidelines are provided below and it is noted that they are sensitive to local conditions and consequently the performance indicators and guidelines presented in this Informative Annex are presented only as examples.

D.2.2 Protection of public health

Safe drinking water

Performance indicator: Potability

Total number of reportable treated water tests complying with legislation during the year X 100 / total number of reportable treated water tests – unit - %

Comment: Each jurisdiction should establish legislated requirements or guidelines for safe drinking water and use acceptable methods of measurement. This performance indicator can also apply to individual parameters including microbiological, chemical, radioactivity, and aesthetic requirements or guidelines.

Sufficient supply of drinking water: Sufficiency

Total water supplied per person X 100 / quantity required to be supplied per person – unit -%

Guidance: Sufficient supply means a quantity of water available to the consumer in accordance with relevant national public health standards, regulations, or guidelines taking into account the WHO Sanitation Guidelines.

Comment: Equity of distribution is important, so the numerator should relate to the customer or customers receiving the least quantity of water.

D.2.3 Provision of services

Availability of drinking water

Performance indicators: Coverage of served population

Residential population served X 100 / total population – unit -%

Comment: This performance indicator provides an indication of the degree to which the residential population has access to water. It is important to recognize that the drinking water supply system ensures water is continuously available under normal conditions and available to critical customers or service areas under emergency conditions.

D.2.4 Sustainability of the drinking water system

Treatment capacity

Performance indicator: Surplus capacity ratio

Maximum daily volume of water treated per year X 100 / maximum daily capacity of the treatment plants - units -%

Storage capacity

Performance indicator: Capacity of impounding reservoirs

Capacity of impounding reservoirs X 365 X 100 / authorized consumption (including exported water) plus losses – units -%

Comment: The physical capability of the system can be measured by comparing the design capacity with the utilization of the physical assets. These performance indicators provide a measure of this utilization level.

Transport system capacity

Performance indicator: Main failures – Transmission

Number of main failures per year / total length of mains – units - number / 100 km / year.

Distribution system capacity

Performance indicator: Main Failures – Distribution

Number of main failures per year / total length of mains – units - number / 100 km / year.

Comment: This performance indicator provides an indication of the reliability of the supply system. Similar performance indicators can be used for failures of service connections, hydrants, and power supplies.

D.2.5 Promotion of sustainable development of the community

Sustainable development

Guidance: Sustainable development is the ability of the community to grow and prosper without limiting the use of the water resources, including:

1) contributing to and implementation of sustainable water resources; and

2) contributing to development planning and resource allocation.

D.2.6 Protection of the environment

Water losses

Performance indicator: Water loss per service connection

Water losses / number of service connections – units - m3 / connection

Sludge management

Performance indicator: Recycled treatment sludge

Recycled treatment process sludge X 100 / total treatment sludge generated - units -%

Comment: A drinking water supply system should be operated in a manner that minimizes adverse effects on the environment. Adverse effects include water losses, excess energy use, the generation of environmental pollutants or emissions, sludge, and other waste management.

Annex E
(informative)

Performance indicators and related components - An example of a confidence-grading scheme

E.1 General

The quality of input data should be therefore assessed in terms of its accuracy and reliability: The accuracy accounts for measurement errors in the acquisition of input data.

NOTE 1 No measurement device is completely accurate, and some of the data to be used to assess the performance indicators may have been obtained by less accurate methods.

The reliability accounts for uncertainties in how reliable the source of the data may be.

NOTE 2 Old records may be reliable in terms of depicting the current situation of assets.

E.2 Reliability bands

E.2.1 A - Highly reliable

Actual	Data based on sound records, procedures, investigations or analyses that are properly documented and recognized as the best available assessment methods.
Forecasts	Based on extrapolations of high-quality records covering or applicable to 100% of the service's area, kept and updated for a minimum of five years (the forecast will have been reviewed during the reporting period).

E.2.2 B - Reliable

Actual	Generally as in band A, but with minor shortcomings, e.g.: some of the documentation is missing, the assessment is old, or some reliance on unconfirmed reports or some extrapolations are made.
Forecasts	Based on extrapolations of records covering or applicable to more than 50% of the service's area, kept and updated for a minimum of five years. The forecast will have been reviewed during the previous two years.

E.2.3 C - Unreliable

Actual	Data based on extrapolation from a limited sample for which band A or B is available.
Forecasts	Based on extrapolations of records covering more than 30% of the service's area. The forecast will have been reviewed during the previous five years.

E.2.4 D - Highly unreliable

Actual	Data based on unconfirmed verbal reports and/or cursory inspections or analysis.
Forecasts	Based on extrapolated information not complying with bands A, B or C.

E.3 Accuracy bands

Accuracy is defined as the approximation between the result of a given measurement and the (conventionally) correct value for the variable to be measured. The accuracy bands presented below are based on the system adopted in England and Wales.

They are to be applied to the measurement and not to the measuring equipment. For example, in some cases the equipment may be highly accurate but is used out of range. Whenever the measurement accuracy cannot be assessed, it should be graded as greater than 100%.

The accuracy bands suggested are:

1) Better than or equal to +/- 1%

2) Not band 1, but better than or equal to +/- 5%

3) Not bands 1 or 2, but better than or equal to +/- 10%

4) Not bands 1, 2 or 3, but better than or equal to +/- 25%

5) Not bands 1, 2, 3 or 4 but better than or equal to +/- 50%

6) Not bands 1, 2, 3, 4 or 5 but better than or equal to +/- 100%

X) Values which fall outside the valid range, such as > 100%, or small numbers.

E.4 Overall confidence grades

The confidence grades (c.g.) will be an alphanumeric code, which couples the reliability band and the accuracy band, for instance:

A2 - Data based on sound records etc. (Highly Reliable, Band A) which is estimated to be within +/- 5% (Accuracy band 2).

C4 - Data based on extrapolation form a limited sample (Unreliable, Band C), which is estimated to be within +/- 25% (Accuracy band 4).

The reliability and accuracy bands would form the matrix of confidence grades shown below (table E.1):

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				

Table E.1 — Matrix of confidence grades

Confidence grades should be assessed for every water service and for every indicator, and the corresponding results reported as follows:

Year	Result	*'short description'* PI1	*'short description'* PI2	*'short description'* PI3	*'short description'* *PI4*	*'short description'* *PI5*	*'short description'* *PI…*
1996	*PI* c.g.	*20%* *B3*	*87%/year* *[C4]*	*34/m^3* *A2*	*40/km sewer* *A1*	*55%/year* *B3*	*45%* *A3*
1997	*PI* c.g.	*21%* *A2*	*86%/year* *B3*	*30/m^3* *A1*	*45/km sewer* *B1*	*65%/year* *B2*	*45%* *B2*
1998	*PI* c.g.	*23%* *A1*	*84%/year* *C2*	*31/m^3* *A1*	*42/km sewer* *A3*	*67%/year* *[B4]*	*45%* *A2*
1999	*PI* c.g.	*23%* *B2*	*85%/year* *A3*	*26/m^3* *A3*	*40/km sewer* *C1*	*68%/year* *C2*	*45%* *C1*
...	...	...	...	...	...	...	...
NOTE: '[ ]' means that the original values were corrected by the audit							

Table E.2 — Reporting of confidence grades (c.g.) for a sequence of years

To make it possible for comparisons to be carried out between services, confidence grades should be chosen appropriately and applied consistently. The descriptions outlined above are minimum values expected, to achieve the quality of information stated.

Clearly, "A1" or "A2" confidence grades can be achieved for some input variables, although they may not be generally attainable. Services are encouraged to aim for a grade of "B2" (i.e. good or excellent) or better.

Confidence grades can only be estimated directly for the variables. Based on these, PI confidence grades can either be assessed either quantitatively or, at least, qualitatively.

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